NATURE

A WEEKLY JOURNAL OF SCIENCE

> *"To the solid ground*
> *Of nature trusts the Mind that builds for aye."*—WORDSWORTH.

Cok-H0 6685-144-RP 2-74

144

Volume 144

JULY 1, 1939, to DECEMBER 30, 1939

LONDON
MACMILLAN AND CO., LTD.
NEW YORK: THE MACMILLAN COMPANY

DATES AND PAGINATION OF WEEKLY ISSUES

Serial No.		Date of Issue			Pagination
3635	..	July	1	..	1–48
3636	..	,,	8	..	49–88
3637	..	,,	15	..	89–128
3638	..	,,	22	..	129–170
3639	..	,,	29	..	171–220
3640	..	August	5	..	221–260
3641	..	,,	12	..	261–302
3642	..	,,	19	..	303–342
3643	..	,,	26	..	343–394
3644	..	September	2	..	395–454
3645	..	,,	9	..	455–488
3646	..	,,	16	..	489–526
3647	..	,,	23	..	527–564
3648	..	,,	30	..	565–606
3649	..	October	7	..	607–644
3650	..	,,	14	..	645–682
3651	..	,,	21	..	683–720
3652	..	,,	28	..	721–762
3653	..	November	4	..	763–796
3654	..	,,	11	..	797–842
3655	..	,,	18	..	843–876
3656	..	,,	25	..	877–918
3657	..	December	2	..	919–952
3658	..	,,	9	..	953–990
3659	..	,,	16	..	991–1024
3660	..	,,	23	..	1025–1058
3661	..	,,	30	..	1059–1100

RP274

INDEX

NAME INDEX

Aavakivi (R.), [Prof. H. Perlitz and], Atomic Parameters of γ-Silver-Cadmium, 708
Abbie (Dr. A. A.), The Ancestors of the Eutheria, 523
Abderhalden (Prof. E.), elected an honorary member of the Société Philomathique of Paris, 110
Abercrombie (M.), Evocation in the Chick, 1091
Adams (Dr. T.), Town Planning and Urban Concentration, 603
Adamson (A. M.), Fauna of the Marquesas Islands, 1007
Adarkar (B. P.), If War Comes (an essay on India's Military Problems), (*Review*), 371
Addison (Dr. C. C.), 'Breaks' in Interfacial Tension Curves, 249; Interfacial Activity of Short-chain Isomers, 783
Adrian (Prof. E. D.), appointed a member of the Medical Research Council, 905
Agar (H.), appointed tutor in obstetrics and gynæcology in Leeds University, 47
Aharoni (Dr. J.), A New Method of Determining e/m for Medium High Velocities, 203
Ahmad (Dr. Nazir), Transplants of Sea-Island Cotton, 785
Aiyar (Prof. R. G.), Salmacis (The Indian Sea-Urchin), (*Review*), 363
Albert (Prof. A. L.), Fundamental Electronics and Vacuum Tubes (*Review*), 401
Albrecht (G.), and R. B. Corey, Crystal Structure of Glycine, 40
Allard (W.), The Hydrology of the Upper White Nile (*Review*), 495
Allchin (J. P.), [Dr. J. Newton Friend and], Colour of Celestine, 633
Allcock (H. J.), and J. R. Jones, The Nomogram: the Theory and Practical Construction of Computation Charts. Second edition (*Review*), 369
Allee (Prof. W. C.), The Social Life of Animals (*Review*), 5; [Prof. O. Park, Prof. V. E. Shelford and], A Laboratory Introduction to Animal Ecology and Taxonomy (*Review*), 583
Allen (Dr. J. F.), and Dr. J. Reekie, Forces Associated with Heat Flow in Helium II, 475
Allen (Prof. S. W.), An Introduction to American Forestry (*Review*), 614
Allen (W. D.), and C. Hurst, Scattering of D—D Neutrons, 509
de Allende (T. Lopez Colombo), Female Reproductive Organs of the Toad, 253
Allison (F. E.), C. A. Ludwig, S. R. Hoover and F. W. Minor, Legume Nodule Metabolism and Nitrogen Fixation, 711
Ambler (F. W.) [E. P. Wilson and], Revision Notes in Inorganic Chemistry: to Higher School Certificate (*Review*), 1079
Amulree (Lord), The Museum as an Aid to the Encouragement of Arts, Manufactures and Commerce, 124
Anderson (M.), Coal Utilization by Electricity, 505
Anderson (Prof. W. B.), Physics for Technical Students: Sound, Electricity and Magnetism, Light. Third edition (*Review*), 373
Andrade (Prof. E. N. da C.), and C. Dodd, Effect of an Electric Field on the Viscosity of Liquids, 117
Andrew (G.), appointed Government geologist in the Anglo-Egyptian Sudan, 1010
Angell (Prof. F.), [death], 933
Antevs (E.), elected a corresponding member of the American Geographical Society, 199
Appel (H. P.), [R. Furth, K. Sitte and], Determination of Stellar Diameters by Interferometer, 40
Appell (P.), Analyse mathématique, cinquième édition. Tome 2 (*Review*), 369
Appleton (Prof. E. V.), Characteristic Variation of Region F_2 Ionization throughout the Year, 151
Appleyard (Dr. E. T. S.), [obituary article], 14
Aravamuthan (J. G.), India and Crete, 1095
Archenhold (H. G.), Sunspots and Magnetic Disturbances, 985
Arhimo (Dr. A. A.), [Prof. A. I. Virtanen and], Oxalo-acetic Acid in the Leguminous Plants, 36; [Prof. A. I. Virtanen, Dr. H. Suomalainen and], Estimation and Occurrence of Keto-Acids in Green Plants, 597
Armitage (E.), Higher School Certificate Practical Physics (*Review*), 743
Armstrong (Dr. E. F.), The Leader to Perfect Health (*Review*), 264
Arnot (Dr. F. L.), resignation of lectureship in St. Andrews University; appointed a lecturer in Sydney University, 127
Arps (Prof. G. F.), [death], 624
Asami (Prof. Yoshihiro) and Prof. Takeo Hori, Spectrum of the Torch Discharge, 981
Ashbridge (Sir Noel), Progress Made in Broadcasting and Television, 322
Ashby (Prof. E.), Correlation between Seed Weight and 'Adult' Weight in Tomatoes, 712
Ashworth (Dr. J. R.), Ferromagnetism: the Development of a General Equation to Magnetism (*Review*), 399
Assémat (Dr. A.), Dust and Disease, 662
Astrup (Dr. T.), Autocatalysis and Blood Coagulation, 76
Atkin (W. R.), appointed honorary research assistant of the Procter International Research Laboratory, 938
Atkinson (Dr. G. H.), [Dr. G. W. Brindley and], Effect of Temperature on the Intensity of X-Ray Reflections from Copper, 477
Atkinson (W. T.), awarded a scholarship of the North-East Coast Institution of Engineers and Shipbuilders, 665
Auber (Dr. L.), The Colour-producing Structure in the 'Dominant Grey' Budgerigar, 157
Auerbach (C.), [Prof. F. A. E. Crew and], Genetics of the Rex Mouse, 557
Auger (Dr. P.), Scientific and Technical Literature and Information, 1089
Avery (A. G.), [A. F. Blakeslee and], Fifteen Years' Research on Datura, 253
Avery (J. H.), [W. F. F. Shearcroft and], Practical Physics (*Review*), 743
Avery (P.), [T. H. Goodspeed and], Trisomic Nicotiana, 1095
Awbery (J. H.), The Teaching of Mechanics, 792
Axelrod (A. E.), H. A. Sober and Prof. C. A. Elvehjem. Reduction of the *d*-Amino-Acid Oxidase Content of Rat Tissues in Riboflavin Deficiency, 670
Aykroyd (Miss Olive E.), [Prof. J. B. Gatenby and], Cytology of the Human Uterine Gland Cell, 331

Aynard (Rose), [Prof. J. Cabannes and], Mechanism of Nitrogen Excitation in the Night Sky, 442
Azarkh (R. M.), [Prof. A. E. Braunstein and], Transamination of *l*- and *d*-Amino Acids in Normal Muscle and in Malignant Tumours, 669

Babcock (E. B.), and G. L. Stebbins, jun., American Species of Crepis, 45
Bacharach (A. L.), Winton's The Structure and Composition of Foods. Vol. 4 (*Review*), 366; Ergebnisse der Vitamin- und Hormonforschung. Band 2 (*Review*), 1080
Baddeley (Dr. G.), Mesomerism and Orientation, 444
Bagot (J. H.), Juvenile Delinquency, 703
Bailar (J. C.), and J. P. McReynolds, Stereochemistry of Complex Inorganic Compounds, 1096
Bailey (Prof. E. B.), Dame Ogilvie Gordon, 142; Dr. W. B. Wright, 775
Bailey (M. A.), [death], 736; [obituary article], 890
Baker (Prof. R. H.), Astronomy: A Textbook for University and College Students. Second edition (*Review*), 899
Baker (William Morrant), centenary of the birth of; work of, 661
Baker (Wilson) and D. M. Bealy, Structure of the Dimeric Forms of *o*-*Iso*propenyl-phenols, 865
Baker (Z.), [H. E. Himwich, J. F. Fazekas and], Respiratory Metabolism of Infant Brain, 38
Bakker (G. J. T.), appointed acting chairman of the International Executive Council of the World Power Conference, 781
Balls (Prof. A. K.), and H. Lineweaver, Nature of a Group in Papain Essential to its Activity, 513
Banerjee (H. N.), [Dr. B. K. Kar and], Effect of Ethylene on *Mangifera indica*, 597
Banga (I.), S. Ochoa and Prof. R. A. Peters, Pyruvate Oxidation System in Brain, 74
Bannerman (Dr. D. A.), The Birds of Tropical West Africa, with Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria. Vol. 5 (*Review*), 364
Barbeau (M.), The Assomption Sash, 756
Barcroft (Sir Joseph), appointed a member of the advisory council to the Committee of the Privy Council for Scientific and Industrial Research, 665
Bardswell (N. D.), Tuberculosis in Cyprus, 362
Barnard (J. E.), Towards the Smallest Living Things, 80
Barnard (R. W.), General Analysis, 295
Barnard (W. G.), appointed professor of pathology at St. Thomas's Hospital Medical School, 219
Barnóthy (Dr. J.), and Dr. M. Forró, Directional Distribution of the Hard and Soft Component of Cosmic Radiation, 116
Barnum (Prof. H. H.), [death], 185
Barrett (Sir James), The Wyperfeld (Mallee) National Park, Victoria, 272
Barrois (Prof. C.), [death], 933
Barrow (Dr. F.), conferment upon, of the title of reader in chemistry by London University, 762
Barry (J. G.), [T. H. Johnson and], Cosmic Rays at High Altitude, 677
Bartels (Prof. J.), elected to the physical mathematical class of the Prussian Academy of Sciences, 70
Bartlett (Dr. M. S.), Statistics in Theory and in Practice (*Review*), 799
Bartlett (R. J.), Measurement in Psychology, 432; 498
Barton (R. F.), Philippine Pagans: the Autobiographies of Three Ifugaos (*Review*), 1077
Bartsch (P.), [W. H. Dall, H. A. Rehder and], Recent and Fossil Marine Pelecypod Mollusks of the Hawaiian Islands, 484
Basu (Minendra Nath), Bunas of Bengal, 789
Bate (Dr. A. E.), Formula for the Change of Velocity of Sound with Temperature, 479
Bate (Ruth C.), [B. P. Kaufmann and], Chromosome Rearrangements in *Drosophila melanogaster*, 121
Bates (Dr. G. H.), Polyploidy Induced by Colchicine and its Economic Possibilities, 315
Bates (Prof. L. F.), Modern Magnetism (*Review*), 399; Artificial Radioactivity (*Review*), 689
Baulig (Prof. H.), elected an honorary member of the American Geographical Society, 199
Bayon (Dr. H. P.), Ancient Tests for Pregnancy, 826
Bazalgette (H. L.), Victoria Falls Hydro-Electric Scheme, 1098
Beadle (D. G.), and H. S. Patterson, Effect of Tube-length on the Visibility of Dust Particles with an Oil-immersion Objective, 327
Beadle (Prof. G. W.), [Prof. A. H. Sturtevant and], An Introduction to Genetics (*Review*), 1067
Beaglehole (Ernest and Pearl), Tongan Colour-Vision, 983
Beakbane (A. B.), and E. C. Thompson, Anatomy of Apple Roots, 447
Beal (J. M.), Cytology and Taxonomy of Calochortus, 335
Beall (D.), Isolation of Œstrone from the Adrenal Gland, 76
Beard (H. H.), [C. J. Kelly and], Creatine as a Product of Methylation, 162
Beauchamp (J. W.), Function of the Electrical Supply Engineer in War-time, 914
Beck (Dr. W. A.), Determination of Growth-rates by the Optical Lever Method, 786
Beddard (Dr. A. P.), [death], 857
Beebe (Dr. W.), and Jocelyn Crane, Deep-Sea Fishes of Bermuda, 638
de Beer (Dr. G. R.), Experimental Embryology (*Review*), 493
Beeson (C. F. C.) and B. M. Bhatia, Biology of the Cerambycidæ, 120
Beghin (P.), Industry and Agriculture in Belgium, 188
Bell (O.), Sociological Aspects of the Cinema, 520
Benedict (C. B.), Ontogeny and Phylogeny of the Human Nose, 252
Benioff (Dr. H.), and Dr. B. Gutenberg, Observations with Electromagnetic Microbarographs, 478
Bennet-Clark (Prof. T. A.), and Miss Dorothy Bexon, Expression of Vacuolar Sap, 243
Bennett (A.), Vegetation of a South Westmorland Fell, 715
Bennett (E. G.), [R. L. Sanford and], Magnetic Testing, 838
Berenson (Mrs. Mary), A Vicarious Trip to the Barbary Coast (*Review*), 585
Berg (Dr. W. F.), Photography in Scientific Research, 356
Berkner (L. V.), Nature of Radio Fade-out, 947
Bernacchi (Comdr. L. C.), Saga of the *Discovery* (*Review*), 198
Bernal (Prof. J. D.), Science in a Changing World (*Review*), 3
Bernheim (Prof. F.), and J. E. Morgan, Photo-oxidation of Pyrrhole, 290
Berry (A. J.), Volumetric Analysis: including the Analysis of Gases; with a Chapter on Simple Gravimetric Determinations. Fifth edition (*Review*), 366
Bealy (D. M.), [Wilson Baker and], Structure of the Dimeric Forms of *o*-*Iso*propenyl-phenols, 865
Best (Prof. C. H.), awarded the Baly gold medal of the Royal College of Physicians, 242; and Prof. N. B. Taylor, A Text in Human Physiology (*Review*), 228; [Prof. D. Y. Solandt and], Role of Dietary Choline in Neurohumour Production, 376
Beust (Nora E.), Professional Library Education, 240
Bevan (E.), Symbolism and Belief (Gifford lectures), 196
Bexon (Miss Dorothy), [Prof. T. A. Bennet-Clark and], Expression of Vacuolar Sap, 243
Bessonoff (Dr. N.), and Mme. M. Woloszyn, Platinum Potential of Vitamin C Solutions in Contact with Molecular Oxygen, 289
Bhatia (B. M.), [C. F. C. Beeson and], Biology of the Cerambycidæ, 120
Bigger (Prof. J. W.), Man against Microbe (*Review*), 371
Bijl (Dr. A.), [Dr. A. Michels, Dr. J. de Boer and], Effect of an Excitation Energy on the Specific Heat of Liquid Helium II and its Relation to the Exchange Effect in a Non-Ideal Bose-Einstein Gas, 594
Bingham (E. C.), and S. D. Stookey, Fluidity and Temperature, 448

NAME INDEX

Binns (A. L.), Present Position of Technical Education in the West Riding, 84
Bish (P. E.), awarded the Earl of Durham prize of the Institution of Naval Architects, 546
Biswas (K.), and C. C. Calder, Hand-Book of the Common Water and Marsh Plants of India and Burma, 1936 (*Review*), 727
Bjerknes (Prof. J.), awarded the Symons gold medal of the Royal Meteorological Society, 1088
Blackett (Prof. P. M. S.), Instability of the Mesotron and the Gravitational Constant, 30
Blagoveschensky (V. A.), Weather Periodicities in Turkestan, 791
Blair (Dr. G. W. Scott), An Introduction to Industrial Rheology (*Review*), 197; and Miss F. M. V. Coppen, Differential Threshold for Compression Modulus, 286
Blake (M. A.), Fruit Breeding in the U.S.A., 209
Blakeslee (A. F.), Chemistry and Genetics, 120; [H. E. Warmke and], Sex Determination in Melandrium, 252; and A. G. Avery, Fifteen Years' Research on Datura, 253
Blanc (Dr. A. C.), Discovery of Neanderthal Man in Italy, 106
Bledisloe (Viscount), presidential address to the Museums Association, 124
Bloch (Dr. M.), [Dr. J. Dufay and], The Forbidden $^3P_2$–$^1D_2$ Line of O III in the Nebular Spectrum of Nova Herculis 1934, 593
Block (L. P.), [J. H. Simons and], Reaction of Fluorine with Carbon, 947
Bloomfield (L.), Linguistic Aspects of Science, 240
Blumenthal (E.), [J. B. M. Herbert and], Mechanism of Hydrolysis of Inorganic Esters, 248
Boas (Prof. F.), The Mind of Primitive Man. Revised edition (*Review*), 738
Boele (J.), awarded an R. L. Weighton memorial medal of the North-East Coast Institution of Engineers and Shipbuilders, 665
de Boer (Dr. J.). [Dr. A. Michels, Dr. A. Bijl and], Effect of an Excitation Energy on the Specific Heat of Liquid Helium II and its relation to the Exchange Effect in a Non-Ideal Bose-Einstein Gas, 594
Bogue (Prof. J. Yule), Sir Frederick Hobday, 184
Bohr (Prof. Niels), conferment upon, of an honorary doctorate by London University, 875; and Prof. R. Peierls and Dr. G. Placzek, Nuclear Reactions in the Continuous Energy Region, 200
Bolliger (A.), and A. Carrodus, Ambisexual Action of Progesterone as observed in the common Australian Opossum, 671; Effect of Œstrogens on the Pouch of the Marsupial *Trichosurus vulpecula*, 1049
Bolton (D. J.), Superimposed Control Applications with special references to Tariffs and Load Levelling, 126
Bomskov (Dr. C.), Methodik der Hormonforschung, Band 2 (*Review*), 192
Bond (C. J.), [death], 933; [obituary article], 1038
Bond (Dr. G.), Utilization of Carbohydrates in Leguminous Symbiosis, 906
Bond (G.), and J. Boyes, Nitrogenous Excretion from Root Nodules, 946
Bond (Dr. G.), [Dr. S. Williams and] Practical Botany: a First Year Course for University and Intermediate Science Students (*Review*), 739
Bonet-Maury (Dr. P.), and H. R. Olivier, Effect of Irradiating the Tubercle Bacillus with Radon, 833
Bonner (J.), [J. English, A. J. Haagen-Smit and], Wound Hormones in Plants, 984
Bonner [Kirby Smith and], Raman Spectrum of Gaseous Methylamine, 1018
Booth (H. S.), S. G. Frary and F. B. Dutton, Fluorination of Phosphorus Halides, 1017
Bor (N. L.), Vegetation of the Aka Hills, Assam, 39
Borghs (J.), [Prof. A. van Itterbeek, W. van Dingenen and], Adsorption of Helium Gas on Active Charcoal between 4·2° and 1·78° K., 249
Borgström (G.), Formation of Cleistogamic and Chasmogamic Flowers in Wild Violets as a Photoperiodic Response, 514
Boring (E. G.), H. S. Langfeld, H. P. Weld and others, Introduction to Psychology (*Review*), 744
von Borries and E. Ruska, The Electron Microscope and the Investigation of Viruses, 40
Bosazza (V. L.), Occurrence of Wax-like Substances in Peaty Fireclay, 835
Bose (S. R.), Vacuolar Stain in Fungal Hyphæ, 80
Bostrøm (Dr. K. J.), Dr. J. Koch and Dr. T. Lauritsen, Delayed Neutron Emission accompanying Uranium Fission, 830
Boswell (Prof. P. G. H.), The Earth's Crust: its Fabric and Foundations (*Review*), 403
Bourne (M. C.), and H. Grüneberg, Inheritance of Cataract, 38
Bovey (Dr. W.), presented with the Lorne Pierce medal of the Royal Society of Canada, 255
Bowen (Marjorie), Ethics in Modern Art (Conway Memorial Lecture) (*Review*), 1082
Bower (Prof. F. O.), Botany of the Living Plant. Third edition. With the assistance of Prof. J. M. F. Drummond and Dr. G. Bond (*Review*), 400
Bowman (Dr. I.), Science and Social Pioneering, 565
Boyd (Dr. W. C.), Blood Group Tables, 321
Boyer (C. B.), The Concepts of the Calculus: a Critical and Historical Discussion of the Derivative and the Integral (*Review*), 802
Boyes (J.), [G. Bond and], Nitrogenous Excretion from Root Nodules, 946
Boyland (Dr. E.), [Prof. A. C. Chibnall, M. W. Rees. G. R. Tristram, E. F. Williams and], The Glutamic Acid of Tumour Proteins, 71
Boyle (P. J.), [Prof. E. J. Conway and], A Mechanism for the Concentrating of Potassium by Cells, with Experimental Verification for Muscle, 709; [Prof. E. J. Conway, Dr. F. Kane, H. O'Reilly and], Localization of Electrolytes in Muscle, 752
Braak (Dr. C.), Fog in the Netherlands, 947
Braddick (Dr. H. J. J.) and G. S. Hensby, Evidence for the Occurrence of Meson Pairs, 1012
Bradfield (Major-Gen.), An Indian Medical Review, 1087
Bragg (Sir William), History in the Archives of the Royal Society (Pilgrim Trust Lecture), 21; X-Ray Analysis and the Structure of Matter, 961; re-elected president of the Royal Society, 976
Bragg (Prof. W. L.), elected a *correspondant* of the Paris Academy of Sciences, 150
Brandenberger (Dr. E.), Angewandte Kristallstrukturlehre: Ein Hilfsbuch zur Bestimmung von Kristallstrukturen (*Review*), 587
Brandon (Dorothy), Rose Propagation, 1096
Brandstatter (Dr. V.), [death], 236
Braun (Dr. W.), An Experimental Attack on some Problems of Physiological Genetics, 114
Braunholtz (H. J.), Archæology in Peru: Recent Progress, 841
Braun-Menéndez (E.), [J. M. Muñoz, J. C. Fasciolo, L. F. Leloir and], Hypertensin: the Substance causing Renal Hypertension, 980
Braunstein (Prof. A. E.), and R. M. Azarkh, Transamination of *l*- and *d*-Amino Acids in Normal Muscle and in Malignant Tumours, 669; and S. M. Bychkov, A Cell-free Enzymatic Model of *l*-Amino-acid Dehydrogenase ('*l*-Deaminase'), 751
Breder (C. M.), and E. B. Gresser, The four-eyed Blenny, 675
Bredereck (Dr. H.), und Dr. R. Mittag, Vitamine und Hormone: und ihre technische Darstellung. Teil 1. Zweite Auflage (*Review*), 739
Breit (G.), H. M. Thaxton and L. Eisenbud, Scattering of Protons by Protons, 254
Brezina (E.), W. Hellpach, R. Hesse, E. Martini, B. de Rudder, A. Schittenhelm, A. Seybold and Prof. L. Weickmann, Herausgegeben von H. Woltereck. Klima, Wetter, Mensch (*Review*), 1066
Brierley (Prof. W. B.), The Royal Agricultural Show, 61
Brierly (J. L.), Encirclement (*Review*), 1031
Briggs (Dr. L. H.), Constitution of Solasonine (Solanine-*s*), 247

Briggs (Dr. L. J.), Standards of Physical Measurement (*Review*), 458
Brightman (R.), Youth and National Service (*Review*), 723
Brigl, Gronemeier and Schultz, The Ethyl-Thioglucosides and a New Monoacetoneglucose, 680
Brimble (L. J. F.), Intermediate Botany. Second edition (*Review*), 739
Brindley (Dr. G. W.), and Dr. G. H. Atkinson, Effect of Temperature on the Intensity of X-Ray Reflections from Copper, 477
Bristow (Col. W. A.), Fuel Industry in Great Britain, 825
Bristowe (Dr. W. S.), The Comity of Spiders. Vol. 1 (*Review*), 895
Britton (K.), Pragmatical Logic (*Review*), 880
Broda (Dr. E. E.), Dr. C. F. Goodeve, Dr. R. J. Lythgoe and E. Victor, Cataphoretic Measurements on Solutions of Visual Purple and Indicator Yellow, 709
de Broglie (Prof. L.), Le Principe de Correspondance et les Interactions entre la Matière et le Rayonnement, 544
de Broglie (Maurice), Atomes, radioactivité, transmutations (*Review*), 689
Brohult (S.), and S. Claesson, Dissociation of the Hæmocyanin Molecule, 111
Brooks (Dr. C. E. P.), Climate and Man (*Review*), 1066
Brooks (Prof. F. T.), conferment upon, of an honorary doctorate by St. Andrews University, 605
Brose (D. T.), and A. Caliver, Negro Education in the United States, 293
Brough (J.), appointed lecturer in the zoology of vertebrates in Edinburgh University, 47; The Triassic Fishes of Besano, Lombardy (*Review*), 615
Brough (Dr. P.), Avoidance of Crystal Formation during embedding of Plant Material in Paraffin Wax, 250
Brown (Sir Edward), [death], 318
Brown (E.), Students and Military Training, 17
Brown (Leslie), Outlaw of the Air (*Review*), 1079
Brown (O. F.), and E. L. Gardiner, The Elements of Radio-Communication. Second edition (*Review*), 1068
Brown (Dr. T. W. F.), awarded an engineering gold medal of the North-East Coast Institution of Engineers and Shipbuilders, 665
Brown (Dr. William), War and Peace: Essays in Psychological Analysis (*Review*), 845
Brown (Dr. W. H.), [death], 970
Browne (F. L.), [E. Sutermeister and], Casein and its Industrial Applications. Second edition (*Review*), 584
Brownlee (A.), [R. G. Linton and], Vitamin A content of the Livers of a Hundred Healthy Dogs, 978
Bruce (Brig.-Genl. the Hon. C. G.), [death], 143; [obituary article], 407
Bruce (Miss Maye), Modification of the Steiner Composting Process, 280
Brunt (Prof. D.), Atmospheric Turbulence (*Review*), 651
Buchsbaum (Dr. R.), Animals without Backbones: an Introduction to the Invertebrates (*Review*), 847
Buddin (W.), Hot Water Treatment of Iris Bulbs, 716
Buller (Prof. A. H. R.), Symbiosis between Fungi and Scale Insects (*Review*), 531
Bullough (W. S.), and Dr. R. Carrick, Spring Development of the Gonads of the Starling (*Sturnus v. vulgaris* L.), 33
Burbank (Luther), An Architect of Nature: being the Autobiography of, with Biographical Sketch by W. Hall (*Review*), 896
Burk (Dr. D.), appointed senior chemist in the National Cancer Institute, U.S. Public Health Service, and associate professor of biochemistry at Cornell University, 282
Burkill (I. H.), [Sir David Prain and], An account of the genus Dioscorea in the East. Part 2: The Species which twine to the Right; with Addenda to Part 1, and a Summary (*Review*), 895
Burns (Prof. D.), Assessment of Physical Fitness, 431; 466
Burr (Dr. M.), The Insect Legion (*Review*), 739
Burt (Prof. C. L.), conferment upon, of an honorary doctorate by Aberdeen University, 127; Prof. S. Freud, 735
Burt (Dr. J. Barnes), elected interim chairman of the International Society of Medical Hydrology, 1087
Buss (Prof. A.), [death], 812
Butenandt (Prof. A.), elected to the Physical Mathematical Class of the Prussian Academy of Sciences, 70; awarded the Nobel prize for chemistry for 1939; work of, 858
Butler (C. G.), Choice of Water by the Honey Bee, 984
Butler (H. B.), conferment upon, of an honorary doctorate by Edinburgh University, 87
Butler (Dr. J. A. V.), The Fundamentals of Chemical Thermodynamics. Part 1: Elementary Theory and Electrochemistry. Third edition (*Review*), 584
Buxton (Prof. J. B.), and R. E. Glover, Tuberculin Tests in Cattle, 108
Bychkov (S. M.), [Prof. A. E. Braunstein and], A Cell-free Enzymatic Model of *l*-Amino-acid Dehydrogenase ('*l*-Deaminase'), 751
Byerly (P.), Crustal Structure of California, 639

Cabannes (Prof. J.), and Rose Aynard, Mechanism of Nitrogen Excitation in the Night Sky, 442
Cadman (Lord), appointed honorary adviser on oil to the Secretary for Mines, 1088
Calder (C. C.), [K. Biswas and], Hand-Book of the Common Water and Marsh Plants of India and Burma, 1936 (*Review*), 727
Calder (R. M.), re-appointed Graham scholar in pathology in London University, 219
Caley (E. R.), Composition of Ancient Greek Bronze Coins, 1096
Caliver (A.), [D. T. Brose and], Negro Education in the United States, 293
Callendar (G. S.), [Prof. A. C. Egerton and], The 1939 Heat Entropy Diagram for Steam Plotted from the 1939 Callendar Steam Tables (*Review*), 1069
Callendar (late Prof. H. L.), revised by G. S. Callendar, Abridged Callendar Steam Tables. Fourth edition. Centigrade Units; Fahrenheit Units; Charts (*Review*), 1069
Calman (Dr. W. T.), Instincts of the Herd (*Review*), 5; Regnum Animale (*Review*), 269; Caridea of the John Murray Expedition, 715
Calvin (J.), [E. F. Ricketts and], Between Pacific Tides (*Review*), 1078
Cameron (G. R.), and Cecile R. Doniger, Toxicity of certain Insecticides, 790; Toxicity of Indene, 1095
Cameron (T. W. M.), Trichinosis in Pigs, 756
Campbell (Prof. D. H.), eightieth birthday; work of, 972
Campbell (Dr. J. A.), The Last Thousand Feet on Everest: Possible Bacterial Factor, 118
Campbell (Sir Malcolm), New Water Speed Record, 362
Campbell (Dr. M.), Dr. E. P. Poulton, 969
Campbell (W. P.), [L. F. Fieser, E. M. Fry and], Vitamins K_1 and K_2, 519
Camper (Petrus), (1722–1789), 276
Candiani (Dr. H.), Scientific and Medical Aspects of the Work of Dr. Jean Paul Marat, 1007
Canney (Dr. M.), Skin of Rebirth, 335
Capron (P. C.), [J. B. R. Rajam, Prof. M. de Hemptinne and], Evaluation of the Beta Upper Energy Limits with simple Absorption Data, 202
Carleton (P.), Buried Empires: The Earliest Civilisations of the Middle East (*Review*), 893
Carlson (Dr. W.), appointed a fellow in the department of research in pure chemistry in the Mellon Institute; work of, 507
Carmichael (Dr. H.), and E. G. Dymond, Balloon Experiments in High Latitudes, 294; and Chang-Ning Chou, Cosmic Ray Ionization Bursts, 325
Carpenter (F. M.), Lower Permian Insects of Kansas, 641
Carpenter (Sir Harold) and Dr. J. M. Robertson, Metals and their Alloys. 2 vols. (*Review*), 612
Carpenter (Dr. J. R.), An Ecological Glossary (*Review*), 1030
Carpenter (P. G.), [L. Friedman and], Diffusion Velocity and Molecular Weight, 386
Carrel (A.), and C. A. Lindberg, The Culture of Organs (*Review*), 95

Carrick (Dr. R.), [W. S. Bullough and], Spring Development of the Gonads of the Starling (*Sturnus v. vulgaris* L.), 33
Carrodus (A.), [A. Bolliger and], Ambisexual Action of Progesterone as observed in the common Australian Opossum, 671 ; Effect of Œstrogens on the Pouch of the Marsupial *Trichosurus vulpecula*, 1049
Carroll (J.), Control of the Potato Root Eelworm, 1095
Carroll (J. A.), Determination of Stellar Diameters by Interferometer, 1018
Carter (Dr, G. S.), O. Gatty, Dr. J. H. Schulman and Dr. H. Walston, Calcium in Ciliary and Muscular Movement, 980
Carter (H. B.), [Dr. A. B. Wildman and], Fibre-Follicle Terminology in the Mammalia, 783
Carter (Dr. R. Owen), and Dr. J. L. Hall, Physical Characterization of Calf Thymus Nucleohistone, 329
Carvalho (A.), [C. A. King and], Genetical Proof of the existence of Coffee Endosperm, 515
Casson (S.), The Collapse of Ancient Civilizations, 404
Catcheside (D. G.), Position Effect in Œnothera, 837
Catchpole (Dr. H. R.), and Dr. J. F. Fulton, Tarsiers in Captivity, 514
Catlin (Prof. G.), The Anglo-Saxon Tradition (*Review*), 398
Cave (A. J. E.), Cranial Deformation Among the Ancient Maya, 447
Chaffer (Clifford), [obituary article], 471
Chain (E.), and E. S. Duthie, A Mucolytic Enzyme in Testis Extracts, 977
Chambard (Prof. P.), elected president of the International Society of Leather Trades' Chemists, 603
Champion (H. G.), Manual of Indian Silviculture. Part 1 : General Silviculture (*Review*), 494 ; appointed professor of forestry in Oxford University, 990
Champion (Dr. S. G.), A Selection of The World's Proverbs arranged Linguistically (*Review*), 582
Chandrasekhar (Dr. S.), An Introduction to the Study of Stellar Structure (*Review*), 130
Chapman (Prof. S.), United States Geophysical Expedition to the Pacific Ocean, 182 ; Magnetic Observations of Sunspots (*Review*), 266 ; International Union of Geodesy and Geophysics, 717 ; and Dr. T. G. Cowling, The Mathematical Theory of Non-Uniform Gases : an Account of the Kinetic Theory of Viscosity, Thermal Conduction, and Diffusion in Gases (*Review*), 993
Chapman (Dr. V. J.), Cambridge University Expedition to Jamaica, 964
de Chardin (P. Teilhard), Late Cenozoic History of North China, 1054
Chase (Prof. W. P.), Symphyogenetic Development, 445
Chatley (Dr. H.), conferment upon, of the Order of the Brilliant Jade of China, 938
Chatwin (C. P.), "Lost Atlantis", 86
Chiang (Monlin), The National University of Peking, 242
Chibnall (Prof. A. C.), M. W. Rees, G. R. Tristram, E. F. Williams and Dr. E. Boyland, The Glutamic Acid of Tumour Proteins, 71
Childe (Prof. V. Gordon), elected an honorary member of the Prehistoric Society of Switzerland ; work of, 65
Childers (N. F.), Lime Sulphur Injury, 210
Childs (Dr. W. M.), [obituary article], 63
Chittenden (F. J.), Royal Gardens of Queen Anne, 974
Chlopin (W. G.), M. A. Paswik-Chlopin and N. F. Wolkov, A particular mode of Fission of the Uranium Nucleus, 595
Chou (Chang-Ning), [Dr. H. Carmichael and], Cosmic Ray Ionization Bursts, 325
Christiansen (Prof. Viggo), [death], 1006
Ciaranfi (Dr. E.), Oxidation of Methyl Esters of Monocarboxylic Fatty Acids by Normal and Neoplastic Tissue, 751
Ciocco (Dr. A.), [Dr. W. Hughson, Dr. C. Palmer and], Causes of Deafness, 160
Claesson (S.), [S. Brohult and], Dissociation of the Hæmocyanin Molecule, 111
Clark (Prof. A. J.), appointed a member of the Medical Research Council, 282
Clark (Miss A. R.), [death], 318
Clark (Dr. C. H. Douglas), Interrelation of Dissociation Energy and Inter-nuclear Distance for some simple Di-Atoms in Ground States, 285
Clark (Dr. Grahame), Archæology and Society (*Review*), 1077
Clark (J. A.), F. R. Gorton and F. W. Sears, Physics To-day (*Review*), 588
Clark (Prof. W. E. Le Gros), The Tissues of the Body : an Introduction to the Study of Anatomy (*Review*), 351 ; Scope and Limitations of Physical Anthropology, 430 ; The Ancestors of the Eutheria, 600 ; Scope and Limitations of Physical Anthropology, 804
Clarke (Dr. A. W.), [Dr. N. S. Rustum Maluf, Dr. K. W. Thompson and], Role of the Renal Innervation in Kidney Function, 292
Clarke (G. R.), The Study of the Soil in the Field. Second edition (*Review*), 581
Clarke (S. H.), Wood as a Raw Material (*Review*), 924
Clay (H. E.), appointed a member of the Industrial Health Research Board, 242
Clay (H. E.), appointed a member of the Industrial Health Research Board, 375
Clay (Dr. Sampson), The Science of Colour (*Review*), 227
Cleary (R. V.), J. Maier and G. H. Hitchings, Metabolism of Chloronaphthalenes, 122
Clough (Brig. A. B.), Ordnance Survey Plans, 590
Clough (Dr. G. W.), Dr. G. D. Lander, 970
Clouston (T. W.), [R. L. Knight and], Genetics of Blackarm Resistance in Cotton, 676
Clow (Dr. A.), and G. Pearson, Pure Ethyl Alcohol for Absorption Spectrophotometry, 208
Cobb (A. J.), Origin of Dahlia Varieties, 209
Cobb (J.), New Land-Speed Record, 438
Cobb (Prof. J. W.), The Gas Industry in Great Britain, 10
Coghlan (H. H.), Early Copper, 484
Cohen (J. I.), Factors Determining Physical Size and Proportions, 944
Cohen (Dr. P. P.), [Dr. H. A. Krebs and], Glutamic Acid as a Hydrogen Carrier in Animal Tissues, 513
Cohn (Dr. B.), Tables of Addition and Subtraction Logarithms with Six Decimals. Second edition (*Review*), 369
Cohnheim (Prof. Julius), centenary of the birth of, 105
Colbeck (J. C.), elected John Lucas Walker student of Cambridge University, 301
Cole (Prof. F. J.), The Complete Correspondence of Leeuwenhoek (*Review*), 956
Cole (H. A.), Further Experiments in the Breeding of Oysters (*Ostrea edulis*) in Tanks, 642
Coles (Jessie V.), The Consumer-Buyer and the Market (*Review*), 195
Collar (A. R.), [Dr. R. A. Frazer, Dr. W. J. Duncan and], Elementary Matrices and some applications to Dynamics and Differential Equations (*Review*), 650
Collingwood (Prof. R. G.), appointed Creighton lecturer in London University for 1939–40, 87
Colwell (Prof. R. C.), and Prof. A. W. Friend, Reflection of Medium and Short Radio Waves in the Troposphere, 31
Comrie (Dr. J. D.), [death], 660 ; [obituary article], 857
Comrie (Dr. L. J.), New Mathematical Tables, 871
Conforto (F.), Le superficie razionali (*Review*), 370
Conklin (Prof. E. G.), Does Science Afford a Basis for Ethics ?, 935
Constable (Prof. F. H.), Comparison of the Adsorption, Electrolytic, and Interference Methods of Measuring Film Areas, 630 ; and M. K. Mahas, Acoustic Properties of Mud Bricks, 33
Conti (Senatore Prince Ginori), [death], 1085
Conway (Prof. E. J.), and P. J. Boyle, A Mechanism for the Concentrating of Potassium by Cells, with Experimental Verification for Muscle, 709 ; Dr. F. Kane, P. J. Boyle and H. O'Reilly, Localization of Electrolytes in Muscle, 752
Cook (E. S.), Prof. J. R. Loofbourow, Sister Cecelia Marie Dwyer, Sister Mary Jane Hart and], Production of Intercellular Hormones by Mechanical Injury, 553

Cook (Prof. J. W.), resignation of the honorary secretaryship of the Chemical Society, 627; [Prof. E. Kennaway, Dr. C. L. Hewett, Dr. I. Hieger, Dr. W. Mayneord and], awarded the prize of the Anna Fuller Fund of New Haven, Conn., 150
Coon (Prof. C. S.), The Races of Europe (*Review*), 767
Coppen (Miss F. M. V.), [Dr. G. W. Scott Blair and], Differential Threshold for Compression Modulus, 286
Corey (R. B.), [G. Albrecht and], Crystal Structure of Glycine, 40
Corner (Prof. G. W.), appointed editor of the *American Journal of Anatomy*, 508; appointed director of the Department of Embryology of the Carnegie Institution, Washington, 1088
Corner (Dr. H. H.), 'Pine' Disease in Sheep, 257
Cornish (late J. G.), edited by Dr. Vaughan Cornish, Reminiscences of Country Life (*Review*), 896
Correvon (Dr. Henry), [obituary article], 183
Cotton (B. C.) and F. K. Godfrey, The Molluscs of South Australia. Part 1 (*Review*), 193
Couch (Prof. J. N.), The Genus Septobasidium (*Review*), 531
Cowles (Prof. H. C.), [death], 624
Cowling (Dr. T. G.), [Prof. S. Chapman and], The Mathematical Theory of Non-Uniform Gases: an Account of the Kinetic Theory of Viscosity, Thermal Conduction, and Diffusion in Gases (*Review*), 993
Craig (Prof. R. A.), [death], 857
Crane (Jocelyn), [Dr. W. Beebe and], Deep-Sea Fishes of Bermuda, 638
Crane (M. B.), and W. J. C. Lawrence, The Genetics of Garden Plants. Second edition (*Review*), 94
Crawford (O. G. S.), Archæological Reconnaissance in Roman Scotland, 543
Cremer (H. W.), and others, Factories and the Black-out, 1023
Crew (Prof. F. A. E.), invited to deliver the Clive Behrens lectures in Leeds University in 1939–1941, 219; Seventh International Genetical Congress, 496; and P. C. Koller, Chromosomes of the Pig, 385; and others, Social Biology and Population Improvement, 521; and C. Auerbach, Genetics of the Rex Mouse, 557
Critchfield (C. L.), [H. L. and R. W. Curtis and], The Absolute Ampere, 294
Critikos (N. A.), Santorin and Crete, 558
Crommelin (Dr. A. C. D.), [obituary article], 578
Crossland (Dr. C.), Rules of Zoological Nomenclature, 942
Crossland (J.), Safety in Mines Research Board, 840
Crowfoot (Dr. Dorothy), and D. Riley, X-Ray Measurements on Wet Insulin Crystals, 1011
Crowther (Prof. J. A.), Co-operation in Research (*Review*), 174; Ions, Electrons and Ionising Radiations. Seventh edition (*Review*), 374
Cueto (A. A.), [Prof. J. R. Loofbourow, D. Whalen, Sister Mary Michaella Lane and], Local Growths in Animals produced by Injection of Intercellular Wound Hormones, 939
Cumming (Surg.-Genl. H. S.), Typhus Fever in the U.S.A., 149
Curie (Mlle. Eve), awarded the Clement Cleveland medal of the New York Cancer Committee, 324
Curtis (H. L. and R. W.), and C. L. Critchfield, The Absolute Ampere, 294
Cushing (Prof. Harvey), elected an honorary member of the Royal Society of Edinburgh, 70; [death], 660; [obituary article], 736; A Bibliography of the Writings of, 900

D

Dafoe (A. R.), [J. W. MacArthur and], The Quintuplets, 870
Dainelli (Prof. G.), elected an honorary member of the American Geographical Society, 199
Daley (Dr. W. A.), appointed Medical Officer of Health and School Medical Officer of the London County Council, 705
Daly (Prof. R. A.), Architecture of the Earth (*Review*), 403
Dainton (F. S.), [Prof. R. G. W. Norrish and], Reaction between Hydrogen and Oxygen Sensitized by Nitrogen Peroxide, 30
Dalcq (Prof. A. M.), Form and Causality in Early Development (*Review*), 493
Dall (W. H.), P. Bartsch and H. A. Rehder, Recent and Fossil Marine Pelecypod Mollusks of the Hawaiian Islands, 484
Danielli (Dr. J. F.), The Biology of the Cell Surface (*Review*), 879
Darlington (Dr. C. D.), The Evolution of Genetic Systems (*Review*), 648; Cytology, 816
Darrah (W. C.), Text-book of Paleobotany (*Review*), 226
Darwin (Dr. C. G.), Positive Eugenic Policy (Galton lecture), 67; conferment upon, of an honorary doctorate by St. Andrews University, 605
Das (A.), [U. N. Kanjilal, P. C. Kanjilal, R. N. De and], Flora of Assam. Vol. 3 (*Review*), 894
D'Aunoy (Prof. J. R.), decorated with the Order of Commendatore of the Crown of Italy, 665
Davenport (Dr. H.), The Theory of Numbers (*Review*), 347
Davidson (M.), Computation of Total Solar Eclipses, 162
Davies (Col. C. E.), elected president of the Newcomen Society, 861
Davis (Dr. H.), [Dr. S. S. Stevens and], Hearing: its Psychology and Physiology (*Review*), 570
Davoud (J. G.), and Prof. C. N. Hinshelwood, Thermal Decomposition of Acetone, 909
Dawson of Penn (Lord), Decline of Population, 17
Dawson (J.), awarded the George Mitchell Harroway scholarship of the North-East Coast Institution of Engineers and Shipbuilders, 665
Dawson (R. B.), Practical Lawn Craft (*Review*), 581
Day (A. M.), Wild-life Restoration in the United States, 902
De (R. N.), [U. N. Kanjilal, A. Das, P. C. Kanjilal and], Flora of Assam. Vol. 3 (*Review*), 894
Dean (R. B.), Potentials at Oil-Water Interfaces, 32
Deering (J. E.), Origin of Defects in Copper Conductors, 950
De La Warr (Earl), Museums and Education, 124; 626
Delvin (J. J.), An Electromechanical Transducer, 39
Demerec (M.), and M. E. Hoover, Hairy Wing (*Hw*) of *Drosophila melanogaster*, 121
Deming (Dr. W. E.), Some Notes on Least Squares (*Review*), 585
Denil (G.), La mécanique du poisson de rivière: Qualités nautiques du poisson; ses méthodes locomotrices, ses capacités; ses limites; résistances du fluide; effet de la vitesse, de la pente; résistance de seuil (*Review*), 567
Densmore (Miss Frances), North American Indian Music, 837
Denston (T. C.), A Textbook of Pharmacognosy. Third edition (*Review*), 192
Dent (A. G. H.), Farm Electrification, 663
Deraniyagala (P.), The Mexican Loggerhead in Europe, 156; Names of some Atlantic Loggerhead Turtles, 673
Dervichian (Dr. D.), A New Technique for the Spreading of Proteins and the 'Spreading Number', 629
Desreux (V.), and R. M. Herriott, Existence of Several Active Components in Crude Pepsin Preparations, 287
Devonshire (Dr. A. F.), [Prof. J. E. Lennard-Jones and], Critical Phenomena in Gases, 793
Dewey (J.), Logic: the Theory of Inquiry (*Review*), 880
Dickens (Dr. F.), Tissue Respiration, 1072
Dickinson (Dr. H. W.), A Short History of the Steam Engine (*Review*), 849
Diebner (Dr. K.), und Dr. E. Grassmann, Künstliche Radioaktivität: Experimentelle Ergebnisse (*Review*), 689
Dieulafoy (Prof. Georges), centenary of the birth of; work of, 861
van Dingenen (W.), [Prof. A. van Itterbeek, J. Borghs and], Adsorption of Helium Gas on Active Charcoal between 4·2° and 1·78° K., 249
Dingle (Prof. H.), The Relativity of Time, 888; 1047

Dirac (Prof. P. A. M.), awarded a Royal medal of the Royal Society, 859; 986
Disertori (Dr. B.), awarded the international prize of Bern University for researches on encephalitis, 1044
Dixey (F.), Peneplanation of South Africa, 676
Dixon (Dr. K. C.), awarded the E. G. Fearnsides scholarship of Cambridge University, 301
Dixon (Dr. M.), Catalysis in Respiration, 1070
Doak (B. W.), Amino-Acids and Rooting of Cuttings, 379
Dobiński (Prof. S.), and M. Niestuchowski, Selective Oxidation of Aluminium Alloys, 510
Dobzhansky (T.), Genetic Differences in Wild *Drosophila pseudoobscura*, 870
Dodd (Dr. C.), appointed lecturer in natural philosophy in the United College, St. Andrews, 605
Dodd (C.), [Prof. E. N. da C. Andrade and], Effect of an Electric Field on the Viscosity of Liquids, 117
Dole (M.), [J. A. Swartout and], Atomic Weight of Hydrogen, 485
Doljanski (Dr. L.), [Dr. R. S. Hoffman, Dr. E. Tenenbaum and], Growth-stimulating Effects of Extracts of Normal Adult Tissues and Tumours, 1092
Domagk (Prof. G.), awarded the Nobel prize for physiology and medicine for 1939; work of, 777; elected an honorary member of the Pharmaceutical Association of the Hindu University of Benares, 938
Donald (H. P.), Human Birth Weights, 38
Doniger (Cecile R.), [G. R. Cameron and], Toxicity of certain Insecticides, 790; Toxicity of Indene, 1095
Donnan (Prof. F. G.), Baron Joji Sakurai, 234; The Garner principle of Co-operative Activation, 446; elected president of the Association of Scientific Workers, 934; conferment upon, of an honorary doctorate by the National University of Ireland, 1044
Dorey (Dr. S. F.), awarded an M. C. James memorial medal of the North-East Coast Institution of Engineers and Shipbuilders, 665
Doss (K. S. Gururaja), A Possible Explanation of Very Slow Adsorption, 448
Douglas (Vice-Admiral Sir Percy), [death], 812; [obituary article], 932
Dowling (Prof. J. J.), Comparing Resistances of Four-Terminal Resistors, 865
Downs (W. R.), [L. J. Gillespie and], Palladium–Deuterium Equilibrium, 757
Dowsett (H. M.), Handbook of Technical Instruction for Wireless Telegraphists. Sixth edition (*Review*), 741
Doyle (Prof. W. L.), Amylase in Amphioxus, 867
Drake (L. R.), [C. D. Hurd and], Structure of Cyclo-Octatetrene, 448
Drakeley (Dr. T. J.), Whither Technical Education?, 84
Draper (E. S.), Economizing on House Fuel, 1041
Drever (Dr. H. L.), Two British Expeditions to Ubekendt Island, West Greenland, 1073
Drew (Kathleen M.), Triploid Red Alga, 209
Driver (Dr. J. E.), Bentley and Driver's Text-Book of Pharmaceutical Chemistry. Third edition (*Review*), 402
Drucker (P.), Alsea Ethnography, 714
Drummond (Prof. J. C.), and Anne Wilbraham, The Englishman's Food: a History of Five Centuries of English Diet (*Review*), 264
Drysdale (Dr. C. V.), Fundamental Concepts of Electromagnetics (*Review*), 91
Dubois (H.-M.), Monographie des Betsileo (Madagascar) (*Review*), 894
Ducassé (Dr. P.), Essai sur les origines intuitives du positivisme; Méthode et intuition chez Auguste Comte (*Review*), 587
Duchesne (Dr. J.), and M. Parodi, Structure of the Tetrachlorethylene Molecule, 382
Dufay (Dr. J.), and Dr. M. Bloch, The Forbidden $^3P_2$–$^1D_2$ Line of O III in the Nebular Spectrum of Nova Herculis 1934, 593
Dulière (Dr. W.), and O. Loewi, Liberation of Potassium by Acetylcholine in the Central Nervous System, 244
Du Manoir (P.), Ce qu'il faut savoir des plantes de montagnes (*Review*), 893
Duncan (Sir Andrew), conferment upon, of an honorary doctorate by Glasgow University, 47
Duncan (Dr. W. J.), [Dr. R. A. Frazer, A. R. Collar and], Elementary Matrices and some applications to Dynamics and Differential Equations (*Review*), 650
Dunworth (J. V.), A Determination of the Half-Value Periods of Radium C′ and Thorium C′, with a note on Time Lags in a Geiger Counter, 152
Du Puy (W. A.), The Nation's Forests (*Review*), 614
Durell (C. V.), A New Geometry for Schools (*Review*), 585
Duthie (E. S.), [E. Chain and], A Mucolytic Enzyme in Testis Extracts, 977
Dutton (F. B.), [H. S. Booth, S. G. Frary and], Fluorination of Phosphorus Halides, 1017
Dwyer (Sister Cecelia Marie), [Prof. J. R. Loofbourow, E. S. Cook, Sister Mary Jane Hart and], Production of Intercellular Hormones by Mechanical Injury, 553
Dymond (Dr. E. G.), Intensity of Mesotrons in the Upper Atmosphere, 782; [H. Carmichael and], Balloon Experiments in High Latitudes, 294

Eakle (Prof. A. S.), Mineral Tables for the Determination of Minerals by their Physical Properties. Third edition, revised by Prof. A. Pabst (*Review*), 742
Eales (Dr. N. B.), Messer's An Introduction to Vertebrate Anatomy (*Review*), 192; Cotton and Godfrey's Molluscs of South Australia. Part 1 (*Review*), 193; A Systematic and Anatomical Account of the Opisthobranchia, 484; The Littoral Fauna of Great Britain: a Handbook for Collectors (*Review*), 997
Earl (Prof. J. C.), Use and Misuse of Science, 409
East (Dr. W. N.), Alcohol and Crime, 703
Eastlick (Dr. H. L.), Reciprocal Hetero-Transplantation of Limb Primordia between Duck, Turkey, Guinea and Chick Embryos, 380
Ebrey (Dr. G. O.), appointed to the Fleming fellowship in the Mellon Institute, 592
Eckardt (Dr. R. E.), [Dr. P. Gyorgy and], Vitamin B_6 and Skin Lesions in Rats, 512
Edgar (Rev. W.), Tardenois Site in Western Scotland, 1052
Edgell (Rear-Admiral J. A.), Vice-Admiral Sir Percy Douglas, 932
Edgeworth (Lt.-Col. K. E.), Fission of Rotating Bodies, 81
Egerton (Prof. A. C.), and G. S. Callendar, The 1939 Heat-Entropy Diagram for Steam Plotted from the 1939 Callendar Steam Tables (*Review*), 1069
von Eiselsberg (Prof. Anton), [obituary article], 1004
Eisenberg (S.), [P. van Rysselberghe and], Activity Coefficients of Strong Electrolytes, 1053
Eisenbud (L.), [G. Breit, H. M. Thaxton and], Scattering of Protons by Protons, 254
Ekenberg (B.), Catalogue of Double Star Orbits, 211
El-Helaly (Dr. A. F.), Control of Kernel Smut of Sorghum, 1096
Ellerton (J.), *Triticum sphaerococcum*, 601
Elliott (Prof. T. R.), appointed a member of the Medical Research Council, 282
Ellis (Henry Havelock), [death], 104; [obituary article], 183
El Sadr (M. M.), H. G. Hind, T. F. Macrae, C. E. Work, B. Lythgoe and Prof. A. R. Todd, Vitamin B Requirements of the Rat, 73
Elsden-Drew (Dr. R.), Blood Groups in Africa, 789
Elvehjem (Prof. C. A.), [A. E. Axelrod, H. A. Sober and], Reduction of the *d*-Amino-Acid Oxidase Content of Rat Tissues in Riboflavin Deficiency, 670
Emeléus (Dr. H. J.), conferment upon, of the title of reader in inorganic chemistry by London University, 87; [A. G. Maddock, C. Reid and], New Iodine and Fluorine Derivatives of Monosilane, 328
Emerson (A.), awarded a shipbuilding gold medal of the North-East Coast Institution of Engineers and Shipbuilders, 665
Engelhardt (Prof. W. A.), and M. N. Ljubimowa, Myosine and Adenosinetriphosphatase, 668
Engle (H. R.), [A. W. Laubengayer and], Oxides and Hydroxide of Gallium, 162
Engledow (Prof. F. L.), M. A. Bailey, 890

English (G. L.), Descriptive List of the New Minerals, 1892–1938 (*Review*), 958
English (J.), J. Bonner and A. J. Haagen-Smit, Wound Hormones in Plants, 984
Enselme (Prof. J.), [Prof. M. Piery and], Reactions of Acclimatization and of Non-Adaptation, 731
Ensor (R. C. K.), Herr Hitler's Self-Disclosure in "Mein Kampf" (*Review*), 1031
Enzmann (E. V.), [K. Sax and], Effect of Temperature on Chromosomes Affected by X-Rays, 790
Ervin (C. D.), Polyploid Cells in *Cucumis Melo*, 946
Erxleben (Dr. H.), [Prof. F. Kögl and], The Glutamic Acid of Tumour Proteins, 111
'Espinasse (Dr. P. G.), Œstrogen Depot Formation, 1013
Eucken (Prof. A.), Lehrbuch der chemischen Physik. Zweite Auflage. Band 1 (*Review*), 193
Eumorfopoulos (G.), [death], 1085
Evans, Goodman, Keevil, Lane and Urry, Helium Ratios of Igneous Rocks, 677
Evans (Dr. I. B. Pole), A Grass Leviathan from East Africa, 34
Evans (Dr. M. G.), elected professor of physical chemistry in Leeds University; work of, 15; 47
Evans (Dr. R. C.), An Introduction to Crystal Chemistry (*Review*), 6
Evershed (Sydney), [obituary article], 623
Ezoe (H.), [Dr. Y. Nishina, T. Yasaki, Prof. K. Kimura, M. Ikawa and], Fission of Thorium by Neutrons, 547

Fairchild (Dr. D.), awarded the Meyer medal of the American Genetic Association; work of, 237
Faires (Prof. V. M.), Applied Thermodynamics; Elementary Thermodynamics (*Review*), 176
Fankhauser (G.), Polyploidy in the Salamander, 1017
Farkas (Dr. A.), and Dr. H. W. Melville, Experimental Methods in Gas Reactions (*Review*), 268
Farrand (Dr. L.), [death], 970
Farrington (Prof. B.), Science and Politics in the Ancient World (*Review*), 764
Farris (Dr. E. J.), appointed executive director of the Wistar Institute of Anatomy and Biology, 199
Fasciolo (J. C.), [J. M. Muñoz, E. Braun-Menéndez, L. F. Leloir and], Hypertensin: the Substance Causing Renal Hypertension, 980
du Fay (Charles-François de Casternay), Bicentenary of, 105
Fazekas (J. E.), [H. E. Himwich, Z. Baker and], Respiratory Metabolism of Infant Brain, 38
Feather (Dr. N.), Deuteron Bombardment of Silver, 547
Feghali (Prof. M.), Proverbes et dictons Syro-Libanais; texte arabe, transcription, traduction, commentaire et index analytique (*Review*), 582
Fei (Dr. Hsiao-Tung), Peasant Life in China: a Field Study of Country Life in the Yangtze Valley (*Review*), 267
Feldtkeller (Prof. R.), Einführung in die Vierpoltheorie der elektrischen Nachrichtentechnik (*Review*), 311
Fell (Honor B.), The Avian Sternum, 557; [H. Grüneberg and], Pleiotropic Gene-effects in the Rat, 293
Fermor (Sir Lewis L.), Soil Destruction in Malaya, 901
Fertel (Dr. G. E. F.), [C. F. Powell and], Energy of High Velocity Neutrons by the Photographic Method, 115; [Dr. W. Heitler, Dr. C. F. Powell and], Heavy Cosmic Ray Particles at Jungfraujoch and Sea-Level, 283
Fick (Prof. Rudolf), [obituary article], 104
Fieser (L. F.), W. P. Campbell and E. M. Fry, Vitamins K_1 and K_2, 519
Fikry (Dr. Amin), Antirrhinum Rust, 913
Finch (R. H.), Ultra-violet Lighting in Generating Stations in War-time, 437
Findlay (Prof. A.), Science and the Community, 605
Findlay (Dr. G. M.), Recent Advances in Chemotherapy. Second edition (*Review*), 194; and F. O. MacCallum, Spontaneous Yellow Fever in Rhesus Monkeys in the Absence of Mosquitoes, 332
Finn (S. R.), and E. O. Powell, Evaporation of Mist Particles and its Bearing on Air Sterilization, 864
Fischer (Dr. A.), Nature of the Growth-Accelerating Substance of Animal Tissue Cells, 113
Fischer (C. E. C.), Aquatic Plants of India and Burma (*Review*), 727; impending retirement from the Royal Botanic Gardens, Kew; work of, 829
Fischer (Prof. E.), awarded the Goethe prize for art and science, 324; [death], 1085
Fisher (Prof. A. G. B.), Economic Self-Sufficiency (*Review*), 1031
Fisher (Miss Eileen E.), Australian 'Sooty Moulds', 253
Fisher (J.), Distribution of the Colour Phases of the Fulmar (*Fulmarus glacialis*), 941
Fisher (Prof. R. A.), and F. Yates, Statistical Tables for Biological, Agricultural and Medical Research (*Review*), 533; Dr. E. B. Ford and Dr. J. S. Huxley, Taste-testing the Anthropoid Apes, 750; and Miss Janet Vaughan, Surnames and Blood-Groups, 1047
Fitzmaurice (R.), Principles of Modern Building. Vol. 1: Walls, Partitions and Chimneys (*Review*), 459
Fleming (Dr. A. P. M.), Education for Industry, 433; 852
Fleure (Prof. H. J.), awarded the Charles P. Daly medal of the American Geographical Society, 199; Cultural Significance of Anthropological Studies, 697
Flexner (Prof. S.), Evolution of the University Clinic and its Laboratories, 147
Flint (W. P.), Fruit Pest Control in the U.S.A., 161
Foan (late G. A.), [H. Stanley Redgrove and], Hair Dyes and Hair Dyeing Chemistry and Technique. New edition completely revised by H. Stanley Redgrove and J. Bari-Woollss (*Review*), 740
Folley (Dr. S. J.), Sex Difference in the Response of the Pigeon Crop-Gland to Prolactin, 834
Ford (Dr. E. B.), [Prof. R. A. Fisher, Dr. J. S. Huxley and], Taste-testing the Anthropoid Apes, 750
Ford (J.), C. M. Hartley, T. Harrisson, P. M. Synge and E. Shackleton. Edited by T. Harrisson, Borneo Jungle: an account of the Oxford Expedition to Sarawak (*Review*), 742
Forman (J.), Extremely Bright Spots on Coolidge Tube Target, 511
Forró (Dr. M.), [Dr. J. Barnóthy and], Directional Distribution of the Hard and Soft Component of Cosmic Radiation, 116
Fowler (Prof. R. H.), Growth of the Kinetic Theory (*Review*), 993
Fox (Sir Cyril), Two Bronze Age Cairns in Wales, 518
Fox (D. C.), [Dr. L. Frobenius and], African Genesis (*Review*), 894
Fox (H.), Arthritis in Wild Mammals, 638
Fraenkel-Conrat (H.), [Prof. K. H. Slotta and]. Crotoxin, 290
Francis (A. J.), awarded a prize of £50 by the Institution of Civil Engineers, 29
Frankel (Dr. M.), and E. Katchalski, Poly-condensation of *a*-Amino Acid Esters, 330; O. Neufeld and E. Katchalski, Carbamates of *a*-Amino-Acid Esters and their Poly-condensation, 832
Frankel (Prof. S. H.). Capital Investment in Africa: its Course and Effects (*Review*), 686
Frary (S. G.), [H. S. Booth, F. B. Dutton and], Fluorination of Phosphorus Halides, 1017
Fraser (Sir James George), The Native Races of Australasia, including Australia, New Zealand, Oceania, New Guinea and Indonesia. A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of. Arranged and edited by R. A. Downie (*Review*), 588; The Native Races of Asia and Europe. A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of. Arranged and edited by R. A. Downie (*Review*), 688
Fraser (Dr. R. A.), Dr. W. J. Duncan and A. R. Collar, Elementary Matrices and some applications to Dynamics and Differential Equations (*Review*), 650
Freeman (Prof. I. M.), Life-time of the Mesotron, 667; [Prof. A. E. Haas and], Elementary Survey of Physics: a Non-Mathematical Presentation, with a Special Supplement for Pre-medical Students (*Review*), 744

Frehden (O.), [Prof. L. Zechmeister and], Achromatographic Study of Lignite, 331

Fremlin (Mrs. Reinet), Salaries of Scientific Workers, 119

Freud (Prof. S.), [death], 579; [obituary article], 735

Freundlich (Dr. E. F.), conferment upon, of the M.A. degree *ad eundem gradum*, by St. Andrews University, 127

Friedenreich (Dr. V.), Blood Groups and Paternity, 542

Friedland (R.), Cement and Concrete (in Hebrew) (*Review*), 367

Friedman (L.), and P. G. Carpenter, Diffusion Velocity and Molecular Weight, 388

Friend (Prof. A. W.), [Prof. R. C. Colwell and], Reflection of Medium and Short Radio Waves in the Troposphere, 31

Friend (Dr. J. Newton), Spectroscopy in Industry (*Review*), 532; Spectrographic Analysis of East Indian Rocks (*Review*), 652; and R. H. Vallance, Vanadiferous Nodules in Worcester Clay, 286; and J. P. Allchin, Colour of Celestine, 633; [A. W. G. Kingsbury and], Occurrence of Greenockite in the Mendips, 1013

Frik (Dr. K.), awarded the Rieder medal of the German Rontgen Society, 508

Frobenius (Dr. L.), and D. C. Fox, African Genesis (*Review*), 894

Froehlich (Dr. A.), appointed pharmacologist to the May Institute for Medical Research of the Jewish Hospital, Cincinnati, 976

Fry (E. M.), [L. F. Fieser, W. P. Campbell and], Vitamins K_1 and K_2, 519

Fulton (J. A.), [death], 857

Fulton (Prof. J. F.), Physiology of the Nervous System (*Review*), 133; Prof. W. P. Lombard, 1084; [Dr. H. R. Catchpole and], Tarsiers in Captivity, 514

Furon (Prof. R.), Manuel de préhistoire générale : Europe, Asie, Afrique, Amérique (*Review*), 737

Fürth (R.), K. Sitte and H. P. Appel, Determination of Stellar Diameters by Interferometer, 40

Gainsborough (G. F.), The Diode as a Frequency-changer for Measurements at Ultra-High Frequencies, 548

Gall (D. C.), Comparing Resistances of Four-Terminal Resistors, 982

Gallop (R.), Mexican Mosaic (*Review*), 883; Basque Origins, 946

Galloway (Dr. I.), appointed scientific superintendent of research at the Pirbright Research Station of the Foot-and-Mouth Disease Research Committee, 705

Gamow (Prof. G.), Nuclear Reactions in Stellar Evolution, 575; 620

Ganguli (N.), [Prof. K. S. Krishnan and], Large Anisotropy of the Electrical Conductivity of Graphite, 667

Gann (late Dr. T. W.), Maya Mounds of British Honduras, 252

Gant (D. H. T.), Fission of Uranium under Deuteron Bombardment, 707; [Dr. R. S. Krishnan and], Deuteron Bombardment of Silver, 547

Gardiner (E. L.), [O. F. Brown and], The Elements of Radio-Communication. Second edition (*Review*), 1068

Gardiner (Prof. J. Stanley), Conservation of Natural Resources (*Review*), 310; The Californian Deserts (*Review*), 460

Gardner (Prof. E. A.), [death], 970

Gardner (H. B.), and C. M. Saeger, Impurities in Brass, 386

Garner (Prof. W. E.), Co-operative Activation, 287

Garnett, jr. (Prof. C. B.), The Kantian Philosophy of Space (*Review*), 587

Garratt (Dr. D. C.), Drugs and Galenicals : their Quantitative Analysis (*Review*), 402

Garrett (A. B.), Mercuric Halide Complex Ions, 1018

Garstang (Prof. W.), Nomenclature of Nudibranchiate Mollusca, 481

Gatenby (Prof. J. B.), and Miss Olive E. Aykroyd, Cytology of the Human Uterine Gland Cell, 331

Gates (Prof. R. R.), Chromosome Structure, 81; Nucleoli, Satellites and Sex Chromosomes, 794; Human Genetics, 821; Relation of the Nucleolus to Secondary Constrictions, 980

Gathorne-Hardy (G. M.), The Fourteen Points and the Treaty of Versailles (*Review*), 1031

Gatty (O.), [Dr. G. S. Carter, Dr. J. H. Schulman, Dr. H. Walston and], Calcium in Ciliary and Muscular Movement, 980

Gaunt (J. F.), appointed research assistant in dyeing in Leeds University, 219

Gavin (W.), appointed agricultural adviser designate to the Minister of Agriculture and Fisheries, 410

Gay (H. J.), Computation and Trigonometry (*Review*), 585

Geddes (M.), and I. L. Thomsen, Surface Features of Mars at the Recent Opposition, 944

Gessain (Dr. R.), Magic in Mexico, 1033, 1039

Gheury de Bray (M. E. J.), Interpretation of the Red-shifts of the Light from Extra-Galactic Nebulæ, 285; Measurements of the Velocity of Light, 945

Ghose (R.), [B. Mukerji and], Elimination of Administered Chloral Hydrate in the Urine as a Test for Liver Function, 112; Blood Clearance of Free Chloral in Normal and Liver-damaged Dogs, 636

Gibbs (D. F.), and Prof. G. P. Thomson, Possible Delay in the Emission of Neutrons from Uranium, 202

Gibson (Prof. C. S.), Sir William Pope, 810

Gillen (late F. J.), [late Sir Baldwin Spencer and], The Native Tribes of Central Australia. New edition (*Review*), 363

Gillespie (J. J.), The Principles of Rational Industrial Management (*Review*), 53

Gillespie (L. J.), and W. R. Downs, Palladium-Deuterium Equilibrium, 757

Gillett (Joyce), Ghost Figures of Santa Cruz, 870

Gilligan (Prof. A.), [death], 736; [obituary article], 812

Gilmour (J. S. L.), and Dr. J. W. Gregor, Demes : a Suggested New Terminology, 333

Ginnings (D. C.), [N. S. Osborne, H. F. Stimson and], Thermal Properties of Water and Steam, 716

Giordano (A.), A Geothermic Generating Plant, 747

Glaister (Dr. J.), [Dr. S. Smith and], Recent Advances in Forensic Medicine. Second edition (*Review*), 371

Glanville (Prof. S. R. K.), Catalogue of Demotic Papyri in the British Museum. Vol. 1 : A Theban Archive of the Reign of Ptolemy I, Soter (*Review*), 582

Glasscock (H. H.), and W. M. Ware, Leaf-spot Disease of Spinach, 602

Glockler (Prof. G.), and Prof. S. C. Lind, The Electrochemistry of Gases and other Dielectrics (*Review*), 93

Glover (R. E.), [Prof. J. B. Buxton and], Tuberculin Tests in Cattle, 108

Glueck (Dr. N.), Excavations at Ezion-Geber, 278

Glynne (A.), Comparison of Resistances of Four-Terminal Resistors, 596

Glynne (Mary D.), Fungal Lodging of Wheat, 39

Godden (W.), Elements in Nutrition, 556

Godfrey (F. K.), [B. C. Cotton and], The Mollusca of South Australia. Part 1 (*Review*), 193

Goldblatt (Prof. H.), awarded the Alvarenga prize of the College of Physicians of Philadelphia, 375

Goldstein (Dr. L.), A. Rogozinski, and R. J. Walen, The Scattering by Uranium Nuclei of Fast Neutrons and the Possible Neutron Emission Resulting from Fission, 201

Golightly (Dr. W. H.), and Dr. Ll. Lloyd, Insect Size and Temperature, 155

Goodeve (Dr. C. F.), [Dr. E. E. Broda, Dr. R. J. Lythgoe, E. Victor and], Cataphoretic Measurements on Solutions of Visual Purple and Indicator Yellow, 709

Goodlet (Prof. B. L.), appointed professor of electrical engineering in Birmingham University, 87

Goodman [Evans, Keevil, Lane, Urry and], Helium Ratios of Igneous Rocks, 677

Goodspeed (T. H.), and P. Avery, Trisomic Nicotiana 1095

Gordon (A. H.), [V. Subrahmanyan, Dr. D. E. Green, and], Isolation of a Catalytically Active Flavoprotein from Liver, 1016

Gordon (A. R.), [S. Shankman and], Vapour Pressures of Sulphuric Acid Solutions, 716

Gordon (Dame Maria Ogilvie), [death], 14; [obituary article], 142

Gorer (G.), Himalayan Village: an Account of the Lepchas of Sikkim (*Review*), 96

Gortner (Prof. R. A.), Outlines of Biochemistry: the Organic Chemistry and the Physicochemical Reactions of Biologically Important Compounds and Systems. Second edition (*Review*), 268

Gorton (F. R.), [J. A. Clark, F. W. Sears and], Physics To-day (*Review*), 588

Goudie (Prof. W. J.), conferment upon, of an honorary doctorate by Glasgow University, 47

Goulden (C. H.), Methods of Statistical Analysis (*Review*), 799

Grant (Dr. J.), The Cellulose Industry, with Special Reference to the Paper and Allied Industries, 217; Wood Pulp (*Review*), 740

Grassmann (Dr. E.), [Dr. K. Diebner und], Künstliche Radioaktivitat: Experimentelle Ergebnisse (*Review*), 689

Graubard (Dr. M.), Man the Slave and Master (*Review*), 310

Graves (Dr. W. W.), awarded the Award of Merit of the St. Louis Medical Society, 829

Gray (B.), Early Islamic Decorative Technique, 912

Gray (Dr. L. H.), and Dr. J. Read, Measurement of Neutron Dose in Biological Experiments, 439; Dr. J. Read and Dr. J. C. Mottram, Comparison of the Lethal Effect of Fast Neutrons and Gamma-Rays on the Growing Tips of Broad Bean Roots, 478; and Dr. J. Read, Quantitative Comparison of the Biological Effects of Neutrons and other Ionising Radiations, 509

Green (D. E.), Pathological Problems of Fruit and Hops (*Review*), 687; [V. Subrahmanyan, A. H. Gordon and], Isolation of a Catalytically Active Flavoprotein from Liver, 1016

Green (S. L.), The Theory and Use of the Complex Variable (*Review*), 741

Greene (Dr. Raymond), Scientific Research in the Region of Mount Everest, 158

Greenlees (A. E.), The Amplification and Distribution of Sound (*Review*), 197

Greenwood (Prof. Major), Social Distribution of University Education, 591

Greenwood (Dr. T.), A Century of British Philosophy (*Review*), 51

Gregg (Dr. S. J.), and Dr. E. E. Widdowson, Evaporation of Built-up Molecular Films, 666

Gregor (Dr. J. W.), [J. S. L. Gilmour and], Demes: a Suggested New Terminology, 333

Gregory (Dr. E.), [E. N. Simons and], The Structure of Steel Simply Explained (*Review*), 198

Gregory, James, Tercentenary Memorial Volume, Edited by Prof. H. W. Turnbull (*Review*), 1062

Gregory (P. H.), White Mould Disease of the Daffodil, 253; Indirect Damage by Narcissus Leaf Diseases, 984

Gregory (Dr. P. W.), Relationship between Hereditary Size in Mammals and Glutathione Content of the Tissues, 561

Gregory, Bt. (Sir Richard), elected president of the British Association; work of, 472; Contacts of Religion and Science, 522; Natural and Political Philosophies (*Review*), 764; Old and New Astronomy (*Review*), 1028

Gregory (Dr. W. K.), and M. Hellman, Dentition of Australopithecus (Plesianthropus), 451

Grenfell (Sir Wilfred), elected an honorary member of the American Geographical Society, 199

Gresser (E. B.), [C. M. Breder and], The Four-eyed Blenny, 675

Griaule (M.), Masques Dogons; Jeux Dogons (*Review*), 738

Griffiths (Dr. Gwenvron M.), appointed to the Kathleen Schlesinger research fellowship for 1939–40, 242

Griggs (D.), A Theory of Mountain-Building, 602

Grigson (W. V.), The Maria Gonds of Bastar (*Review*), 1076

Grimmett (L. G.), and G. V. B. Herford, An Experiment on the Effects of γ-Radiation on the Grain Weevil, 939

Grimshaw (P. H.), [death], 891; [obituary article], 1004

Grinnell (Prof. J.), [death], 65

Gronemeier [Brigl, Schultz and], The Ethyl-Thioglucosides and a new Monoacetoneglucose, 680

Gross (Dr. F.), [Dr. H. Pettersson, F. Koczy and], Large-scale Plankton Culture, 332

Grossern (Prof. O.), awarded the silver medal of the Jena Society of Medicine and Natural Sciences, 199

Groves (Miss R. C.), Exfoliation of Vermiculite by Chemical Means, 554

Grüneberg (H.), [M. C. Bourne and], Inheritance of Cataract, 38; and H. B. Fell, Pleiotropic Gene-effects in the Rat, 298

Guha (B. S.), Aboriginal Races of India, 293

Gunn (Prof. J. A.), Prof. H. H. Meyer, 968

Gurevich (Dr. I.), Phase Transitions of Nuclear Matter, 326

Gustafson (Prof. A. F.), Prof. H. Ries, Prof. C. H. Guise, and Prof. W. J. Hamilton, jr., Conservation in the United States (*Review*), 310

Gutenberg and Richter, The Central Core of the Earth, 210

Gutenberg (Dr. B.), [Dr. H. Benioff and], Observations with Electromagnetic Microbarographs, 478

Gutton (C.), Télégraphie et téléphonie sans fil (*Review*), 1068

Gwynne-Vaughan (Dame Helen), appointed Director of the Auxiliary Territorial Service, Army Branch, 70

Gyorgy (Dr. P.), and Dr. R. E. Eckardt, Vitamin B$_6$ and Skin Lesions in Rats, 512

Haagen-Smit (A. J.), [J. English, J. Bonner and], Wound Hormones in Plants, 984

Haas (Prof. A. E.), and Prof. I. M. Freeman, Elementary Survey of Physics: a Non-Mathematical Presentation, with a Special Supplement for Pre-medical Students (*Review*), 744

Haasis (F. A.), Studies on Narcissus Mosaic, 448

Haayman (P. W.), [Prof. J. P. Wibaut and], Ozonization of *O*-Xylene and the Structure of the Benzene Ring, 290

Haddow (Dr A.), Genetical Aspects of Growth, Normal and Abnormal, 823

Hahn (Dr. L.), and Prof. G. Hevesy, Interaction between the Phosphatides of the Plasma and the Corpuscles, 72; Phosphatide Exchange between Plasma and Organs, 204

Hahn (Prof. O.), Fission of Uranium Nuclei by Neutrons, 46

Haines and Schofield, Movement of Water in the Soil, 210

Haist (Dr. R. E.), [Prof. A. W. Ham and], Histological Effects of Diabetogenic Anterior Pituitary Extracts, 835

Halberstaedter (L.), A Benzpyrene Tumour Strain in Hamsters with Tendency to Metastasis Formation, 377

Halcrow (W. T.), presented with the gold medal of the Société des Ingénieurs Civils de France, 70

Haldane (Prof. J. B. S.), Dr. J. S. Huxley, and Dr. H. J. Muller, "Introduction to Modern Genetics", 78; and U. Philp, Genetics of Man, 557

Hale (late Dr. G. E.), and Dr. S. B. Nicholson, Magnetic Observations of Sunspots, 1917–1924. 2 parts (*Review*), 266

Hall (Dr. J. L.), [Dr. R. Owen Carter and], Physical Characterization of Calf Thymus Nucleohistone, 329

Hall (J. S.), Velocity of Coloured Light, 871

Hall (K.), [Dr. V. Korenchevsky and], Metaplasia and Adenoma-like Changes in the Uterus of Rats Injected with Sex Hormones, 1048

Hall (Patricia), and H. W. Locke, Incentives and Contentment: a Study made in a British Factory (*Review*), 1082

Hall (P. M.), Hybrid Wild Orchids of Great Britain, 85

Halle (R.), appointed a research assistant in glass technology in Sheffield University, 168

Ham (Prof. A. W.), and Dr. R. E. Haist, Histological Effects of Diabetogenic Anterior Pituitary Extracts, 835

Handley (W. R. C.), Water Movement and Radial Growth in Trees, 984

Hanle (Prof. W.), Künstliche Radioaktivität und ihre kernphysikalischen Grundlagen (*Review*), 689

Hann (R. M.), W. D. Maclay and C. S. Hudson, Structures of Diacetone Dulcitols, 757

Hannell (F. G.), appointed assistant lecturer in geography in Sheffield University, 168

Hardy (A. C.), Electric Propulsion at Sea, 780

Hardy (Prof. G. H.), and Prof. E. M. Wright, An Introduction to the Theory of Numbers (*Review*), 347

Harington (Prof. C. R.), and Rosalind V. Pitt Rivers, Preparation of Thyroxine from Casein Treated with Iodine, 205

Harker (Dr. A.), [death], 236; [obituary article], 316

Harland (Dr. S. C.), appointed director of the Institute of Cotton Technology of the National Agricultural Society of Peru, 705

Harley (L. S.), and Dr. R. W. Lunt, The Electric Discharge in Engineering Science (*Review*), 769

Harrington (Dr. A. H.), Music in Mental Diseases, 1008

Harris (G. M.), Municipal Self-Government in Britain, 1060

Harris (Prof. H. A.), Growth of the Mandible in the Pig, 552

Harris (Prof. T. Maxwell), British Purbeck Charophyta (*Review*), 1077

Harris (Thistle Y.), Wild Flowers of Australia (*Review*), 7

Harrison (Dr. G. E.), elected to a Rockefeller foundation fellowship in natural science, 278

Harrisson (T.), [J. Ford, C. M. Hartley, P. M. Synge, E. Shackleton and], edited by T. Harrisson, Borneo Jungle: An Account of the Oxford Expedition to Sarawak (*Review*), 742

Hart (Sister Mary Jane), [Prof. J. R. Loofbourow, E. S. Cook, Sister Cecelia Marie Dwyer and], Production of Intercellular Hormones by Mechanical Injury, 553

Hart (P. D'Arcy) and G. P. Wright, Tuberculosis and Social Conditions in England, 447

Hartley (C. M.), [J. Ford, T. Harrisson, P. M. Synge, E. Shackleton and], edited by T. Harrisson, Borneo Jungle: An Account of the Oxford Expedition to Sarawak (*Review*), 742

Hartley (Sir Harold B.), appointed a member of the advisory council to the Committee of the Privy Council for Scientific and Industrial Research, 665; appointed honorary adviser on the development of home-produced fuels to the Secretary for Mines, 1088

Hartog (Sir Philip), The Newer Views on Priestley and Lavoisier, 232

Hartree (Dr. E. F.), [Prof. D. Keilin and], Mechanism of Decomposition of Hydrogen Peroxide by Catalase, 787; 1091

Hartridge (Prof. H.), Theories of Vision and Hearing (*Review*), 94; Theories of Hearing (*Review*), 570

Harvey (A.), Coalbursting, 872

Harvey (G. M.), appointed electrical inspector of mines, 862

Haskins (W. T.), and C. S. Hudson, Preparation of *l*-Tartaric Acid, 211

Hatfield (Dr. W. H.), New Researches in Steel Metallurgy, 56

Haupt (Prof. A. W.), An Introduction to Botany (*Review*), 402

Haven (H. C.), Evolution of a Sun-fish, 756

Hawkins (Prof. H. L.), Local Scientific Societies and the Community, 435; awarded the Lyell medal of the Geological Society of London, 1044

Hawkins (T. H.), Biology, The School and Society, 140; Introducing Biological Principles (*Review*), 847

Haworth (Prof. R. D.), appointed professor of chemistry in Sheffield University, 144; 168; work of, 144

Hawtrey (R. G.), conferment upon, of an honorary doctorate by London University, 875

Healy (Dr. W.), Personality in Formation and Action (Thomas W. Salmon memorial lectures) (*Review*) 588

Heilbron (Prof. I. M.), conferment upon, of an honorary doctorate by Glasgow University, 47

Heitler (Dr. W.), Dr. C. F. Powell and Dr. G. E. F. Fertel, Heavy Cosmic Ray Particles at Jungfraujoch and Sea-Level, 283

Helger (M. B.), Urban and Rural Housing, 1041

Heller (Dr. E.), [death], 318

Hellman (M.), [Dr. W. K. Gregory and], Dentition of Australopithecus (Plesianthropus), 451

Helmer (O. M.), and I. H. Page, Properties of Renin, 209

Helson (G. A. H.), Oriental Peach Moth in Australia, 913

de Hemptinne (Prof. M.), [J. B. R. Rajam, P. C. Capron and], Evaluation of the Beta Upper Energy Limits with Simple Absorption Data, 202

Henderson (Dr. E. Ellice), appointed inspector of anatomy in England, Scotland and Wales, 1088

Henderson (H. D.), Colonies and Raw Materials (*Review*), 1081

Henle (Jacob), translated by Dr. G. Rosen, On Miasmata and Contagia (*Review*), 896

Henry (Dr. T. A.), Pharmaceutical Chemistry (*Review*), 402

Hensby (G. S.), [Dr. H. J. J. Braddick and], Evidence for the Occurrence of Meson Pairs, 1012

Herb (R. G.), D. W. Kerst, D. B. Parkinson and G. J. Plain, Scattering of Protons by Protons, 254

Herbert (J. B. M.) and E. Blumenthal, Mechanism of Hydrolysis of Inorganic Esters, 248

Herford (G. V. B.), [L. G. Grimmett and], An Experiment on the Effects of γ-Radiation on the Grain Weevil, 939

Hermann (R. N.), [A. R. Martin and], Action of Copper Salts on Emulsions Stabilised by Sodium Oleate, 479

Herrick (C. E.), [N. W. Rakestraw, W. D. Urry and], Helium-Neon Content of Sea Water, 838

Herring (Prof. P. T.), The Problem of Pain, 770

Herriott (R. M.), [V. Desreux and], Existence of Several Active Components in Crude Pepsin Preparations, 287

Hervey (G. E. R.), [J. G. Horsfall, R. F. Suit and], Damage by Spray Fluid, 947

Hevesy (Prof. G.), [Dr. L. Hahn and], Interaction between the Phosphatides of the Plasma and the Corpuscles, 72; Phosphatide Exchange between Plasma and Organs, 204

Hewett (Dr. C. L.), [Prof. E. Kennaway, Prof. J. W. Cook, Dr. I. Hieger, Dr. W. Mayneord and], awarded the prize of the Anna Fuller Fund of New Haven, Conn., 150

Hewlett (Prof. R. T.), One Hundred Years of Microscopy: The Royal Microscopical Society, 850; More about Microbes (*Review*), 998

Heymans (Prof. C.), awarded the Nobel prize for physiology and medicine for 1938; work of, 777

Heywood (Dr. H.), appointed reader in mechanical engineering at the Imperial College of Science and Technology, 47

Hieger (Dr. I.), [Prof. E. Kennaway, Prof. J. W. Cook, Dr. C. L. Hewett, Dr. W. Mayneord and], awarded the prize of the Anna Fuller Fund of New Haven, Conn., 150

Higbee (Prof. F. G.), 101 Problems in Drawing-Board Geometry (*Review*), 369

Higbie (Prof. H. H.), [Prof. W. H. Timbie and], Essentials of Alternating Currents. Second edition (*Review*), 585

Hildebrand (S. F.), Panama Canal as a Fish Highway, 756

Hilgenberg (Dr. L.), und Prof. W. Kirfel, Vāgbhaṭa's Aṣṭāṅgahṛdayasaṃhitā. Lief. 5, 6, 7 (*Review*), 370

Hill (Sir Arthur W.), Pelargoniums, 639

Hill (Dr. B.), [Dr. Edith Straker, Dr. R. Lovell and], Bacteria of the Throat and Nose, 1017

Hill (C. P.), Juvenile Delinquency, 703

Hill (J. R.), Public Health in Relation to the Recognition, Definition, Standardisation and Controlled Supply of Medicaments, 185

Hill (Sir Leonard), Penetration of Rays through the Skin, and Radiant Energy for the Treatment of Wounds, 973

Hills (Dr. E. S.), Geological Characteristics of the Wyperfeld (Mallee) National Park, Victoria, 274

Himwich (H. E.), Z. Baker and J. E. Fazekas, Respiratory Metabolism of Infant Brain, 38

Hind (H. G.), [M. M. El-Sadr, T. F. Macrae, C. E. Work, B. Lythgoe, Prof. A. R. Todd and], Vitamin B Requirements of the Rat, 73

Hinderer (F.), Spectrum of Comet 1939*d*, 254
Hindley (Sir Clement), Engineers in War-time, 825
Hines (H. J. G.), [C. H. Williams and], Toxicity of *Salvia reflexa*, 118
Hinks (A. R.), On Some Misrepresentations of Antarctic History, 901
Hinshelwood (Prof. C. N.), [J. G. Davoud and], Thermal Decomposition of Acetone, 909
Hirano (Y.), [N. Shinohara, M. Yoshioka and], Extensions of Carrier Telephone Systems, 545
Hiro (F.), Barnacle Communities, 1017
Hitchings (G. H.), [R. V. Cleary, J. Maier and], Metabolism of Chloronaphthalenes, 122
Hoard (J. L.), and W. B. Vincent, Structure of Complex Fluorides, 984; and H. H. Nordsieck, Structure of Potassium Molybdocyanide Dihydrate, 1018
Hoare (Dr. F. E.), A Textbook of Thermodynamics. Second edition (*Review*), 176
Hobday (Sir Frederick), [death], 14; [obituary article], 184
Hobson (Dr. R. P.), Effect of Suint on Sheep Dips, 1093
Hodgkin (A. L.), and A. F. Huxley, Action Potentials Recorded from Inside a Nerve Fibre, 710
Hodgson (E. A.), Bibliography of Seismology, 189
Hodson (H. V.), The British Empire (*Review*), 1031
van Hoepen (Dr. E. G. N.), New South African Stone Age Cultures, 385
Hoffer (M.), and Prof. T. Reichstein, Activity of β-Alanine in Stimulating Growth of Young Rats on a Diet Deficient in 'Filtrate Factor', 72
Hoffman (Dr. R. S.), Dr. E. Tenenbaum and Dr. L. Doljanski, Growth-stimulating Effects of Extracts of Normal Adult Tissues and Tumours, 1092
Hoheisel (Prof. G.), Gewöhnliche Differentialgleichungen. Dritte auflage (*Review*), 370
Holderness (A.), [J. Lambert, Dr. F. Sherwood Taylor and], The Essentials of Volumetric Analysis (*Review*), 1080
Holland (Sir Thomas), American Mineral Deficiencies (*Review*), 921; Prof. W. Lindgren, 1083
Holleman (H. C. A.), Manufacture of Rare Gases, 241
Hollis (H. P.), [death], 275; [obituary article], 470
Holmes (Prof. A.), awarded the Murchison medal of the Geological Society of London, 1044
Holmes (Dr. E.), [P. Ostern and], Formation and Breakdown of Glycogen in the Liver, 34
Holmyard (Dr. E. J.), A Higher School Certificate Inorganic Chemistry (*Review*), 584
Honey (N. W.), awarded the Martell scholarship of the Institution of Naval Architects, 546
Hooker (Prof. D.), Origin of the Grasping Movement in Man, 1052
Hoover (M. E.), [M. Demerec and], Hairy Wing (*Hw*) of *Drosophila melanogaster*, 121
Hoover (S. R.), [F. E. Allison, C. A. Ludwig, F. W. Minor and], Legume Nodule Metabolism and Nitrogen Fixation, 711
Hopkins (Prof. A. J.), [death], 1085
Hopp (R. J. G.), History of Intensive Cultivation, 1086
Hopper (Prof. V. F.), Medieval Number Symbolism: Its Sources, Meaning and Influence on Thought and Expression (*Review*), 586
Hopwood (A. T.), Excavations at Brundon, Suffolk, 556
Hopwood (Prof. F. L.), M. H. Salaman and Dr. A. S. McFarlane, Effect of Ultrasonic Vibration on Vaccinia Virus, 377
Horder (Lord), elected president of the National Society for the Prevention of Venereal Diseases, 110
Hori (Prof. Takeo), [Prof. Yoshihiro Asami and], Spectrum of the Torch Discharge, 981
Horn (Sir Arthur), Sir William Prout, 1004
Horn (Dr. Walther), [obituary article], 857
Horodniczy (Dr. H.), and Dr. A. Jabłoński, Influence of Temperature on the Pressure Broadening of Spectral Lines, 594
Horrocks (Jeremiah), Observation of the Transit of Venus; other work, 860
Horsfall (J. G.), G. E. R. Hervey and R. F. Suit, Damage by Spray Fluid, 947
Horsley (J. A. B.), Special Duties for the Mines Department, 862
Horton (Prof. F.), elected vice-chancellor of London University for 1939–40, 47
Houstoun (Dr. R. A.), Kepler's Law of Refraction, 441
Hovy (J. W. H.), Oligodynamic Control of Eelworm (*Heterodera marioni*), 672
Howard (H. W.), Monogenic Broods in *Armadillidium vulgare* Latr., 979
Howarth (W. O.), Denston's A Textbook of Pharmacognosy (*Review*), 192
Hoyle (F.), and R. A. Lyttleton, The Evolution of the Stars, 1019
Hruby (K.), Origin of the Duke Cherries, 757
Hubble (Dr. E.), Cosmic Data, 507
Hudson (C. S.), [W. T. Haskins and], Preparation of *l*-Tartaric Acid, 211; [R. M. Hann, W. D. Maclay and], Structures of Diacetone Dulcitols, 757
Hudson (G. F.), Turkey, Greece and the Eastern Mediterranean (*Review*), 1031
Hudson (Dr. R. G. S.), elected professor of geology in Leeds University; work of, 16; 47
Huebner (W.), Geology and Allied Sciences: A Thesaurus and a Co-ordination of English and German Specific and General Terms. Part 1: German-English (*Review*), 368
Hughes (Prof. H. K.), and G. T. Miller, Trigonometry, with Tables (*Review*), 1081
Hughes (Dr. L. E. C.), Motion Picture Sound Engineering (*Review*), 374
Hughson (Dr. W.), Dr. A. Ciocco and Dr. C. Palmer, Causes of Deafness, 160
Hulme (H. R.), and L. S. T. Symons, Law of Error and the Combination of Observations, 558
Hunter (Dr. D.), appointed a member of the Industrial Health Research Board, 242; 375
Hurd (C. D.), and L. R. Drake, Structure of Cyclo-Octatetrene, 448
Hurst (Sir Arthur), awarded the Moxon gold medal of the Royal College of Physicians, 242
Hurst (C.), [W. D. Allen and], Scattering of D-D Neutrons, 509
Hurst (Dr. H. E.), and late Dr. P. Phillips, The Nile Basin. Vol. 5: The Hydrology of the Lake Plateau and Bahr El Jebel (*Review*), 495
Huse (G.), [H. M. Powell and], Structure of Aromatic Polynitro Compound–Hydrocarbon Complexes, 77
Huxley (A. F.), elected Michael Foster student in Cambridge University, 301; [A. L. Hodgkin and], Action Potentials Recorded from Inside a Nerve Fibre, 710
Huxley (Dr. J. S.), [Prof. J. B. S. Haldane, Dr. H. J. Muller and], "Introduction to Modern Genetics", 78; [Prof. R. A. Fisher, Dr. E. B. Ford and], Taste-testing the Anthropoid Apes, 750; "Race" in Europe (*Review*), 1031
Hyre (R. A.), Spraying and Photosynthesis, 447

von Ihering (Dr. R.), [death], 891
Iitaka (Ichirô), and Shigeto Yamaguchi, Electron Diffraction Examination of Oxide Films on Light Metals, 1090
Ikawa (M.), [Dr. Y. Nishina, T. Yasaki, H. Ezoe, Prof. K. Kimura and], Fission of Thorium by Neutrons, 547
Ikebe (T.), [H. Nagaoka and], A Sensitive Induction Magnetograph, 827
Imahori (Dr. K.), Analysis of Varying Sound, 708
Imamura (I.), Tyōkō and his Seismoscope, 840
Imms (Dr. A. D.), Insects in the Upper Air, 406; Dipterous Larvæ and Wound Treatment, 516; A 'Safe' Fluid for Museum Use, 599; Physiology of Insects (*Review*), 800; Dr. Walther Horn, 857
Ingold (Dr. C. T.), Spore Discharge in Land Plants (*Review*), 959
Iodko [Jezowská and], Double Oxy-chlorides of Rhenium, 81
Ionides (Stephen A. and Margaret L.), One Day Telleth Another (*Review*), 1028
Irving (J. T.), and M. B. Richards, Influence of Age upon the Requirement of Vitamin A, 908

Irving (R. F.), 'Vibrated' Concrete, 904
Ismail (Abdel Fattah Aly), [Prof. A. Schönberg and], A Colour Reaction of Maleic Anhydride, *p*-Benzoquinone and their Partially Substituted Derivatives, 910
van Itterbeek (Prof. A.), W. van Dingenen and J. Borghs, Adsorption of Helium Gas on Active Charcoal between 4·2° and 1·78° K., 249
Iwanenko (Prof. D.), Classical Dynamics of the Meson, 77
Iyengar (Lt.-Col. K. R. K.), Report of the Pasteur Institute of Southern India for 1937, 148

Jabłoński (Dr. A.), [Dr. H. Horodniczy and], Influence of Temperature on the Pressure Broadening of Spectral Lines, 594
Jack (R. W.), Physiology and Behaviour of *Glossina morsitans*, 714
Jacks (G. V.), and R. O. Whyte, The Rape of the Earth: a World Survey of Soil Erosion (*Review*), 647
Jackson (F.), The L.C.C. as an Electricity Consumer, 146
Jacob (L.), Electron Optics (*Review*), 401
Jacobs (Dr. M. B.), The Chemical Analysis of Foods and Food Products (*Review*), 194
Jaeger (E. C.), with chapters by S. S. Berry and M. J. Rogers, The Californian Deserts: a Visitor's Handbook. Revised edition (*Review*), 460
Japan (Empress of), gift for tuberculosis research, 665
Jeffreys (M. D. W.), Sacred Twinned Vessels, 638
Jenkins (Dr. G. I.), and A. Norris, Thickness of Built-up Films, 441
Jenkins (Dr. H. O.), Dipole Moment and Alkyl Chain Length, 667
Jerram (M. R. K.), [T. Thomson and], An Outline of Forestry (*Review*), 614
Jezowská and Iodko, Double Oxy-chlorides of Rhenium, 81
Johannsen (Dr. O. A.), [Dr. W. A. Riley and], Medical Entomology. Second edition (*Review*), 191
Johnson (A.), appointed assistant lecturer in weaving mechanism in Leeds University, 219
Johnson (F. H.), and Dr. K. L. van Schouwenburg, Decomposition of Hydrogen Peroxide by Catalase, 634
Johnson (N. G.), and G. Liljequist, Angular Distribution of Submarine Daylight, 44
Johnson (T. H.), and J. G. Barry, Cosmic Rays at High Altitude, 677
Johnston (Arnrid), Animal Families and Where They Live (*Review*), 1078
Johnstone (A. S.), appointed lecturer in radiology in Leeds University, 47
Johnstone-Taylor (F.), River Engineering: Principles and Practice. Second edition (*Review*), 194
Jolly (Prof. W. A.), [death], 143
Jones (Dr. Brynmor), appointed lecturer in organic chemistry in Sheffield University, 168
Jones (E. W. Knight), A New Record of *Phoronis hippocrepia* Wright, 836
Jones (F. W.), [death], 65; [obituary article], 236
Jones (Prof. F. Wood), Environmental Conditions and Physical Characters (*Review*), 177; Introducing Human Anatomy (*Review*), 351
Jones (G. O.), appointed research fellow in the Department of Glass Technology of Sheffield University, 1010
Jones (H. Gwynn), The Charcoal Iron Industry, 916
Jones (Dr. H. Spencer), Evolution of the Earth's Atmosphere, 161; Tidal Effect on the Variation of Latitude at Greenwich, 162; Rotation of the Earth, and the Secular Accelerations of the Sun, Moon and Planets, 254
Jones (H. Trefor), Smoke Pollution, 258
Jones (J. R.), [H. J. Allcock and], The Nomogram: the Theory and Practical Construction of Computation Charts. Second edition (*Review*), 369
Jones (late Dr. W.), edited by Margaret Welpley Fisher, Ethnography of the Fox Indians, 914
Jorge (Prof. Ricardo), [obituary article], 700
Jost (Prof. L.), awarded the Charles R. Barnes honorary life membership of the American Society of Plant Physiology, 282
Jourdain (Rev. F. C. R.), [H. F. Witherby, N. F. Ticehurst, B. W. Tucker and], The Handbook of British Birds. Vol. 3 (Hawks to Ducks) (*Review*), 691; Birds of Britain, 942
Jungers [Taylor and], Exchange between Nitrogen Isotopes on Metal Surfaces, 1053
Just (Dr. E. E.), The Biology of the Cell Surface (*Review*), 879

Kalfarentzos (E.), Ancient Greek Measures and Athletic Records, 360
Kamal (M.), Hymenopterous Parasites of Aphidophagous Syrphidæ, 639
Kanai (K.), [K. Sezawa and], Range of Possible Existence of Stoneley Waves, 121; 'Packet Velocity' of Dispersive Elastic Waves, 448; Rayleigh Waves in an Inner Stratum of the Earth, 519
Kane (Dr. F.), [Prof. E. J. Conway, P. Boyle, H. O'Reilly and], Localization of Electrolytes in Muscle, 752
Kanjilal (P. C.), [U. N. Kanjilal, A. Das, R. N. De and], Flora of Assam, Vol. 3 (*Review*), 894
Kanjilal (U. N.), A. Das, P. C. Kanjilal and R. N. De, Flora of Assam, Vol. 3 (*Review*), 894
Kaplan (Prof. J.), Nitric Oxide in the Earth's Upper Atmosphere, 152
Kapterev (Prof. P.), Contemporaries of the Mammoth, 702
Kar (Dr. B. K.) and H. N. Banerjee, Effect of Ethylene on *Mangifera indica*, 597
Karny (Dr. H.), [death], 660
Katchalski (E.), [Dr. M. Frankel and], Poly-condensation of α-Amino Acid Esters, 330; [Dr. M. Frankel, O. Neufeld and], Carbamates of α-Amino-Acid Esters and their Poly-condensation, 832
Katô (M.), Temperature Rhythm in an Ant-hill, 385
Kaufmann (B. P.), Chromosome Rearrangements in Drosophila, 385; and Ruth C. Bate, Chromosome Rearrangements in *Drosophila melanogaster*, 121
Kaul (K. N.), appointed assistant for India at the Royal Botanic Gardens, Kew, 829
Kaulback (R.), Salween (*Review*), 1076
Kausche, Pfankuch and H. Ruska, The Electron Microscope and the Investigation of Viruses, 40
Kawamura (T.), Artificial Parthenogenesis and Chromosome Constitution, 209
Keeler (C. E.), [Prof. H. C. Trimble and], Preference of Dalmatian Dogs for Particular Positions in Coach Running, and Inheritance of this Character, 671
Keevil [Evans, Goodman, Lane, Urry and], Helium Ratios of Igneous Rocks, 677
Keilin (Prof. D.), awarded a Royal Medal of the Royal Society, 859; 986; and Dr. T. Mann, Carbonic Anhydrase, 442; and Dr. E. F. Hartree, Mechanism of Decomposition of Hydrogen Peroxide by Catalase, 787; 1091
Keith (Sir Arthur), Science and the National Ideal, 408
Kelley (Prof. T. L.), The Kelley Statistical Tables (*Review*), 741
Kelly (C. J.) and H. H. Beard, Creatine as a Product of Methylation, 162
Kemp (E. E.), Vegetative Propagation of a Fern, 294
Kennaway (Prof. E.), Prof. J. W. Cook, Dr. C. L. Hewett, Dr. I. Hieger and Dr. W. Mayneord awarded the prize of the Anna Fuller Fund of New Haven, Conn., 150
Kennedy (Dr. T.), A Solid Naphthenic Acid from Iranian Petroleum, 832
Kennelly (Prof. A. E.), [obituary article], 64
Kepler (Johannes), Gesammelte Werke, Band 1: Mysterium Cosmographicum, De Stella Nova, Herausgegeben von Max Caspar (*Review*), 223; Gesammelte Werke, Band 2: Astronomiæ Pars Optica, Herausgegeben von F. Hammer (*Review*), 306
Kerst (D. W.), [R. G. Herb, D. B. Parkinson, G. J. Plain and], Scattering of Protons by Protons, 254
Kessel (E. L.), Embryology of Fleas, 160

Kidson (Dr. Edward), [obituary article], 103

Kimura (Prof. K.), [Dr. Y. Nishina, T. Yasaki, H. Ezoe, M. Ikawa and], Fission of Thorium by Neutrons, 547

Kinberg (Prof. O.), Mental Disease and War, 409

Kingsbury (A. W. G.), A New British Locality for Fluorite in Somerset, 1013; and Dr. J. Newton Friend, Occurrence of Greenockite in the Mendips, 1013

Kinmah (T. H.), Radio Interference Measurements; Electrical Interference in Flying, 211

Kirby-Smith and Bonner, Raman Spectrum of Gaseous Methylamine, 1018

Kirfel (Prof. W.), [Dr. L. Hilgenberg and], Vāgbhaṭa's Aṣṭāṅgaṛhdayasamhitā, Lief. 5, 6, 7 (*Review*), 370

Kirihara (S. H.) and K. Nakamura, Employment Tests for Rayon Factory Hands, 789

Kirkpatrick (Dr. T. P. C.), Medicine in Ancient Ireland, 543

Kitchener (Earl), Measurements of the Velocity of Light, 945

Klauber (L. M.), Replacement of Fangs in Rattlesnakes, 714

Kleine (Dr. F. K.), awarded the Shield of Nobility of the Reich, 282

Kleinpell (R. M.), Miocene Stratigraphy of California (*Review*), 1030

Klemperer (O.), Electron Optics (by the Research Staff of Electric and Musical Industries, Ltd.) (*Review*), 401

Klingstedt (H.), Crossing of *Chorthippus bicolor* and *Ch. biguttatus*, 161

Knapman (C. E. H.), [E. Vanstone and], Food Value of Broccoli, 335

Knight (Dr. B. H.), Training of Engineers, 673

Knight (Prof. H. O.), [death], 857

Knight (R. L.), and T. W. Clouston, Genetics of Blackarm Resistance in Cotton, 676

Knox-Shaw (Dr. H.), The New Radcliffe Observatory, 19

Koch (Dr. J.), [Dr. K. J. Bostrøm, Dr. T. Lauritsen and], Delayed Neutron Emission Accompanying Uranium Fission, 830

Kocsy (F.), [Dr. H. Pettersson, Dr. F. Gross and], Large-scale Plankton Culture, 332

von-Koenigswald (Dr. G. H. R.), and Prof. F. Weidenreich, The Relationship between Pithecanthropus and Sinanthropus, 926; 933

Koga (I.), and M. Tatibana, Extremely Bright Spots on Coolidge Tube Target, 511

Kögl (Prof. F.), and Dr. H. Erxleben, The Glutamic Acid of Tumour Proteins, 111

Kol (Dr. E.), Life in Arctic Ice and Snow, 39

Koller (Dr. P. C.), A Synopsis of Genetics (*Review*), 1067; [Prof. F. A. E. Crew and], Chromosomes of the Pig, 385

Kolthoff (Prof. I. M.), [H. A. Laitinen and], Study of Diffusion Processes by Electrolysis with Micro-electrodes, 549

Komarov (Prof. V. L.), awarded the Order of Lenin by the Soviet Government; work of, 777

Korenchevsky (Dr. V.), and K. Hall, Metaplasia and Adenoma-like Changes in the Uterus of Rats Injected with Sex Hormones, 1048

Kosterlitz (Dr. H. W.), Galactose-1-Phosphoric Acid in Galactose Metabolism, 635

Kostoff (Prof. D.), Heterochromatic Regions of Chromosomes, 38; Effect of the Fungicide 'Granosan' on Atypical Growth and Chromosome Doubling in Plants, 334; Abnormal Mitosis in Tobacco Plants Forming Hereditary Tumours, 599; Polyploids are More Variable than their Original Diploids, 868

Kothari (Dr. D. S.), The Meson and Cosmology, 548

Kotschnig (W. M.), Unemployment in the Learned Professions, 148

Kraus (Prof. E. H.), and Prof. C. B. Slawson, Gems and Gem Materials. Third edition (*Review*), 372

Krebs (Dr. H. A.), and Dr. P. P. Cohen, Glutamic Acid as a Hydrogen Carrier in Animal Tissues, 513; Dismutation of Keto Acids in Bacteria and Animal Tissue, 1072

Krige (J. D.), Cattle and Marriage Among Southern Bantu, 912

Krishnan (Prof. K. S.), and N. Ganguli, Large Anisotropy of the Electrical Conductivity of Graphite, 667

Krishnan (Dr. R. S.), and D. H. T. Gant, Deuteron Bombardment of Silver, 547

Krol (Prof. M. B.), [obituary article], 503

Krug (C. A.), and A. Carvalho, Genetical Proof of the Existence of Coffee Endosperm, 515

Kuczynski (R. R.), "Living-Space" and Population Problems (*Review*), 1031

Kuhn (Prof. Richard), awarded the Nobel prize for chemistry for 1938; work of, 858

Kundt (August A. E. E.), centenary of the birth of; work of, 861

Kuno (H.), The Daruma Volcano, Japan, 485

de Lacerda Castelo Branco (Vice-Admiral H. C.), translated by Dr. A. F. Jardim, The Climate of Madeira: with a Comparative Study (*Review*), 742

Lacroute (P.), Determination of Stellar Diameters by Interferometer, 1018

Ladewig (Dr. P.), Precipitation of Protein Fractions in Solutions Particularly Poor in Proteins, 76

Laitinen (H. A.), and Prof. I. M. Kolthoff, Study of Diffusion Processes by Electrolysis with Micro-electrodes, 549

Lal (Awadh Behari), [Dr. Bawa Kartar Singh and], Difference in Odour of *d*-, *l*- and *dl*-Derivatives of Amino- and Bisamino-Methylenecamphors, 910

Lalkaka (K. E.), Hot Spraying of Shellac, 936

Lamb (J.), and E. A. Houghton Roberts, Cytochrome Oxidase in Tea Fermentation, 867

Lambert (J.), in conjunction with A. Holderness and Dr. F. Sherwood Taylor, The Essentials of Volumetric Analysis (*Review*), 1080

Lambert (R. C.), [death], 812

Lamberton (Dr. A. H.), appointed assistant lecturer in chemistry in Sheffield University, 762

Lamont (Dr. A.), Cranidial Muscle Scars of '*Illaenus*' *proles* var. *shelvensis* Whittard, 206

Lander (Dr. G. D.), [obituary article], 970

Landy (M.), Influence of Glutamine on the Growth of *Streptococcus haemolyticus*, 512

Lane (Dr. Clayton), The Story of Plague and other Tropical Diseases (*Review*), 801

Lane [Evans, Goodman, Keevil, Urry and], Helium Ratios of Igneous Rocks, 677

Lane (Sister Mary Michaella), [Prof. J. R. Loofbourow, A. A. Cueto, D. Whalen and], Local Growths in Animals Produced by Injection of Intercellular Wound Hormones, 939

Langdon-Brown (Sir Walter), appointed president of the British Social Hygiene Council, 1088

Langfeld (H. S.), [E. G. Boring, H. P. Weld and others], Introduction to Psychology (*Review*), 744

Langhans (Theodor), centenary of the birth of; work of, 546

Larsen (E. S.), and G. Switzer, Melting of Granodiorite by Andesite, 676

Laszt (L.), Influence of Sodium Chloride on Glucose Absorption from the Intestine of Iodoacetate-poisoned Rats, 244

Latimer (Prof. W. M.), The Oxidation States of the Elements and their Potentials in Aqueous Solutions (*Review*), 367

Laubengayer (A. W.), and H. R. Engle, Oxides and Hydroxide of Gallium, 162

von Laue (Prof. M.), sixtieth birthday of; work of, 625

Lauritsen (Dr. T.), [Dr. K. J. Bostrøm, Dr. J. Koch and], Delayed Neutron Emission Accompanying Uranium Fission, 830

Laustsen (O.), [O. Winge and], Hybridization in Yeast, 253

Lawrence (Prof. E. O.), awarded the Nobel prize for physics for 1939; work of, 859

Lawrence (Dr. J.), and others, Neutrons and Radio-Elements and their Biological Applications, 657

Lawrence (W. J. C.), [M. B. Crane and], The Genetics of Garden Plants. Second edition (*Review*), 94; and J. Newell, Seed and Potting Composts, with Special Reference to Soil Sterilization (*Review*), 581; R. Scott-Moncrieff and V. C. Sturgess, Genetics of Streptocarpus, 676
Lawton (Dr. G.), Mental Hygiene in Old Age, 902
Lea (Prof. F. C.), Hydraulics: for Engineers and Engineering Students. Sixth edition (*Review*), 584
Learmonth (Prof. J. R.), Dr. W. J. Mayo, 274; Prof. Archibald Young, 407
Lecat (M.), Bibliographie de Maurice Maeterlinck: Littérature, Science, Philosophie (*Review*), 1081
Lecoin (M.), [Mlle. M. Perey and], β Spectrum of Actinium K, 326; and I. Zlotowski, Microcalorimetric Measurement of the Mean Energy of Disintegration of Radium E, 440
Leeming (E. L.), Road Development in the United States, 719
Leet (Prof. L. Don), Ground Vibrations near Dynamite Blasts, 791; Practical Seismology and Seismic Prospecting (*Review*), 881
van Leeuwenhoek (Antoni), Alle de brieven (The Collected Letters of Antoni van Leeuwenhoek). Deel (part) 1 (*Review*), 956
Lefèvre (Jules), awarded the Grand Prix Prince Albert I de Monaco of the Paris Academy, 474
Le Gall (Dr. A.), Alcoholism and Mental Disease, 543
Legg (P. H.), An Introduction to Astronomical Navigation (*Review*), 586
Legge (J. W.), [Dr. R. Lemberg, M. Norrie and], Catalase, 551
Leith-Ross (Mrs. Sylvia), African Women: A Study of the Ibo of Nigeria (*Review*), 737
Leloir (L. F.), [J. M. Muñoz, E. Braun-Menéndez, J. C. Fasciolo and], Hypertensin: The Substance Causing Renal Hypertension, 980
Lemberg (Dr. R.), M. Norrie and J. W. Legge, Catalase, 551
Lennard-Jones (Prof. J. E.), and Dr. A. F. Devonshire, Critical Phenomena in Gases, 793
Lennox (F. G.), Development of a Synthetic Medium for Aseptic Cultivation of Larvæ of *Lucilia cuprina*, 676
Leonard (Prof. F. C.), Goose Lake Siderite, 913
Le Page (G. A.), [Dr. L. B. Pett, Marian Lipkind and], Vitamin A in Ling Cod Liver Oil, 634
Lettau (Dr. H.), Atmospharische Turbulenz (*Review*), 651
Leuschner (Prof. A. O.), Minor Planets of the Hecuba Group (Halley lecture), 871
Levin (Major A. E.), [obituary article], 969
Levy (Prof. H.), Modern Science: A Study of Physical Science in the World To-day (*Review*), 3
Lévy-Bruhl (Prof. L.), [death], 318; [obituary article], 471
Lewis (D.), Genetics of the Raspberry, 601
Lewis (Dr. G. W.), Some Modern Methods of Research in the Problems of Flight (Wilbur Wright memorial lecture), 229
Lewis (Dr. J. F.), [death], 1006
L'Hermite (R.), Tests of Materials, 189
Liche (Dr. H.), and Prof. K. Wodzicki, Vaginal Smears and the Œstrous Cycle of the Cat and the Lioness, 245
van Liempt (J. A. M.), and J. A. de Vriend, Testing of Electric Fuses, 122
Liljequist (G.), [N. G. Johnson and], Angular Distribution of Submarine Daylight, 44
Lind (Prof. S. C.), [Prof. G. Glockler and], The Electrochemistry of Gases and Dielectrics (*Review*), 93
Lindberg (C. A.), [A. Carrel and], The Culture of Organs (*Review*), 95
Lindegren (Dr. A.), Education in Germany, 321
Lindgren (Prof. W.), [death], 970; [obituary article], 1083
Lineweaver (H.), [Prof. A. K. Balls and], Nature of a Group in Papain Essential to its Activity, 513
Linge (C. A.), conferment upon, of an honorary degree by Durham University, 875
Linning (W. A.), appointed a lecturer in engineering in Leeds University, 219
Linton (D. L.), [S. W. Wooldridge and], Structure, Surface and Drainage in South-East England, 121
Linton (R. G.), and A. Brownlee, Vitamin A Content of the Livers of a Hundred Healthy Dogs, 978
Lipkind (Marian), [Dr. L. B. Pett, G. A. Le Page and], Vitamin A in Ling Cod Liver Oil, 634
Lipmann (Prof. F.), Role of Phosphate in Pyruvic Acid Dehydrogenation, 381
Lister (Sir Spencer), [death], 624
Little (C. C.), Hybridization and Tumour Formation in Mice, 1052
Livingston (Prof. R.), Physico-Chemical Experiments (*Review*), 897
Ljubimowa (M. N.), [Prof. W. A. Engelhardt and], Myosine and Adenosinetriphosphatase, 668
Lloyd (Dr. Dorothy Jordan), awarded the Fraser Muir Moffat medal of the Foundation of Tanners' Research Laboratory of America, 603
Lloyd (Dr. Ll.), [Dr. W. H. Golightly and], Insect Size and Temperature, 155
Lloyd (Lord), Leadership in Democracy (Walker Trust lecture), 359
Locke (H. W.), [Patricia Hall and], Incentives and Contentment: a Study made in a British Factory (*Review*), 1082
Lodge (Sir Oliver), The Life-work of My Friend, F. W. H. Myers (*Review*), 1027
Loeser (Dr. J. A.), [death], 579
Loewi (Prof. O.), elected an honorary member of the Royal Society of Edinburgh, 70
Loewi (O.), [Dr. W. Dulière and], Liberation of Potassium by Acetylcholine in the Central Nervous System, 244
Loewinson-Lessing (Prof. F. Y.), [obituary article], 1005
Lombard (Prof. W. P.), [death], 236; [obituary article], 1084
Long (Prof. E. R.), elected president of the Wistar Institute of Anatomy and Biology, 199
Longrée (K.), Powdery Mildew of the Rose, 485
Longstaff (Dr. T. G.), Gen. the Hon. C. G. Bruce, 407
Lonnberg (E.), Adaptation in a Dolphin's Backbone, 675
Loofbourow (Prof. J. R.), E. S. Cook, Sister Cecelia Marie Dwyer and Sister Mary Jane Hart, Production of Intercellular Hormones by Mechanical Injury, 553; A. A. Cueto, D. Whalen and Sister Mary Michaella Lane, Local Growths in Animals Produced by Injection of Intercellular Wound Hormones, 939
Loomis (Dr. W. E.), and Dr. C. A. Shull, Experiments in Plant Physiology: A Laboratory Text-book (*Review*), 583
Loughnane (J. B.), *Myzus ornatus* a Vector of Potato Viruses, 785
Lovell (Dr. A. C. B.), and J. G. Wilson, Investigation of Cosmic Ray Showers of Atmospheric Origin, Using Two Cloud Chambers, 863
Lovell (Dr. R.), [Dr. Edith Straker, Dr. B. Hill and], Bacteria of the Throat and Nose, 1017
Low (Prof. A.), conferment upon, of an honorary doctorate by Aberdeen University, 127
Lowe (P. R.), awarded the Verner von Heidstoum gold medal of the Royal Swedish Academy of Sciences, 749
Lowie (R. H.), Ethnography of the Washo of Nevada, U.S.A., 638
Luckwill (Dr. L. C.), Heterosis in Tomatoes, 121; Heterosis in Lycopersicum Crosses in Relation to Seed Weight, 908
Ludin (Prof. A.), elected to the physical mathematical class of the Prussian Academy of Sciences, 70
Ludlow (E. J.), awarded the Founders Company fellowship, 242
Ludwig (C. A.), [F. E. Allison, S. R. Hoover, F. W. Minor and], Legume Nodule Metabolism and Nitrogen Fixation, 711
Lunt (Dr. R. W.), Chemical Reaction in the Electric Discharge (*Review*), 93; [L. S. Harley and], The Electric Discharge in Engineering Science (*Review*), 769
Lyon (Prof. C. J.), Dendrochronology in the Eastern United States, 1086
Lyot (B.), elected an honorary member of the Royal Society of Edinburgh, 70

Lyth (R.), [J. M. Twort and], Skin Cancer due to Handling Coal Tars Used for Preservation of Fishing Nets, 446
Lythgoe (B.), [M. M. El-Sadr, H. G. Hind, T. F. Macrae, C. E. Work, Prof. A. R. Todd and], Vitamin B Requirements of the Rat, 73
Lythgoe (Dr. R. J.), [Dr. E. E. Broda, Dr. C. F. Goodeve, E. Victor and], Cataphoretic Measurements on Solutions of Visual Purple and Indicator Yellow, 709
Lyttleton (R. A.), Fission of Rotating Bodies, 295; [F. Hoyle and], The Evolution of the Stars, 1019

MacArthur (J. W.), and A. R. Dafoe, The Quintuplets, 870
MacArthur (Mary), and R. H. Wetmore, Vascular Anatomy of the Apple, 1053
Macartney (C. A.), The Danubian Basin (*Review*), 1031
McBain (Prof. J. W.), awarded the Davy medal of the Royal Society, 825; 987
McBain (Dr. Mary Evelyn Laing), elected national president of the American Women's Chemical Honor Society, Iota Sigma Pi, 1044
MacCallum (F. O.), [Dr. G. M. Findlay and], Spontaneous Yellow Fever in Rhesus Monkeys in the Absence of Mosquitoes, 332
McCandlish (Prof. D.), appointed honorary director of the Procter International Research Laboratory, 958
McCaskie (W. Ll.), Leaf Cuttings, 161
Maclay (W. D.), [R. M. Hann, C. S. Hudson and], Structures of Diacetone Dulcitols, 757
McCleary (G. F.), Population: To-day's Question (*Review*), 193
McClement (W. D.), [N. W. Pirie, K. M. Smith, E. T. C. Spooner and], Tobacco Necrosis Virus, 80
McClintock (B.), Genetical Analysis of Abnormal Chromosomes, 837
McCombie (Dr. H.), appointed temporary director of the Laboratory of General and Organic Chemistry of Cambridge University, 990
McCoy (H. N.), Salts of Europium, 791
McCrea (Prof. W. H.), Analytical Astrophysics (*Review*), 130; Stellar Structure and Stellar Energy, 985
Macdonald (Lieut. F. W.), [Prof. F. E. Terman and], Fundamentals of Radio (*Review*), 368
McEntegart (Rev. W.), Binocular Stereoscopic Vision, 154
McFadden (Prof. J. H.), [death], 236
McFarlane (Dr. A. S.), and M. G. Macfarlane, Effect of Lipoid Solvents on Vaccinia Virus, 376; [Prof. F. L. Hopwood, M. H. Salaman and], Effect of Ultrasonic Vibration on Vaccinia Virus, 377
Macfarlane (M. G.), [Dr. A. S. McFarlane and], Effect of Lipoid Solvents on Vaccinia Virus, 376
McGowan (Dr. J. P.), Nicotinic Acid, Pentose-Nucleotides and Anæmia, 244
Mackie (Col. F. P.), Insects in Aircraft, 250
Mackintosh (J.), Feeding of Dairy Cows, 257
McKenzie (Prof. A.), conferment upon, of an honorary doctorate by St. Andrews University; work of, 660
McKenzie (A. E.), Electric Heating of Domestic Hot Water Supply, 280
McKerrow (J. C.), Human Origins and Taboo, 1048
MacKinney (Prof. L. C.), Early Medieval Medicine (*Review*), 308
McLeod (Prof. J. W.), [Prof. M. Stewart and], Report for 1937 and 1938 of the Department of Pathology and Bacteriology of Leeds University, 109
McMath (R. R.), Motion Pictures of Small Chromospheric Flocculi, 336
Macmillan (Harold), Traditions and Future of British Democracy (*Review*), 398
McMillan (Cadet V. A.), awarded the Howard prize of the Royal Meteorological Society, 70
McMurrich (late Prof. J. P.), awarded the Flavelle medal of the Royal Society of Canada, 255
McNeill (J. McF.), conferment upon, of an honorary doctorate by Glasgow University, 47
Macovei (Prof. G.), Les gisements de pétrole: géologie, statistique, économie (*Review*), 1060
McPetrie (Dr. J. S.), and J. A. Saxton, Diffraction of Ultra-Short Radio Waves, 631
Macrae (T. F.), [M. M. El-Sadr, H. G. Hind, C. E. Work, B. Lythgoe, Prof. A. R. Todd and], Vitamin B Requirements of the Rat, 73
McReynolds (J. P.), [J. C. Bailar and], Stereochemistry of Complex Inorganic Compounds, 1096
McWilliam (Rev. J. M.), and Lord David Stuart, New Breeding Place of Gannet, 675
Macy-Hoobler (Dr. Icie), awarded the gold medal and prize of the Borden Company, 781
de Madariaga (Don Salvador), Museums and World Peace, 124
Maddock (A. G.), C. Reid and Dr. H. J. Emeléus, New Iodine and Fluorine Derivatives of Monosilene, 328
Maes (Dr. J. P.), Neural Mechanism of Sexual Behaviour in the Female Cat, 598
Mahas (M. K.), [F. H. Constable and], Acoustic Properties of Mud Bricks, 33
Maier (J.), [R. V. Cleary, G. H. Hitchings and], Metabolism of Chloronaphthalenes, 122
Main (Hugh), elected president of the British Empire Naturalists Association; work of, 185
Major (Prof. R. H.), Classic Descriptions of Disease, with Biographical Sketches of the Author. Second edition (*Review*), 195
Majumdar (Dr. D. N.), Family Life of Rajputs, 80
Makins (F. K.), Concise Flora of Britain for the Use of Schools: With Explanatory Illustrations and Keys to Identification (*Review*), 365
Mallowan (M. E. L.), Archæological Excavations in Northern Syria, 702
Maluf (Dr. N. S. Rustum), Dr. R. W. Clarke and Dr. K. W. Thompson, Role of the Renal Innervation in Kidney Function, 292
Mangham (Prof. S.), Earth's Green Mantle: Plant Science for the General Reader (*Review*), 364
Mann (P. J. G.), and Dr. J. H. Quastel, Benzedrine and Brain Metabolism, 943
Mann (Dr. T.), [Prof. D. Keilin and], Carbonic Anhydrase, 442
Mansfield (Dr. W. C.), [death], 408
Manton (Dr. I.), Cytology of the Common Male Fern in Britain, 291; Spiral Structure of *Osmunda regalis*, 716
Marcy (G.), Rock Paintings and Engravings of the Western Sahara, 38
Marett (R. H. K.), An Eye-Witness of Mexico (*Review*), 883
Marett (Dr. R. R.), Speleolatry, 319; Prof. Edward Westermarck, 502
Marinatos (S.), Volcanic Action in Minoan Crete, 1095
Mark (Prof. H.), Structure of the Rayon Fibre, 313
Marks (Simon), conferment upon, of an honorary doctorate by London University, 875
Marr (J. W. S.), Commdr. F. Wild, 578
Marsh (R. W.), Apple Canker, 913
Marshall (A.), Chemistry of Chemical Warfare (*Review*), 996
Marshall (Dr. F. H. A.), conferment upon, of an honorary doctorate by Edinburgh University, 219
Martin (A. C.), and F. M. Uhler, Food of Game Ducks, 1007
Martin (A. R.), and R. N. Hermann, Action of Copper Salts on Emulsions Stabilized by Sodium Oleate, 479
Martin (Sir Charles), Institute of Medical and Veterinary Science, Adelaide: Opening of New Laboratories, 392
Martin (H.), Fungicides, 217
Martin (J. T.), and F. Tattersfield, Insecticides, 217
Martin (Dr. P. S.), Prehistoric Indian Village, New Mexico, 543
Martindale, The Extra Pharmacopœia. Twenty-first edition. Vol. 2 (*Review*), 195
de Martonne (Prof. E.), awarded the Cullum geographical medal of the American Geographical Society, 199
Massicotte (Dr. E. Z.), presented with the Tyrrell medal of the Royal Society of Canada, 255
Mather (Dr. K.), Crossing-over Near the Centromere, 161; A Study of Human Relations (*Review*), 310; Plant Breeding in the Light of Genetics, 820
Matschoss (Prof. C.), translated by Dr. H. S. Hatfield, Great Engineers (*Review*), 690

Matthews (L. H.), Reproduction of the Spotted Hyæna, 983
Mattoon (W. R.), [W. A. Ross and], Farm Forestry, 828
Mande (Pamela F.), "The Merton Catalogue", 120
May (D. H.), awarded a Charles Hawksley prize of the Institution of Civil Engineers, 29
Mayneord (Dr. W.), [Prof. E. Kennaway, Prof. J. W. Cook, Dr. C. L. Hewett, Dr. I. Hieger and], awarded the prize of the Anna Fuller Fund of New Haven, Conn., 150
Mayo (Dr. C. H.), [obituary article], 103
Mayo (Major R. H.), Trans-Atlantic Air Services, 678
Mayo (Dr. W. J.), [death], 236; [obituary article], 274
Mazur (Dr. J.), Anomalous Thermal Expansion of Carbon Disulphide at Low Temperatures, 328
Mecking (Prof. L. L.), elected a corresponding member of the American Geographical Society, 199
Meigs (P.), Kiliwa Indians of Lower California, 675
Meiklejohn (Miss Jane), A Light-sensitive Strain of *Pseudomonas aeruginosa*, 908
Meldahl (K. G.), Tidal Forces in the Sun's Corona Due to Planets (*Review*), 726
Mellanby (Sir Edward), The Experimental Method in the Conquest of Disease (Stephen Paget memorial lecture), 504
Mellanby (Prof. J.), [death], 143; [obituary article], 358
Mellanby (Dr. K.), Rhythmic Processes in Biology, 560
Melland (Miss A. M.), Relation of the Nucleolus to Secondary Constrictions, 980
Melnick (Dr. J. L.), [Dr. K. G. Stern and], Oxidation of Succinate by Heart Muscle, 330
Melville (Dr. H. W.), New Lamps for Old, 604; New Technique in Physical Chemistry, 925; [Dr. A. Farkas and], Experimental Methods in Gas Reactions (*Review*), 268
Mendel (Prof. B.), Dorothy Mundell and Frida Strelitz, Cholinesterase and Electrolytes, 479
Mendelssohn (Dr. J. and Dr. K.), Specific Heat of a Substance Showing Spontaneous Electric Polarization, 595
Mennell (Dr. J. B.), awarded a gold key of the American Congress of Physical Therapy, 976
Menninger (Dr. K. A.), Man Against Himself (*Review*), 744
Menzies (Sir Frederick), resignation of the post of medical officer of health and school medical officer of the London County Council, 705
Meredith (Prof. H. O.), Rates and Taxes, 429
van der Merwe (Dr. P. K.), Removal of Fluorine from Potable Waters, 668
Messer (Prof. H. M.), An Introduction to Vertebrate Anatomy (*Review*), 192
Metcalfe (Dr. C. R.), The Living Plant (*Review*), 400; and W. G. Templeman, Experiments with Plant Growth-Substances for the Rooting of Cuttings, 1043
Metcalfe (Dr. G.), A Bacterial Disease of Forsythia, 1050
Metz (Dr. R.), translated by Prof. J. W. Harvey, Prof. T. E. Jessop, H. Sturt. Edited by Dr. J. H. Muirhead, A Hundred Years of British Philosophy (*Review*), 51
Meyer (Prof. E.), Electro-Acoustics (*Review*), 741
Meyer (Prof. H. H.), [obituary article], 968
Meyer (Prof. K.), elected to the physical mathematical class of the Prussian Academy of Sciences, 70
Meyer (Prof. R. I.), [death], 104; [obituary article], 1005
Michels (Dr. A.), Dr. A. Bijl and Dr. J. de Boer, Effect of an Excitation Energy on the Specific Heat of Liquid Helium II and its Relation to the Exchange Effect in a Non-Ideal Bose-Einstein Gas, 594
Middleton (H.), Systematic Qualitative Organic Analysis (*Review*), 366
Middleton (Sir Thomas), The Farmer's Position and the Scientific Worker's Programme, 434; Scientific Research and Agriculture, 616
Miljutin (G. A.), [O. N. Trapesnikowa and], Specific Heat of Methane under Pressure, 632
Mill (Dr. H. R.), Dr. W. H. Neale, 184
Millard (Dr. C. Killick), C. J. Bond, 1038
Miller (Prof. F. H.), Calculus (*Review*), 585; [Prof. H. W. Reddick and], Advanced Mathematics for Engineers (*Review*), 369
Miller (G. T.), [Prof. H. K. Hughes and], Trigonometry, with Tables (*Review*), 1081
Mills (F. P.), appointed honorary secretary of the North of England Institute of Mining and Mechanical Engineers, 150
Milne-Watson (Sir David), appointed president of the Gas Research Board, 375
Milnthorpe (Miss W.), [Dr. B. P. Uvarov and], Locust Problem in 1937, 86
Milward (G. E.), Guide to Business Management Books. Seventh edition (*Review*), 372
Minett (Prof. F. C.), appointed director of the Imperial Veterinary Research Institute of the Government of India; work of, 105
Minor (F. W.), [F. E. Allison, C. A. Ludwig, S. R. Hoover and], Legume Nodule Metabolism and Nitrogen Fixation, 711
Mittag (Dr. R.), [Dr. H. Bredereck und], Vitamine und Hormone: und ihre technische Darstellung. Teil 1. Zweite auflage (*Review*), 739
Miwa (M.), H. Yamashita and K. Mori, Lethal Action of Alpha-Rays on Sea-Urchin Eggs, 378
Mohamed (Dr. Z.), A Trypanosome in a Tigress, 790
Moir (J. Reid), The Cromer Forest Bed Implements, 205; Excavations at Brundon, Suffolk, 556
von Mojsvar (Mojsisovics), centenary of the birth of; work of, 661
Molin (Dr. K.), Magnetic Observations in Sweden, 519
Møller (Dr. C.), and Dr. L. Rosenfeld, The Electric Quadrupole Moment of the Deuteron and the Field Theory of Nuclear Forces, 476; Prof. L. Rosenfeld and Dr. S. Rozental, Connexion between the Life-time of the Meson and the Beta-decay of Light Elements, 629
Monod (T.), Rock Paintings and Engravings of the Western Sahara, 38
Montalenti (G.), Elementi di Genetica (*Review*), 364
Moore (Dr. H.), British Non-Ferrous Metals Research Association, 83
Moore (Dr. M.), Alcoholism and Suicide, 1040
Moore (W. C.), Diseases of Bulbs (*Review*), 1075
Morant (Dr. G. M.), The Races of Central Europe: A Footnote to History (*Review*), 767
Morgan (Dr. A. E.), The Needs of Youth: A Report Made to King George's Jubilee Trust Fund (*Review*), 723
Morgan (E. E.), Stream and Channel Flow (Hydraulic Graphs and Tables) (*Review*), 367
Morgan (Dr. John), with an Introduction by A. Flexner, A Discourse upon the Institution of Medical Schools in America (*Review*), 308
Morgan (J. E.), [Prof. F. Bernheim and], Photo-Oxidation of Pyrrhole, 290
Morgan (Prof. T. H.), awarded the Copley medal of the Royal Society, 825; 986
Mori (K.), [M. Miwa, H. Yamashita and], Lethal Action of Alpha-Rays on Sea-Urchin Eggs, 378
Morrell (Dr. R. S.), The Scientific Aspects of Artists' and Decorators' Materials (*Review*), 175
Morton (Prof. W. E.), An Introduction to the Study of Spinning (*Review*), 198
Mosely (M. E.), The British Caddis Flies (Trichoptera). A Collector's Handbook (*Review*), 364
Moss (A. G.), Electrical Progress in Poland, 341
Mottram (J. C.), An Increase in the Rate of Growth of Paramecium Subjected to the Blastogenic Hydrocarbon 3:4-Benzpyrene, 154; [Dr. L. H. Gray, Dr. J. Read and], Comparison of the Lethal Effect of Fast Neutrons and Gamma-Rays on the Growing Tips of Broad Bean Roots, 478
Moullin (E. B.), Spontaneous Fluctuations of Voltage Due to Brownian Motions of Electricity, Shot Effect and Kindred Phenomena (*Review*), 900
Moy-Thomas (J. A.), Palæozoic Fishes (*Review*), 1078
Mozley (Dr. A.), Human Schistosomiasis and its Intermediate Hosts, 293
Mukerji (Dr. B.), and Dr. R. Ghose, Elimination of Administered Chloral Hydrate in the Urine as a Test for Liver Function, 112; Blood Clearance of Free Chloral in Normal and Liver-damaged Dogs, 636

Mukerji (Prof. S. K.), and L. Singh, Structure of *p*-Diphenylbenzene and its Raman Spectrum, 382
Muller (Dr. H. J.), How Genetic Systems Come About (*Review*), 648; Bibliography on the Genetics of Drosophila, 781; Gene and Chromosome Theory, 814; [Prof. J. B. S. Haldane, Dr. J. S. Huxley and], "Introduction to Modern Genetics", 78
Mulligan (B. O.), An Inter-generic Hybrid, 160
Mullins (C.), Delinquency and Psychology, 626
Mundell (Dorothy), [Prof. B. Mendel, Frida Strelitz and], Cholinesterase and Electrolytes, 479
Mundkur (B. B.), Smut Fungi of India, 294
Muñoz (J. M.), E. Braun-Menéndez, J. C. Fasciolo and L. F. Leloir, Hypertensin: the Substance Causing Renal Hypertension, 980
Murray (Prof. G. M.), [death], 579
Murray (H. D.), and Dr. D. A. Spencer, Colour in Theory and Practice. Vol. 1: General Theory (*Review*), 227
Murry (J. Middleton), The Price of Leadership (*Review*), 343
Muskat (Dr. M.), with an Introductory Chapter by R. D. Wyckoff, The Flow of Homogeneous Fluids through Porous Media (*Review*), 197
Myers (F. W. H.), Human Personality and its Survival after Bodily Death. 2 Vols. (*Review*), 1027
Myers (L. M.), Electron Optics: Theoretical and Practical (*Review*), 401
Myres (Prof. J. L.), Sir Henry Stuart-Jones, 148

Nagaoka (H.), and T. Ikebe, A Sensitive Induction Magnetograph, 827
Nakamura (K.), [S. H. Kirihara and], Employment Tests for Rayon Factory Hands, 789
Narayanan (E. S.), 'Auto-parasitism' by *Nemeritis canescens* (Grav.) (Ichneumonidæ), 207
Naunyn (Bernhard), centenary of the birth of, 410
Neale (Dr. W. H.), [obituary article], 184
Needham (Dr. J.), Chemical Aspects of Organizer Phenomena, 561
Neill (R. M.), Reproductive Cycle in *Salmo salar* Linn., 332
Nemenyi (Dr. P.), Fish Movements and Fish Passes (*Review*), 567
Nettleton (Dr. H. R.), Absolute Measurement of Electrical Resistance, 782
Neufeld (O.), [Dr. M. Frankel, E. Katchalski and], Carbamates of α-Amino-Acid Esters and their Polycondensation, 832
Neugebauer (Dr. O.), The Egyptian Picture of the Sky, 1042
Neurath (H.), Apparent Shape of Protein Molecules, 386
Newcombe (Col. L.), Accessibility of British University Thesis Literature, 1041
Newell (J.), [W. J. C. Lawrence and], Seed and Potting Composts, with Special Reference to Soil Sterilization (*Review*), 581
Newell (Prof. J. S.), [Prof. A. S. Niles and], Airplane Structures. 2 Vols. Second edition (*Review*), 898
Newman (Miss Barbara and L.), Birth Customs in East Anglia, 412
Newman (Sir George), The Building of a Nation's Health (*Review*), 345
Newman (M. H. A.), The Relativity of Time, 1046
Newton (H. W.), A Simple Wedge-Photometer, 211
Nicholls (A.), H.M.S. *Seagull*, 223
Nichols (Prof. G. E.), [death], 104
Nichols (Dr. J. E.), Animal Breeding in the Light of Genetics, 818
Nicholson (F. C.), conferment upon, of an honorary doctorate by Edinburgh University, 87
Nicholson (Dr. S. B.), [late Dr. G. E. Hale and], Magnetic Observations of Sunspots, 1917–1924. 2 Parts (*Review*), 266
Nicol (H.), Microbes by the Million (*Review*), 998
Niemann (C.), [L. Pauling and], Structure of Proteins, 336
Niesluchowski (M.), [Prof. S. Dobiński and], Selective Oxidation of Aluminium Alloys, 510
Niles (Prof. A. S.), and Prof. J. S. Newell, Airplane Structures. 2 Vols. Second edition (*Review*), 898
Nishina (Dr. Y.), T. Yasaki, H. Ezoe, Prof. K. Kimura and M. Ikawa, Fission of Thorium by Neutrons, 547
Nissan (A. H.), Dunstan's Law, 383
Nixon (H. C.), Forty Acres and Steel Mules (*Review*), 586
Nixon (Dr. J. A.), Jenner and Napoleon, 278
Nonaka (I.), Resonance Capture of Slow Neutrons and Emission of Gamma-Rays, 831
Nordsieck (H. H.), [J. L. Hoard and], Structure of Potassium Molybdocyanide Dihydrate, 1018
Norman (H. B.), Standards of Physical Development in School Boys, 518
Norrie (M.), [Dr. R. Lemberg, J. W. Legge and], Catalase, 551
Norris (A.), [Dr. G. I. Jenkins and], Thickness of Built-up Films, 441
Norrish (Prof. R. G. W.), and F. S. Dainton, Reaction between Hydrogen and Oxygen Sensitized by Nitrogen Peroxide, 30
Noyes (Prof. A. A.), and Prof. M. S. Sherrill, A Course of Study in Chemical Principles. Second edition (*Review*), 897

Ochoa (Dr. S.), Necessity of Magnesium in the Pyruvate Oxidation System of Brain, 834; Tissue Respiration, 1078; [I. Banga, Prof. R. A. Peters and], Pyruvate Oxidation System in Brain, 74; Prof. R. A. Peters and Dr. L. A. Stocken, Acetylphosphate and Pyruvate Oxidation, 750; and R. J. Rossiter, Flavin-Adenine-Dinucleotide in Tissues of Rats on Diet Deficient in Flavin, 787
Ockenden (F. E. J.), Effect of Tube-length on the Visibility of Dust Particles with an Oil-immersion Objective, 516
Ogg, jun. (R. A.), Hydrolysis of Alkyl Halides, 519
Ogilvie (A.), [P. Parrish and], Calcium Superphosphate and Compound Fertilisers: their Chemistry and Manufacture (*Review*), 848
d'Oliveira (Dr. B.), Can Rusts Fix Nitrogen ? 480
Olivier (H. R.), [Dr. P. Bonet-Maury and], Effect of Irradiating the Tubercle Bacillus with Radon, 833
O'Rahilly (Prof. A.), Electromagnetics: A Discussion of Fundamentals (*Review*), 91
O'Reilly (H.), [Prof. E. J. Conway, Dr. F. Kane, P. Boyle and], Localization of Electrolytes in Muscle, 752
Orekhov (Prof. A. P.), [obituary article], 891
Orr (Sir John Boyd), Nutrition During War-Time, 738
Orton (Prof. J. H.), [E. Lowe Pierce and], Sagitta as an Indicator of Water Movements in the Irish Sea, 784
Osborn (Prof. T. G. B.), Some Eastern Australian Wild Flowers (*Review*), 7
Osborne (N. S.), H. F. Stimson and D. C. Ginnings, Thermal Properties of Water and Steam, 716
Osler (late Sir William), Aequanimitas; with Other Addresses to Medical Students, Nurses and Practitioners of Medicine. Reprinted from the third edition. Biographical Note by Sir Walter Langdon-Brown (*Review*), 899
Ostern (P.), and Dr. E. Holmes, Formation and Breakdown of Glycogen in the Liver, 34
Owen (Prof. E. A.), and R. Wilson Williams, Effect of Temperature on the Intensity of X-Ray Reflections from Gold, 477

Pacsu (Prof. E.), Condensation of the Hexapeptide Ester of Glycine into the 96– and Higher (3×2^n) Peptide Esters, 551
Page (I. H.), [O. M. Helmer and], Properties of Renin, 209
Paget, Bt. (Sir Richard), Binocular Stereoscopic Vision, 153
Paine (C. E.), The Golden Gate Bridge, San Francisco, 146
Palmén (Dr. E.), appointed director of the Thalassological Institute, Helsinki, 592
Palmer (Dr. C.), [Dr. W. Hughson, Dr. A. Ciocco and], Causes of Deafness, 160
Paneth (Dr. F. A.), Age of Meteorites, 639
Panikkar (N. K.), Osmotic Behaviour of *Palæmonetes varians* (Leach), 866

Pape (Capt. A. G.), Anthropometry and the War, 933
Paramasivan (S.), Technique of the Painting Process in the Bagh Caves in Gwalior State, 554
Park (Prof. O.), Prof. W. C. Allee and Prof. V. E. Shelford, A Laboratory Introduction to Animal Ecology and Taxonomy (*Review*), 583
Parker (H. W.), The Mexican Loggerhead in Europe, 156; Names of Some Atlantic Loggerhead Turtles, 673
Parker (Dr. R. C.), appointed head of the Squibb laboratory for the study of filterable virus diseases, 504
Parker-Rhodes (A. F.), Humoral Immunity Among Plants, 907
Parkinson (D. B.), [R. G. Herb, D. W. Kerst, G. J. Plain and], Scattering of Protons by Protons, 254
Parodi (M.), [Dr. J. Duchesne and], Structure of the Tetrachlorethylene Molecule, 382
Parran (Dr. T.), presented with the Sedgwick medal of the American Public Health Association, 1010
Parrish (P.), and A. Ogilvie, Calcium Superphosphate and Compound Fertilisers: their Chemistry and Manufacture (*Review*), 848
Parsons (Dr. L. Dorothy), Bile Production in Tumour-bearing Mice and the Use of Bile in Filtration, 75
Partington (Prof. J. R.), and Kathleen Stratton, Intermediate Chemical Calculations (*Review*), 740
Paswik-Chlopin (M. A.), [W. G. Chlopin, N. F. Wolkov and], A Particular Mode of Fission of the Uranium Nucleus, 595
Patch (Lt.-Col. C. J. L.), Psychiatry in the Punjab, 662
Paterson (T. T.), [H. de Terra and], Studies on the Ice Age in India and Associated Human Cultures (*Review*), 738
Patterson (H. S.), [D. G. Beadle and], Effect of Tube-length on the Visibility of Dust Particles with an Oil-immersion Objective, 327
Pauling (L.), and C. Niemann, Structure of Proteins, 336
Payman (Dr. W.), Prof. R. V. Wheeler, 931
Peabody (Prof. C.), [death], 660
Peacock (Prof. A. D.) Recent, Work on Experimental Parthenogenesis, 1036; and Ann R. Sanderson, Cytology of *Thrinax macula* Kl., 121
Pearl (Prof. R.), The Natural History of Population (*Review*), 55
Pearse (Dr. H. L.), Plant Hormones and their Practical Importance in Horticulture, 747
Pearson (G.), [Dr. A. Clow and], Pure Ethyl Alcohol for Absorption Spectrophotometry, 208
Peek (B. M.), The Great Red Spot on Jupiter, 987
Peers (Sir Charles), conferment upon, of an honorary doctorate by Durham University, 875
Pei (W. C.), Upper Cave Industry of Choukoutien, 1086; 1097
Peierls (Prof. R.), [Prof. N. Bohr, Dr. G. Placzek and], Nuclear Reactions in the Continuous Energy Region, 200
Pellew (Miss A.), awarded the Edgell Sheppee scholarship in engineering science in Oxford University, 990
Pelseneer (J.), Reproduction of Unpublished Letters of Newton, 901
Penniman (T. K.), appointed curator of the Pitt-Rivers Museum of Oxford University, 701
Péquart (Marthe and Saint-Just), Excavations at Mas d'Azil, France, 556
Perey (Mlle. M.), and M. Lecoin, β-Spectrum of Actinium K, 326
Perham (Miss Margery), awarded a silver medal by the Royal African Society, 150
Périer (Dr. A. L.), Deformation in Griqua Skulls, 189
Perkin (late Sir William), memorial to, 242; 318
Perlitz (Prof. H.), and R. Aavakivi, Atomic Parameters of γ-Silver-Cadmium, 708
Perner (Prof. J.), seventieth birthday of; work of, 237
Perret (F. A.), The Volcano-Seismic Crisis at Montserrat 1933–1937, 677
Perry (R. K.), elected president of the Merseyside Naturalists' Association, 1042
Perutz (M. F.), and G. Seligman, Structure of Glaciers, 757
Petch (T.), Entomogenous Fungi, 557
Peters (J. H.), Attachment for a Milne-Shaw Seismograph, 81
Peters (Prof. R. A.), Tissue Respiration, 1070; [I. Banga, S. Ochoa and], Pyruvate Oxidation System in Brain, 74; [Dr. S. Ochoa, Dr. L. A. Stocken and], Acetylphosphate and Pyruvate Oxidation, 750
Peters (W. H.), Electrical Development in Iraq, 505
Peterschmitt (E.), Earthquakes Registered During February 1939, 81
Petrović (A.), Further Concepts of Serbian Gypsies Relating to Disease, 837
Pett (Dr. L. B.), Marian Lipkind and G. A. LePage, Vitamin A in Ling Cod Liver Oil, 634
Pettersson (Dr. H.), Dr. F. Gross and F. Koczy, Large-Scale Plankton Culture, 332
Pfankuch [Kausche, H. Ruska and], The Electron-Microscope and the Investigation of Viruses, 40
Pfizenmeyer (Dr. E. W.), translated by Muriel D. Simpson, Siberian Man and Mammoth (*Review*), 198
Philadelphus (Dr. A.), The Anavysos Kouros, 278
Philbrick (F. A.), Inorganic Chemistry (*Review*), 740; Factual Tests in Inorganic Chemistry (Post School Certificate Standard; Answers to Factual Tests in Inorganic Chemistry) (*Review*), 897
Phillips (late Dr. P.), [Dr. H. E. Hurst and], The Nile Basin. Vol. 5: The Hydrology of the Lake Plateau and Bahr El Jebel (*Review*), 495
Philp (U.), [Prof. J. B. S. Haldane and], Genetics of Man, 557
Piaggio (Prof. H. T. H.), Mathematics of the Armaments Race (*Review*), 692
Pickwell (Dr. G.), Deserts (*Review*), 460
Piekara (Dr. A.), [K. Zakrzewski and], On the Theory of Dielectric Polarization in Liquids, 250
Pierce (E. Lowe), and Prof. J. H. Orton, Sagitta as an Indicator of Water Movements in the Irish Sea, 784
Pieron (Prof.), elected president of the French Association, 449
Piery (Prof. M.), and Prof. J. Enselme, Reactions of Acclimatization and of Non-Adaptation, 731
Pirie (N. W.), K. M. Smith, E. T. C. Spooner and W. D. McClement, Tobacco Necrosis Virus, 80
Placzek (Dr. G.), [Prof. N. Bohr, Prof. R. Peierls and], Nuclear Reactions in the Continuous Energy Region, 200
Plain (G. J.), [R. G. Herb, D. W. Kerst, D. B. Parkinson and], Scattering of Protons by Protons, 254
Planck (Prof. Max), elected an honorary member of the Société Philomathique of Paris, 110
Plimmer (Prof. R. H. A.), Organic and Bio-chemistry. Sixth edition (*Review*), 268
Plotz (Dr. H.), awarded the gold Pasteur medal of the Paris Pasteur Institute, 474
Plugge (Capt. L. F.), elected chairman of the Parliamentary and Scientific Committee of the House of Commons, 1009
Plummer (Prof. H. C.), Regiomontanus and Kepler (*Review*), 223; Kepler's Approach to Optics (*Review*), 306; James Gregory (1638–1675) (*Review*), 1062
Polanyi (Prof. M.), Rights and Duties of Science, 972
Pole-Evans (Dr. I. B.), Report on a Visit to Kenya, 255
Poll (Dr. H.), [death], 318
Polunin (Dr. N.), Arctic Plants in the British Isles, 352
Pontecorvo (Dr. B.), Recent Experimental Results in Nuclear Isomerism, 212
Pope (Sir William), [death], 700; [obituary article], 810
Pordal (Dr. R.), Medicina aborigen americana (*Review*), 308
Porter (Dr. Annie), Larval Trematodes in Mollusca, 715
Porter (Dr. M. W.), and R. C. Spiller, Crystallo-Chemical Analysis: The Barker Index at Oxford, 298
Portevin (Prof. A. M.), Metals and Their Alloys (*Review*), 612
Portevin (G.), Ce qu'il faut savoir pour manger les bons champignons (*Review*), 893
Posselt (F.), Tree Ritual in Southern Rhodesia, 484
Potts (Dr. W. A.), [death], 185; [obituary article], 275
Poulton (Dr. E. P.), [death], 736; Tissue Respiration, 1073

Powell (Dr. C. F.), and Dr. G. E. F. Fertel, Energy of High-Velocity Neutrons by the Photographic Method, 115; [Dr. W. Heitler, Dr. G. E. F. Fertel and], Heavy Cosmic Ray Particles at Jungfraujoch and Sea-Level, 283

Powell (E. Q.), [S. R. Finn and], Evaporation of Mist Particles and its bearing on Air Sterilization, 864

Powell (H. M.), and G. Huse, Structure of Aromatic Polynitro Compound–Hydrocarbon Complexes, 77

Prabhu (S.), Sterility in *Drosophila melanogaster*, 557

Prain (Sir David), and I. H. Burkill, An Account of the Genus Dioscorea in the East. Part 2: The Species which Twine to the Right; with Addenda to Part 1, and a Summary (*Review*), 895

Prankerd (Dr. Theodora L.), [death], 891; [obituary article], 932

Preston (Lt.-Col. the Hon. R. M.), elected president of the Institute of Metals, 905

Pretty (Mrs. E. M.), Gift of Sutton Hoo Antiquities to the Nation, 410

Price (Dr. A. G.), White Settlers in the Tropics (*Review*), 172

Price (Harry), Fifty Years of Psychical Research: a Critical Study (*Review*), 1082

Priestley (Prof. J. H.), and Lorna I. Scott, An Introduction to Botany, with special reference to the Structure of Flowering Plant (*Review*), 492

Priston (Commdr. W. R.), Solar Variation and the Weather, 550

Prout (Sir William), [death], 891; [obituary article], 1004

Pugsley (A. J.), Dewponds in Fable and Fact (*Review*), 185

Purchon (R. D.), Reduction of the Ctenidia in the Lamellibranchia, 206

Pyefinch (K. A.), Parasitic Cirripedes of the John Murray Expedition, 601

Quastel (Dr. J. H.), Reactions of the Organised Tissue Respiration System to the Action of Narcotics, 1072; and D. M. Webley, Vitamin B_1 and Acetate Oxidation by Bacteria, 633; [P. J. G. Mann and], Benzedrine and Brain Metabolism, 943

Radcliffe-Brown (Prof. A. R.), Taboo (Frazer lecture), 562

Raeburn (J. R.), Market Economics of the Apple, 385

Rajam (J. B. R.), P. C. Capron and Prof. M. de Hemptinne, Evaluation of the Beta Upper Energy Limits with Simple Absorption Data, 202

Rake (Dr. G.), and M. F. Shaffer, Propagation of the Agent of Measles in the Fertile Hen's Egg, 672

Rakestraw (N. W.), C. E. Herrick and W. D. Urry, Helium-Neon Content of Sea Water, 838

Ramadan (Dr.), Penaeids of the John Murray Expedition, 518

Ramsbottom (Dr. J.), The Royal Swedish Academy of Science: Bicentenary Celebrations, 270

Raper (Prof. H. S.), Tissue Respiration, 1072

Rawdon-Smith (Dr. A. F.), Theories of Sensation (*Review*), 94

Rawles (Mary E.), Robin Redbreast Pigment in Fowls, 1052

Rawlins (F. I. G.), Crystal Chemistry (*Review*), 6; Science, Art and Design (*Review*), 175

Raymont (J. E. G.), appointed lecturer in the zoology of invertebrates in Edinburgh University, 47

Rayner (G. W.), Preliminary Results of the Marking of Whales by the *Discovery* Committee, 999

Read (Prof. H. H.), Metamorphism and Igneous Action, 437; 729; 772

Read (Prof. J.), Growing-Points of Organic Chemistry (*Review*), 349

Read (Dr. J), Baade and Zwicky's Theory of Cosmic Rays, and the Helium Content of Beryls, 1046; [Dr. L. H. Gray and], Measurement of Neutron Dose in Biological Experiments, 439; [Dr. L. H. Gray, J. C. Mottram and], Comparison of the Lethal Effect of Fast Neutrons and Gamma-Rays on the Growing Tips of Broad Bean Roots, 478; [Dr. L. H. Gray and], Quantitative Comparison of the Biological Effects of Neutrons and other Ionizing Radiations, 509

Reddick (Prof. H. W.), and Prof. F. H. Miller, Advanced Mathematics for Engineers (*Review*), 369

Redgrove (H. S.), Progress in Cosmetics, 217; and the late G. A. Foan, Hair-Dyes and Hair-Dyeing Chemistry and Technique. New edition completely revised by H. Stanley Redgrove and J. Bari-Woollss (*Review*), 740

Reedy (Prof. J. H.), Theoretical Qualitative Analysis (*Review*), 365

Reekie (Dr. J.), [Dr. J. F. Allen and], Forces Associated with Heat Flow in Helium II, 475

Rees (M. W.), [Prof. A. C. Chibnall, G. R. Tristram, E. F. Williams, Dr. E. Boyland and], The Glutamic Acid of Tumour Proteins, 71

Rehder (H. A.), [W. H. Dall, P. Bartsch and], Recent and Fossil Marine Pelecypod Mollusks of the Hawaiian Islands, 484

Reich (Prof. H. J.), Theory and Applications of Electron Tubes (*Review*), 401

Reichstein (Prof. T.), [M. Hoffer and], Activity of β-Alanine in Stimulating Growth of Young Rats on a Diet Deficient in 'Filtrate Factor', 72

Reid (C.), [A. G. Maddock, Dr. H. J. Emeléus and], New Iodine and Fluorine Derivatives of Monosilane, 328

Reid (Prof. R. W.), [death], 236; [obituary article], 275

Reifenberg (Dr. A.), translated by Dr. C. L. Whittles, The Soils of Palestine: Studies in Soil Formation and Land Utilization in the Mediterranean (*Review*), 1075

Reitz (Col. D.), The Forests of Northern Zululand, 280

Resende (Dr. F.), Chromosome Structure as Observed in Root Tips, 481

Reyner (J. H.), Testing Television Sets (*Review*), 194

Rhodes (Dr.), Juvenile Delinquency, 703

Rice (T. D.), [death], 776

Richards (M. B.), [J. T. Irving and], Influence of Age upon the Requirement of Vitamin A, 908

Richardson (Dr. L. F.), Generalized Foreign Politics: a Study in Group Psychology (*Review*), 692

Richmond (I. A.), Appeal for a Museum of the Roman Wall, 411

Richmond (K.), Evidence of Identity (*Review*), 372

Richter [Gutenberg and], The Central Core of the Earth, 210

von Richter (V.), edited by the late Prof. R. Anschutz. The Chemistry of the Carbon Compounds. Vol. 2: The Alicyclic Compounds and Natural Products, translated by Prof. A. Butenandt and others. Third edition (*Review*), 849

Richtmyer (Prof. F. K.), [death], 970

Rickard (C. E.), Progress made in Radio-Telegraphy and Radio-Telephony, 339

Ricketts (E. F.), and J. Calvin, Between Pacific Tides (*Review*), 1078

Rideal (Prof. E. K.), Film Reactions as a New Approach to Biology, 427; 693; and Dr. J. H. Schulman, Reactions with Monolayers and their Biological Analogies, 100

Riesman (Prof. D.), Medicine in Modern Society (*Review*), 371

Riley (D.), [Dr. Dorothy Crowfoot and], X-Ray Measurements on Wet Insulin Crystals, 1011

Riley (Prof. H. A.), [Prof. F. Tilney and], The Form and Functions of the Central Nervous System: an Introduction to the Study of Nervous Diseases. Third edition (*Review*), 50

Riley (R. V.), appointed research assistant in the Fuel Department of Leeds University, 47

Riley (Dr. W. A.), and Dr. O. A. Johannsen, Medical Entomology. Second edition (*Review*), 191

Rissik (H.), Possibilities of Alternating Currents for Long-Distance Transmission, 988

Ritchie (Prof. J.), Supply and Training of Teachers in Biology, 129; 140; Perspectives in Evolution, 428; 534; P. H. Grimshaw, 1004

Rivers (Rosalind V.), [Prof. C. R. Harington and], Preparation of Thyroxine from Casein treated with Iodine, 205

Rivett (Sir David), Fisheries Research in Australia, 312

Roach (Dr. W. A.), Flame Method of Spectrochemical Analysis, 1047

Roberts (E. A. Houghton), [J. Lamb and], Cytochrome Oxidase in Tea Fermentation, 867

Roberts (E. J.), Grass Drying, 545

Roberts, jun. (Dr. F. H. H.), Ancient House Types in Arizona, 556; Folsom Man: Further Investigation in Colorado, 902; Tree Rings and Cultures in the South-Western United States, 967

Robertson (Dr. G. J.), [obituary article], 659

Robertson (Dr. J. M.), [Sir Harold Carpenter and], Metals and Their Alloys. 2 vols. (*Review*), 612

Robinson (G. A.), Technical and Vocational Education in the U.S.A., 84

Robinson (G. G.), Mouth-parts of the Female Anopheles Mosquito, 870

Robinson (Sir Robert), conferment upon, of an honorary doctorate by London University, 875

Robson (Dr. W. A.), The Government and Misgovernment of London (*Review*), 846

Roder (J.), Prehistoric Rock Pictures in Dutch New Guinea, 946

Roderick (J. W.), appointed a lecturer in engineering in Leeds University, 219

Rodger (Sir Alexander), Prof. R. S. Troup, 699

Rogers (Sir Leonard), The Antimony Treatment of Kala-Azar, 1003

Rogers (W. S.), Observation of Growing Roots, 386

Rogozinski (A.), [Dr. L. Goldstein, R. J. Walen and], The Scattering by Uranium Nuclei of Fast Neutrons and the Possible Neutron Emission resulting from Fission, 201

Rojansky (Prof. V.), Introductory Quantum Mechanics (*Review*), 743

Rolleston (Dr. J. D.), History of Medicine (*Review*), 308, Prof. Ricardo Jorge, 700; Dr. G. A. Sutherland, 776; Dr. J. D. Comrie, 857; Prof. Anton von Eiselsberg, 1004; Prof. C. G. Santesson, 1039

Room (Prof. T. G.), The Geometry of Determinantal Loci (*Review*), 960

Rose (T. G.), Importance of a Training in Management for Engineers, 218

Rosenfeld (Dr. L.), [Dr. C. Møller and], The Electric Quadrupole Moment of the Deuteron and the Field Theory of Nuclear Forces, 476; [Dr. C. Møller, Dr. S. Rozental and], Connexion between the Life-time of the Meson and the Beta-decay of Light Elements, 629

Ross (W. A.), and W. R. Mattoon, Farm Forestry, 828

Rossiter (R. J.), [Dr. S. Ochoa and], Flavin-Adenine-Dinucleotide in Tissues of Rats on Diet Deficient in Flavin, 787

Rotblat (Dr. J.), Application of the Coincidence Method to Testing the Lifetime and Level Scheme of Radium C′, 248

Rothé (J. P.), Disastrous Earthquakes, January–June 1938, 871

Roush (G. A.), Strategic Mineral Supplies (*Review*), 921

Routledge (W. Scoresby), [death], 236; [obituary article], 317

Rozental (Dr. S.), [Dr C. Møller, Prof. L. Rosenfeld and], Connexion between the Life-time of the Meson and the Beta-decay of Light Elements, 629

Rudolph (W. E.), elected a corresponding member of the American Geographical Society, 199

Rudra (M. N.), Role of Manganese in the Biological Synthesis of Ascorbic Acid, 868

Rumney (Dr. J.), The Science of Society: an Introduction to Sociology (*Review*), 195

Ruska (E.), [von Borries and], The Electron-Microscope and the Investigation of Viruses, 40

Ruska (H.), [Kausche, Pfankuch and], The Electron Microscope and the Investigation of Viruses, 40

Russell (Dr. A.), Prof. A. E. Kennelly, 64

Russell (Arthur), elected president of the Mineralogical Society, 862

Russell (Prof. H. N.), Cosmic Data, 507

Russell (Sir John), Crop Production, 217; Prof. A. A. J. de 'Sigmond, 856

Russell (W. T.), [Dr. M. Young and], Appendicitis: a Statistical Study, 452

Rutherford (late Lord), Memorial Tablet to, at McGill University, 1057

Rutherford (R. S. G.), appointed a research officer in the Institute of Research in Agricultural Economics, Oxford University, 875

Ruzicka (Prof. L.), awarded the Nobel prize for chemistry for 1939; work of, 858

Rymill (J. R.), awarded the David Livingstone centenary medal of the American Geographical Society, 199; 546; with two chapters by A. Stephenson and an Historical Introduction by Dr. H. R. Mill, Southern Lights: the Official Account of the British Graham Land Expedition 1934–1937 (*Review*), 54

van Rysselberghe (P.) and S. Eisenberg, Activity Coefficients of Strong Electrolytes, 1053

Sabet (Y.), Cotton Mycorrhiza, 37

Sabin (Dr. A. B.), presented with the Theobald Smith award of the American Association, 546

Sabine (G. B.), Reflectivities in the Ultra-Violet, 295

Saeger (C. M.), [H. B. Gardner and], Impurities in Brass, 386

Saenz (Prof. A.), awarded the gold Pasteur medal of the Paris Pasteur Institute, 474

Sakurai (Baron Joji), [obituary article], 234; 471

Salaman (M. H.), [Prof. F. L. Hopwood, Dr. A. S. McFarlane and], Effect of Ultrasonic Vibration on Vaccinia Virus, 377

Salaman (Dr. R. N.), and W. R. S. Wortley, Potential Hosts of Potato Viruses in Garden and Field, 1049

Salisbury (Prof. E. J.), The Study of British Vegetation (*Review*), 305

Salter (Sir Arthur), Security: Can We Retrieve It? (*Review*), 221; The Dual Policy (*Review*), 1031; Security: Can We Retrieve It?, 1059

Salzman (L. F.), Changing Fashions in Place and Personal Names, 85

Sampson (Miss Kathleen), The Smut Fungi, 210

Sampson (Prof. R. A.), [death], 857; [obituary article], 930

Samuel (Viscount), Decline of Population, 17

Sanderson (Ann R.), [A. D. Peacock and], Cytology of *Thrinax macula* Kl., 121

Sandhurst (Grace A.), North American Bees of the Genus Osmia, 870

Sanford (R. L.), and E. G. Bennett, Magnetic Testing, 838

Sansome (Dr. F. W.), "Introduction to Modern Genetics". 79

Santesson (Prof. C. G.), [obituary article], 1039

Sartori (Dr. M.), translated by L. W. Marrison, The War Gases: Chemistry and Analysis (*Review*), 996

Satterly (Dr. J.), [Dr. R. W. Stewart and], revised by C. T. Archer, Textbook of Heat. Second edition (*Review*), 374

Saunders (Miss E. R.), Floral Morphology: a New Outlook with special reference to the Interpretation of the Gynæceum. Vol. 2 (*Review*), 340

Sax (K.), and E. V. Enzmann, Effect of Temperature on Chromosomes affected by X-Rays, 790

Saxton (J. A.), [Dr. J. S. McPetrie and], Diffraction of Ultra-Short Radio Waves, 631

Schernakow (W. N.), Fur-trade in Northern Manchuria, 936

Schilder (Drs. F. A. and M.), Prodrome of a Monograph on Living Cypræidæ, 642

Schilder (Dr. P.), Psychotherapy (*Review*), 588

Schmidt (Prof. A.), awarded the Goethe medal for art and science, 508

v. Schoen-Wildenegg (E. P.), Urmass und Schopfung: Neuentdeckte Gesetzlichkeiten (*Review*), 373

Schofield [Haines and], Movement of Water in the Soil, 210

Schönberg (Prof. A.), and Abdel Fattah Aly Ismail, A Colour Reaction of Maleic Anhydride, *p*-Benzoquinone and their Partially Substituted Derivatives, 910

Schott (Prof. P. G.), elected a corresponding member of the American Geographical Society, 199

Schotté (Dr.), Regeneration, 562

Schouten (J. F.), Synthetic Sound, 393

van Schouwenburg (Dr. K. L.), [F. H. Johnson and], Decomposition of Hydrogen Peroxide by Catalase, 634

Schrodinger (Prof E.), Nature of the Nebular Red-Shift, 593

Schulman (Dr. J. H.), [Prof. E. K. Rideal and], Reactions with Monolayers and their Biological Analogies, 100; [Dr. G. S. Carter, O. Gatty, Dr. H. Walston and], Calcium in Ciliary and Muscular Movement, 980

Schultz [Brigl, Gronemeier and], The Ethyl-Thioglucosides and a new Monoacetoneglucose, 680

Schumacher and Halbsguth, Union between Host and Parasite in Higher Plants, 258

Scott (Sir Ernest), [death], 1006

Scott (H. Harold), A History of Tropical Medicine, based on the FitzPatrick Lectures delivered before the Royal College of Physicians of London, 1937–8. 2 Vols. (*Review*), 801

Scott (Lorna I.), [Prof. J. H. Priestley and], An Introduction to Botany, with special reference to the Structure of the Flowering Plant (*Review*), 492

Scott (Dr. W. W.), Standard Methods of Chemical Analysis: a Manual of Analytical Methods and General Reference for the Analytical Chemist and for the Advanced Student. Fifth edition. Edited by Prof N. H. Furman and others. 2 Vols. (*Review*), 803

Scott-Moncrieff (R.), [W. J. C. Lawrence, V C. Sturgess and], Genetics of Streptocarpus, 676

Scowen (Dr. E. F.), conferment upon, of the title of reader in medicine by London University, 219

Scroggie (M. G.), Radio Laboratory Handbook (*Review*), 368

Sears (F. W.), [J. A. Clark, F. R. Gorton and], Physics To-day (*Review*), 588

Seewald (Dr. F.), elected to the Physical Mathematical Class of the Prussian Academy of Sciences, 70

Sertz (Dr. F.), Vitamine und Hormone. und ihre technische Darstellung. Teil 2 (*Review*), 739

Selényi (Dr. P.), Mechanical Force due to an Electron Stream, 838

Seligman (Prof. E. R. A.), [death], 185

Seligman (G.), [M. F. Perutz and], Structure of Glaciers, 757

Semmens (Dr. Elizabeth Sidney), Hydrolysis of Starch Films by Polarized Infra-Red Radiation, 379

Seth-Smith (D.), Animal Behaviour, 85

Seward (Sir Albert C.), The Western Isles Through the Mists of Ages, 413; conferment upon, of an honorary doctorate by St. Andrews University, 605

Sezawa (K.), and K. Kanai, Range of Possible Existence of Stoneley Waves, 121; 'Packet Velocity' of Dispersive Elastic Waves, 448; Rayleigh Waves in an Inner Stratum of the Earth, 519

Shackleton (E.), [J. Ford, C. M Hartley, T. Harrisson, P. M. Synge and], edited by T. Harrisson, Borneo Jungle: an Account of the Oxford Expedition to Sarawak (*Review*), 742

Shaffer (M. F.), [Dr. G. Rake and], Propagation of the Agent of Measles in the Fertile Hen's Egg, 672

Shankman (S.), and A. R. Gordon, Vapour Pressures of Sulphuric Acid Solutions, 716

Shapiro (Prof. H. L.), with the field assistance of F. S. Hulse, Migration and Environment: a Study of the Physical Characteristics of the Japanese Immigrants to Hawaii and the effects of Environment on their Descendants (*Review*), 177

Sharman (Dr. B. C.), Stamen Lodicules in Maize, 1093

Shaw (Prof. C. F.), [death], 812; [obituary article], 891

Shear (Prof. T. L.), Discovery at Athens of a Chamber-Tomb of Mycenean Age, 188

Shearcroft (W. F. F.), and J. H. Avery, Practical Physics (*Review*), 743

Sheffield (Miss F. M. L.), Micro-manipulative Studies of Virus-infected Plants, 39

Shelford (Prof. V. E.), [Prof. O. Park, Prof. W. C. Allee and], A Laboratory Introduction to Animal Ecology and Taxonomy (*Review*), 583

Sherrill (Prof. M. S.), [Prof. A. A. Noyes and], A Course of Study in Chemical Principles. Second edition (*Review*), 897

Shinohara (N.), Y. Hirano and M. Yoshioka, Extensions of Carrier Telephone Systems, 545

Shire (E. S.), appointed lecturer in physics in Cambridge University, 762

Shuleikin (Prof. M. V.), [obituary article], 285

Shull (Dr. C. A.), [Dr. W. E Loomis and], Experiments in Plant Physiology. a Laboratory Text-book (*Review*), 583

Sieveking (H. B.), Electrically Manufactured Steels, 1099

de 'Sigmond (Prof. A. A. J.), [obituary article], 856

Sillanpää (N. Frans E.), awarded the Nobel prize for literature for 1939, 859

Silow (R. A.), Multiple Allelomorphism in Cotton, 757

e Silva (M. R.), Determination of Histamine in Biological Extracts, 252

Simons (E. N.), and Dr. E. Gregory, The Structure of Steel Simply Explained (*Review*), 198

Simons (J. H), and L. P. Block, Reaction of Fluorine with Carbon, 947

Simpson (A. A.), [death], 970

Simpson (C.), Animal and Bird Painting: the Outlook and Technique of the Artist (*Review*), 373

Simpson (Sir George), Dr. Edward Kidson, 103

Simpson (Sir John Hope), The Refugee Question (*Review*), 1031

Sinclair (G. F.), Operation and Design of Trolleybuses, 989

Singh (Dr. Bawa Kartar), and Awadh Behari Lal, Difference in Odour of *d*-, *l*- and *dl*-derivatives of Amino- and Bisamino-Methylene Camphors, 910

Singh (L.), [Prof. S K. Mukerji and], Structure of *p*-Diphenylbenzene and its Raman Spectrum, 382

Sitte (K.), [R. Furth, H. P. Appel and], Determination of Stellar Diameters by Interferometer, 40

Slawson (Prof. C. B.), [Prof. E. H. Kraus and], Gems and Gem Materials. Third edition (*Review*), 372

Sloane (Dr. R. H.), appointed lecturer in experimental physics in Queen's University, Belfast, 47

Slotta (Prof. K. H.), and H. Fraenkel-Conrat, Crotoxin, 290

Smart (Prof. W. M), A New Member of the Ursa Major Cluster, 558; Prof. R. A. Sampson, 980

Smieton (Margaret J.), Control of Club-root, 1053

Smith (Dr. A. H.), Saxon Time Measurement, 239

Smith (Dr. E. C. Bate), Anserine in Muscle: Possibility of Determination by Titration, 1015

Smith (Dr. E. W.), awarded a silver medal by the Royal African Society, 150

Smith (Sir Frank), appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 665; appointed director of production of scientific instruments, Ministry of Supply, 665

Smith (Dr. F. G. Walton), Sponge Mortality at British Honduras, 785

Smith (Dr. G. Pugh), Everyday Biology: an Introduction to the Study of Life (*Review*), 191

Smith (J. O.), [H. S. Taylor and], Reactions of Methyl Radicals, 336

Smith (K. M.), [N. W. Pirie, E. T. C. Spooner, W. D. McClement and], Tobacco Necrosis Virus, 80

Smith (L.), Genetic Construction in Triticum, 716

Smith (R. A.), Atlantic Submarine Valleys, 1042

Smith (Dr. R. O. A.), Anti-Rabic Treatment in India, 148

Smith (Dr. S.), and Dr. J. Glaister, Recent Advances in Forensic Medicine. Second edition (*Review*), 371

Smith (William) (1769–1839), The Father of English Geology, 354

Smith (Dr. Wilson), appointed professor of bacteriology in Sheffield University; work of, 168; 185

Smith (W. H.), Breakdown in Stored Plums, 1096

Smith (W. O. Lester), and others, Education and Industry, 760

Smock (R. M.), Wax Emulsions for Deciduous Fruit, 838

Snow (Dr. R.), An Inhibitor of Growth extracted from Pea Leaves, 906

Sober (H. A.), [A. E. Axelrod, Prof. C. A. Elvehjem and], Reduction of the *d*-Amino-Acid Oxidase Content of Rat Tissues in Riboflavin Deficiency, 670

Solandt (Prof. D. Y.), and Prof. C. H. Best, Role of Dietary Choline in Neurohumour Production, 376

Sollazzo (Prof. G.), nominated director of the Ospedale del Perdono, Milan, 905

Somogyi (J. C.), [Prof. F. Verzár and], Connexion between Carbohydrate and Potassium Metabolism in Normal and Adrenalectomized Animals, 1014

Somville (O.), Belgian Earthquake of June 11, 1938, 950

Sosinski (S.), Effect of an Electric Field on the Viscosity of Liquids, 117

Southwell (Prof. R. V.), conferment upon, of an honorary doctorate by St. Andrews University, 605

Spangenberg (Dr. J. J.), nominated president of the Argentine National Department of Health, 938

Spanner (Prof. R.), presented with the bronze memorial medal of the Society of Medicine and Natural History of Jena, 29

Speakman (Dr. J. B.), elected professor of textile industries in Leeds University; work of, 15; 47

Spencer (late Sir Baldwin), and late F. J. Gillen, The Native Tribes of Central Australia. New edition (*Review*), 363

Spencer (Dr. D. A.), [H. D. Murray and], Colour in Theory and Practice. Vol. 1: General Theory (*Review*), 227

Spies (Prof. T. D.), [Drs. S. P. and R. W. Vilter and], Synthesis of Coenzymes I and II, 943

Spiller (R. C.), [Dr. M. W. Porter and], Crystallo-Chemical Analysis: The Barker Index at Oxford, 298

Spooner (E. T. C.), [N. W. Pirie, K. M. Smith, W. D. McClement and], Tobacco Necrosis Virus, 80

Srinivasan (K. S.), A Fungus upon the Liverwort *Riccia Himalayensis*, 210

Stamp (Lord), Decline of Population, 17; conferment upon, of an honorary doctorate by St. Andrews University, 605; appointed adviser on economic co-ordination to a Committee of Ministers, 665

Stamp (Dr. L. Dudley), elected a corresponding member of the American Geographical Society, 199

Stanley (Prof. J.), A Peculiar Phenomenon observed in Larval Populations of the Flour Beetle *Tribolium confusum* Duv., 753

Stapledon (Sir George), awarded the gold medal of the Royal Agricultural Society; work of, 237; The Plough-up Policy and Ley Farming (*Review*), 263; presented with the gold medal and certificate of honorary membership of the Royal Agricultural Society of England, 1010

Staples (Capt. H. A.), Cosmic Machinery in an Electro-Magnetic Universe (*Review*), 900

Stark (Prof. J.), awarded the Goethe medal for art and science, 508

Staudinger (Prof. H.), Macromolecules, 300

Stebbing (Prof. E. P.), The Colonies and Forest Administration, 949

Stebbins, jun. (G. L.), [E. B. Babcock and], American Species of Crepis, 45

Steers (J. A.), Sand and Shingle Formation in Cardigan Bay, 946

Stein (Sir Aurel), conferment upon, of an honorary doctorate by St. Andrews University, 605

Stenton (Prof. F. M.), Dr. W. M. Childs, 63

Sterling (G. E.), The Radio Manual: for Radio Engineers, Inspectors, Students, Operators and Radio Fans. Third edition (*Review*), 1068

Stern (Prof. C.), Relations between Genetics and Embryology, 561

Stern (Dr. K. G.), and Dr. J. L. Melnick, Oxidation of Succinate by Heart Muscle, 330

Stevens (A.), Methods in Geography, 429; The Natural Geographical Region, 653

Stevens (B.), The Psychology of Physics (*Review*), 1081

Stevens (Dr. S. S.), and Dr. H. Davis, Hearing: its Psychology and Physiology (*Review*), 570

Stevenson (E. C.), Discovery of Sugar-Cane Seedlings, 36

Stevenson (Greta B.), Ring Spot Disease of Lettuce, 120

Stewart (G. W.), Structure of Water in Ionic Solutions, 985

Stewart (Prof. M.), and Prof. J. W. McLeod, Report for 1937 and 1938 of the Department of Pathology and Bacteriology of Leeds University, 109

Stewart (O. C.), Northern Paiute Bands, 601

Stewart (Dr. R. W.), and Dr. J. Satterly, revised by C. T. Archer, Textbook of Heat. Second edition (*Review*), 874

Stillwell (Dr. C. W.), Crystal Chemistry (*Review*), 6

Stimson (H. F.), [N. S. Osborne, D. C. Ginnings and], Thermal Properties of Water and Steam, 716

Stinchfield (Dr. Sara M.), and Mrs. Edna Hill Young, Children with Delayed or Defective Speech: Motor-Kinæsthetic Factors in their Training (*Review*), 744

Stobie (H.), appointed professor of dental surgery and pathology at the Royal Dental Hospital of London School of Dental Surgery, 47

Stockdale (Sir Frank), Application of Economic Botany in the Tropics, 563

Stocken (Dr. L. A.), [Dr. S. Ochoa, Prof. R. A. Peters and], Acetylphosphate and Pyruvate Oxidation, 750

Stone (Dr. Witmer), [death], 14; 65

Stoneley (Dr. R.), Long-Wave Phase of Earthquakes, 254; Seismic Prospecting (*Review*), 881

Stoner (Dr. E. C.), elected professor of theoretical physics in Leeds University, 219

Stookey (S. D.), [E. C. Bingham and], Fluidity and Temperature, 448

Stopes (Dr. Marie), Baron Joji Sakurai, 471

Stout (Dr. G. F.), A Manual of Psychology. Revised by C. A. Mace; with an Appendix by Dr. R. H. Thouless (*Review*), 588

Straker (Dr. Edith), Dr. B. Hill and Dr. R. Lovell, Bacteria of the Throat and Nose, 1017

Stratton (Prof. F. J. M.), conferment upon, of an honorary doctorate by Glasgow University, 47

Stratton (Kathleen), [Prof. J. R. Partington and], Intermediate Chemical Calculations (*Review*), 740

Strelitz (Frida), [Prof. B. Mendel, Dorothy Mundell and], Cholinesterase and Electrolytes, 479

Stroud (S. W.), Preliminary Investigation of the Metabolism of Stilbene, 245

Struve (Prof. O.), The McDonald Observatory, Fort Davis, Texas, 186

Stuart (Lord David), [Rev. J. M. McWilliam and], New Breeding Place of Gannet, 675

Stuart-Jones (Sir Henry), [obituary article], 143

Stubbings (Dr. H. G.), Marine Deposits of the Arabian Sea, 841

Stubbs (Dr. J.), appointed temporary research assistant (for bracken investigation) in Leeds University, 219

Stueckelberg (Prof. E. C. G.); A New Model of the Point Charge Electron and of other Elementary Particles, 118

Sturgess (V. C.), [W. J. C. Lawrence, R. Scott-Moncrieff and], Genetics of Streptocarpus, 676

Sturtevant (Prof. A. H.), Increased Mutation due to Hybridization, 912; and Prof. G. W. Beadle, An Introduction to Genetics (*Review*), 1067

Subrahmanyan (V.), Dr. D. E. Green and A. H. Gordon, Isolation of a Catalytically Active Flavoprotein from Liver, 1016

Suit (R. F.), [J. G. Horsfall, G. E. R. Hervey and], Damage by Spray Fluid, 947

Sulman (Dr. F.), [Prof. B. Zondek and], Inactivation of Diethylstilbœstrol in the Organism, 596

Suomalainen (Dr. H.), [Prof. A. I. Virtanen, Dr. A. A. Arhimo and], Estimation and Occurrence of Keto-Acids in Green Plants, 597

Suomalainen (Dr. P.), Artificial Hibernation, 443
Sutermeister (E.), and F. L. Browne, Casein and its Industrial Applications. Second edition (*Review*), 584
Sutherland (Dr. G. A.), [obituary article], 776
Sutherland (Dr. G. B. B. M.), and W. T. Tutte, Absorption of Polymolecular Films in the Infra-Red, 707
Sutton (Eileen), Genetics of the Garden Nasturtium, 838
Swain (Prof. J. E.), A History of World Civilization (*Review*), 569
Swartout (J. A.), and M. Dole, Atomic Weight of Hydrogen, 485
Sweden (King Gustav of), gift for medical research, 592
Swift (Prof. H. W.), Torsional Effects of Torsional Overstrain in Mild Steel, 916
Swinton (Dr. W. E.), Function of Natural History Museums, 125
Switzer (G.), [E. S. Larsen and], Melting of Granodiorite by Andesite, 676
Swynnerton (late C. F. M.), awarded a silver medal by the Royal African Society, 150
Symms (L. S. T.), [H. B. Hulme and], Law of Error and the Combination of Observations, 558
Synge (P. M.), [J. Ford, C. M. Hartley, T. Harrisson, E. Shackleton and], edited by T. Harrisson, Borneo Jungle: an Account of the Oxford Expedition to Sarawak (*Review*), 742

Tamah (P. W.), Progress in Oils, Fats and Detergents, 216
Tanakadate (H.), Recent Volcanic Activity in Japan, 913
Tansley (Prof. A. G.), The British Islands and Their Vegetation (*Review*), 305
Tarr (Prof. W. A.), [death], 318
Tate (H. D.), and S. R. Vandenberg, Aphid Vectors of Sugar-Cane Mosaic, 984
Tatibana (M.), [I. Koga and], Extremely Bright Spots on Coolidge Tube Target, 511
Tattersfield (F.), [J. T. Martin and], Insecticides, 217
Tatum (E. L.), Bacterial Synthesis of an Eye Colour, 1017
Taylor (Prof. C. V.), The Cell and Protoplasm, 884
Taylor (D.), Steel and the Engineer, 793
Taylor (Prof. E. G. R.), A National Atlas of Britain, 929
Taylor (Dr. F. Sherwood), A Short History of Science (*Review*), 196; [J. Lambert, A. Holderness and], The Essentials of Volumetric Analysis (*Review*), 1080
Taylor (Prof. H. S.), New Prospects in Isotope Separation, 8; and J. O. Smith, Reactions of Methyl Radicals, 336
Taylor (Prof. N. B.), [Prof. C. H. Best and], A Text in Human Physiology (*Review*), 228
Taylor and Jungers, Exchange between Nitrogen Isotopes on Metal Surfaces, 1053
Templeman (W. G.), [C. R. Metcalfe and], Experiments with Plant Growth-Substances for the Rooting of Cuttings, 1043
Tenenbaum (Dr. E.), A Pure Strain of *Trichomonas eberthi* in Tissue Culture, 78; [Dr. R. S. Hoffman, Dr. L. Doljanski and], Growth-Stimulating Effects of Extracts of Normal Adult Tissues and Tumours, 1092
Terazawa (Prof. K.), appointed director of the Japanese Earthquake Research Institute, 628
Terman (Prof. F. E.), and Lieut. F. W. Macdonald, Fundamentals of Radio (*Review*), 368
de Terra (Dr. H.), and T. T. Paterson, Studies on the Ice Age in India and associated Human Cultures (*Review*), 738
Thacher (Dr. Thomas), A Brief Rule to Guide the Common People of New England how to order themselves and theirs in the Small Pocks, or Measels, with an Introductory Note by Dr. H. R. Viets (*Review*), 308
Thaxton (H. M.), [G. Breit, L. Eisenbud and], Scattering of Protons by Protons, 254
Theorell (Prof. H.), The Flavoproteins, 1071
Thoday (Prof. D.), Interpretation of Plant Structure, 432; 571
Thomas (D. J.), Electricity in Mining, 937
Thomas (H. A.), The Cellulose Textile Industry, 217
Thomas (Dr. H. Hamshaw), Plant Phylogeny (*Review*), 226
Thompson (Sir D'Arcy W.), Fishery Statistics, 445
Thompson (E. C.), [A. B. Beakbane and], Anatomy of Apple Roots, 447
Thompson (Dr. H. W.), A Course in Chemical Spectroscopy (*Review*), 366
Thompson (Dr. K. W.), [Dr. N. S. Rustum Maluf, Dr. R. W. Clarke and], Role of the Renal Innervation in Kidney Function, 292
Thomsen (I. L.), [M. Geddes and], Surface Features of Mars at the Recent Opposition, 944
Thomson (Dr. D. F.), Totemic Ceremonial in Arnhem Land, Australia, 319
Thomson (Prof. G. H.), Natural Variances of Mental Tests, and the Symmetry Criterion, 516; The Factorial Analysis of Human Ability (*Review*), 532
Thomson (Prof. G. P.), awarded the Hughes medal of the Royal Society, 825; 987; [D. F. Gibbs and], Possible Delay in the Emission of Neutrons from Uranium, 202
Thomson (T.), and M. R. K. Jerram, An Outline of Forestry (*Review*), 614
Thorpe (Sir Jocelyn), and Dr. M. A. Whiteley, Thorpe's Dictionary of Applied Chemistry. Vol. 3: Chemical Calculations—Diffusion. Fourth edition (*Review*), 491
Thorpe (Dr. W. V.), Biochemistry for Medical Students (*Review*), 268
Thouless (Dr. R. H.), Boring, Langfeld and Weld's Introduction to Psychology (*Review*), 744
Thurston (Prof. R. H.), centenary of the birth of; work of, 701; Centenary Celebrations, 1021
Ticehurst (N. F.), [H. F. Witherby, Rev. F. C. R. Jourdain, B. W. Tucker and], The Handbook of British Birds. Vol. 3 (Hawks to Ducks) (*Review*), 691
Tillotson (E.), Earthquake Insurance, 297
Tillyard (late Dr. R. J.), A Reclassification of the Dragonflies, 160
Tilney (Prof. F.), and Prof. H. A. Riley, The Form and Functions of the Central Nervous System: an Introduction to the Study of Nervous Diseases. Third edition (*Review*), 50
Timbie (Prof. W. H.), Industrial Electricity: Direct-Current Practice. Second edition (*Review*), 368; and Prof. H. H. Higbie, Essentials of Alternating Currents. Second edition (*Review*), 585
Timoshenko (Prof. S.), elected a *correspondant* of the Paris Academy of Sciences, 199
Tipson (Dr. R. S.), appointed a fellow in the department of research in pure chemistry in the Mellon Institute; work of, 507
Titchmarsh (Prof. E. C.), The Theory of Functions. Second edition (*Review*), 896
Todd (Prof. A. R.), The Marihuana Problem (*Review*), 611; [M. M. El-Sadr, H. G. Hind, T. F. Macrae, C. E. Work, B. Lythgoe and], Vitamin B Requirements of the Rat, 73
Tolansky (Dr. S.), Hyperfine Structure in the Spark Spectrum of Iodine, 754
Tolman (Prof. R. C.), The Principles of Statistical Mechanics (*Review*), 848
Tomkeieff (Dr. S. I.), Prof. F. Y. Loewinson-Lessing, 1005
van Tongeren (Dr. W.), Contributions to the Knowledge of the Chemical Composition of the Earth's Crust in the East Indian Archipelago. 2 Parts (*Review*), 652
Tongue (H.), A Practical Manual of Chemical Engineering (*Review*), 727
Tory (Dr. H. M.), elected president of the Royal Society of Canada, 256
Tóth (Dr. G.), and L. Zechmeister, Chitin Content of the Mandible of the Snail (*Helix pomatia*), 1049
Townes (C. H.), Apparent Anomalous Isotopic Effect in some Bands associated with the Swan Bands, 631
Trägårdh (Dr. I.), Sveriges Skogsinsekter (*Review*), 582
Trapeznikowa (O. N.), and G. A. Miljutin, Specific Heat of Methane under Pressure, 632
Trendelenburg (Dr. R.), Das Holz als Rohstoff: Seine Entstehung, stoffliche Beschaffenheit und chemische Verwertung (*Review*), 924
Trevor (Sir Gerald), Manual of Indian Silviculture. Part 2: Silvicultural Systems (*Review*), 494

Trikojus (V. M.), and D. E. White, Synthesis of Myristicin, 1016

Trimble (Prof. H. C.), and C. E. Keeler, Preference of Dalmatian Dogs for Particular Positions in Coach Running, and Inheritance of this Character, 671

Tristram (G. R.), [Prof. A. C. Chibnall, M. W. Rees, E. F. Williams, Dr. E. Boyland and], The Glutamic Acid of Tumour Proteins, 71

Trotter (Wilfred), [death], 933

Troup (Prof. R. S.), [death], 624; [obituary article], 699

Trow (Dr. A. H.), [death], 408

Tschuprow (A. A.), translated by Dr. M. Kantorowitsch, Principles of the Mathematical Theory of Correlation (*Review*), 799

Tucker (B. W.), [H. F. Witherby, Rev. F. C. R. Jourdain, N. F. Ticehurst and], The Handbook of British Birds. Vol. 3 (Hawks to Ducks) (*Review*), 691

Tudsbery (Dr. J. H. T.), [death], 812

Tuke (Dr. Margaret J.), A History of Bedford College for Women, 1849–1937 (*Review*), 132

Turner (Prof. G. G.), conferment upon, of an honorary doctorate by Glasgow University, 47

Turner (J. B. G.), Twelve New Southern Variables, 295

Turner (Prof. J. S.), Botanical Characteristics of the Wyperfeld (Mallee) National Park, Victoria, 273

Turrill (Dr. W. B.), The Morphology of the Flower (*Review*), 350; Principles of Plant Geography, 715; Genetics in Relation to Evolution and Systematics, 822

Tutte (W. T.), [Dr. G. B. B. M. Sutherland and], Absorption of Polymolecular Films in the Infra-Red, 707

Twort (J. M.), and R. Lyth, Skin Cancer due to Handling Coal Tars used for Preservation of Fishing Nets, 446

Twyman (F.), Suggestion for Publication of Communications on Spectrochemical Analysis, 827

Tyndall (Prof. A. M.), Dr. E. T. S. Appleyard, 14

Ubbelohde (Dr. A. R.), and I. Woodward, Isotope Effect in Potassium Dihydrogen Phosphate, 632

Uhler (F. M.), [A. C. Martin and], Food of Game Ducks, 1007

Ulich (Prof. H.), unter mitarbeit von Dr. K. Cruse, Kurzes Lehrbuch der physikalischen Chemie (*Review*), 194

Underhill (Miss Ruth Murray), Singing for Power: The Song Magic of the Papago Indians of Southern Arizona (*Review*), 363

Underwood (Dr. A. J. V.), Germany's Oil Supplies, 901

Unna (P. J. H.), Open Type Oxygen Apparatus, 114

Uren (Prof. L. C.), Petroleum Production Engineering: Oil Field Exploitation. Second edition (*Review*), 1080

Urry (W. D.), [Evans, Goodman, Keevil, Lane and], Helium Ratios of Igneous Rocks, 677; [N. W. Rakestraw, C. E. Herrick and], Helium-Neon Content of Sea Water, 838

Usov (Dr. M. A.), [obituary article], 358

Ussing (Dr. H. H.), Analysis of Protein by Means of Deuterium-containing Amino-Acids, 977

Uvarov (Dr. B. P.), and Miss W. Milnthorpe, Locust Problem in 1937, 86

Vahlen (Prof. T.), awarded the Goethe medal for art and science, 242

Vaillant (Prof. C.), [death], 970

Vaillant (Prof. P.), Sixth Centenary of the University of Grenoble, 42

Vallance (R. H.), [Dr. J. Newton Friend and], Vanadiferous Nodules in Worcester Clay, 286

Vallois (Prof. H.), Duration of Life in Fossil Man in China, 1055

Vandenberg (S. R.), [H. D. Tate and], Aphid Vectors of Sugar-cane Mosaic, 984

Van Dijk (Dr. G.), Seismische Registrierungen in De Bilt, 24; 1936, 241

Vanstone (E.), and C. E. H. Knapman, Food Value of Broccoli, 335

Varrier-Jones (Sir Pendrill), awarded the Weber-Parkes medal and prize of the Royal College of Physicians, 242

Vassy (Drs. A. and E.), Temperature of the Stratosphere in High Latitudes, 284

Vaufrey (R.), Rock Art in North Africa, 1052

Vaughan (Miss Janet), [Prof. R. A. Fisher and], Surnames and Blood-Groups, 1047

Vegard (Prof. L.), Hydrogen Showers in the Auroral Region, 1089

Vejdovský (Prof. F.), proposed celebration of the ninetieth birthday of; work of, 276

Veldstra (Dr. H.), Δ 3,5-Cholestadiene from Cholesteryl Oleate and its Possible Bearing upon the Formation of Carcinogenic Substances in Heated Fats, 246

Vellacott (P.), elected Master of Peterhouse, Cambridge, 242

Verwey (Dr. E. J. W.), Electronic Conduction of Magnetite (Fe_3O_4) and its Transition Point at Low Temperatures, 327

Verzàr (Prof. F.), and J. C. Somogyi, Connexion between Carbohydrate and Potassium Metabolism in Normal and Adrenalectomized Animals, 1014

Victor (E.), [Dr. E. E. Broda, Dr. C. F. Goodeve, Dr. R. J. Lythgoe and], Cataphoretic Measurements on Solutions of Visual Purple and Indicator Yellow, 709

Vigoureux (Dr. P.), Adjustment of Electrical Units, 32

del Villar (Prof. E. H.), Los Suelos de la Peninsula Luso-Ibérica (Soils of the Lusitano-Iberian Peninsula) (Spain and Portugal). International edition in Spanish and English, the English text (somewhat abridged) by Prof. G. W. Robinson (*Review*), 1075

Vilter (Drs. S. P. and R. W.), and Prof. T. D. Spies, Synthesis of Coenzymes I and II, 943

Vincent (W. B.), [J. L. Hoard and], Structure of Complex Fluorides, 984

Vinson (J.), Lepidoptera of the Mascarene Islands, 38

Virtanen (Prof. A. I.), and A. A. Arhimo, Oxaloacetic Acid in the Leguminous Plants, 36; Cattle Fodder and Human Nutrition, with special reference to Biological Nitrogen Fixation (*Review*), 134; Dr. A. A. Arhimo and Dr. H. Suomalainen, Estimation and Occurrence of Keto-Acids in Green Plants, 597

Visser (Dr. S. W.), The Snellius Expedition in the Eastern part of the Netherlands East-Indies, 1929–1930, under the leadership of P. M. van Riel. Vol. 1 and Vol. 2, part 4 (*Review*), 651

Vosburgh (Prof. W. C.), Introductory Qualitative Analysis. Revised edition (*Review*), 367

de Vriend (J. A.), [J. A. M. van Liempt and], Testing of Electric Fuses, 122

de Vries (Prof. L.), and others, German-English Science Dictionary, for Students in the Agricultural, Biological and Physical Sciences (*Review*), 900

Waddington (Dr. C. H.), *Drosophila* Development, 561; Order of Magnitude of Morphogenetic Forces, 637; Physiological Genetics, 817; Development of Wings in Drosophila, 912

Wadham (Prof. S. M.), and Prof. G. L. Wood, Land Utilization in Australia (*Review*), 647

Wakiya (Dr. Yojiro), [death], 14

Waksman (Prof. S. A.), Humus: Origin, Chemical Composition and Importance in Nature. Second edition (*Review*), 893

Walch-Sorgdrager (Dr.), Leptospiroses, 412

Walen (R. J.), [Dr. L. Goldstein, A. Rogozinski and], The Scattering by Uranium Nuclei of Fast Neutrons and the Possible Neutron Emission resulting from Fission, 201

Wall (Dr. T. F.), Electricity (*Review*), 588

Wallis (T. E.), awarded the Hanbury medal of the Pharmaceutical Society of Great Britain; work of, 144

Walmsley (Prof. T.), A Manual of Practical Anatomy: a Guide to the Dissection of the Human Body. Second edition. In 3 parts. Part 2 (*Review*), 896

Walston (Dr. H.), [Dr. G. S. Carter, O. Gatty, Dr. J. H. Schulman and], Calcium in Ciliary and Muscular Movement, 980

Walton (Prof. J.), Harris's British Purbeck Charophyta (*Review*), 1077

Walton (Prof. R. P.), Marihuana, America's New Drug Problem: a Sociologic Question with its Basic Explanation dependent on Biologic and Medical Principles (*Review*), 611
Ward (A. G.), The Nature of Crystals (*Review*), 587
Wardlaw (Dr. C. W.), *Cercospora* Leaf Spot Disease of Bananas, 11; Storage of Tropical Fruits, 178
Wardlaw (Prof. W.), appointed honorary secretary of the Chemical Society, 627
Ware (W. M.), [H. H. Glasscock and], Leaf-spot Disease of Spinach, 602
Wark (E. E. and Dr. I. W.), An Easily Arranged Periodic Action, 833
Warmke (H. E.), and A. F. Blakeslee, Sex Determination in Melandrium, 252
Wataghin (Prof. G.), Limits of Validity of Quantum Mechanics, 754
Watson (Prof. D. M. S.), appointed Herbert Spencer lecturer in Cambridge University for 1940, 47
Watson (Dr. Fletcher), Giacobinid Meteors in 1939 and 1940?, 482
Watson (Prof. G. N.), conferment upon, of an honorary doctorate by Edinburgh University, 87
Watson (Prof. W. H.), On Understanding Physics (*Review*), 196
Weaver (R. L.), The House-Sparrow in Canada, 983
Webb (Dr. G. B.), awarded the Trudeau medal of the National Tuberculosis Association, 628
Webley (D. M.), [Dr. J. H. Quastel and], Vitamin B_1 and Acetate Oxidation by Bacteria, 633
Webster (D.), Periodicity of Influenza, 756
Webster (Prof. J. C.), conferment upon, of an honorary doctorate by Edinburgh University, 87
Webster (L. T.), Inheritance of Disease-Resistance, 870
Wedel (W. R.), Pawnee Archæology, 983
Weidenreich (Prof. F.), Origin of Mankind, 1054; Forerunner of *Sinanthropus Pekinensis*, 1055; "Modern Man" in Eastern Asia, 1086; 1097; [Dr. G. H. R. von Koenigswald and], The Relationship between Pithecanthropus and Sinanthropus, 926; 933
Weil-Malherbe (Dr. H.), [Dr. J. Weiss and], Decomposition of Hydrogen Peroxide by Catalase, 866
Weis (L.), Television Transmission over Telephone Cables, 903
Weisner (Prof. L.), Introduction to the Theory of Equations (*Review*), 370
Weiss (Dr. J.), and Dr. H. Weil-Malherbe, Decomposition of Hydrogen Peroxide by Catalase, 866
Welch (Dr. William H.), with an Introduction by Dr. S. Flexner, Adaptation in Pathological Processes (*Review*), 308
Weld (H. P.), [E. G. Boring, H. S. Langfeld and others], Introduction to Psychology (*Review*), 744
Wells (Prof. A. E.), [death], 65
Wells (Dr. G. P.), Intermittent Activity in Polychaete Worms, 940
Wells (H. G.), The Fate of Homo Sapiens: an Unemotional Statement of the Things that are Happening to Him Now, and of the Immediate Possibilities confronting Him (*Review*), 397
Weltzel (H.), 'Hermanation', 789
Wen-Chung (Pei), Markings on Fossil Bones, 1017
Wertenstein (Prof. L.), Radioactive Gases Evolved in Uranium Fission, 1045
West (P. M.), Excretion of Thiamin and Biotin by the Roots of Higher Plants, 1050
Westermarck (Prof. E.), Christianity and Morals (*Review*), 173; [death], 471; [obituary article], 502
Weston (Miss Ruth), Museum Work in America, 19
Wetmore (A.), A Pleistocene Bird's Egg, 790
Wetmore (R. H.), [Mary MacArthur and], Vascular Anatomy of the Apple, 1053
Wever (Prof. F.), Development and Present State of Modern Metallurgical Research, 45
Whalen (D.), [Prof. J. R. Loofbourow, A. A. Cueto, Sister Mary Michaella Lane and], Local Growths in Animals produced by Injection of Intercellular Wound Hormones, 939
Whalley (F.), appointed lecturer in anæsthetics in Leeds University, 47
Wheatcroft (Prof. E. L. E.), Gaseous Electrical Conductors (*Review*), 769
Wheeler (Prof. R. V.), [death], 776; [obituary article], 931
Wheeler (late Prof. W. Morton), selected by Prof. G. H. Parker, Essays in Philosophical Biology (*Review*), 1078
Whewell (Dr. C. S.), appointed assistant lecturer in finishing and research assistant in the textile department of Leeds University, 219
Whipple (R. S.), Instruments in Science and Industry, 426; 461; appointed deputy director of production of scientific instruments, Ministry of Supply, 665
Whitby (R. H.), awarded the Busk studentship in aeronautics of Cambridge University, 199
White (A. Spencer), General Science Biology (*Review*), 896
White (D. E.), [V. M. Trikojus and], Synthesis of Myristicin, 1016
Whiteley (Dr. M. A.), [Sir Jocelyn Thorpe and], Thorpe's Dictionary of Applied Chemistry. Vol. 3: Chemical Calculations—Diffusion. Fourth edition (*Review*), 491
Whitfield (Dr. F. G. S.), Insects in Aircraft, 158
Whiting (Anna R.), Mutant Body Colours in a Parasitic Wasp, 80
Whitrow (Dr. G. J.), Kinematical Relativity and the Geological Time-Scale, 706
Whittaker (C. M.), and C. C. Wilcock, Dyeing with Coal-Tar Dyestuffs: the Principles Involved and the Methods Employed. Third edition (*Review*), 740
Whittaker (Prof. E. T.), elected president of the Royal Society of Edinburgh, 749
Whyte (R. O.), Research on Grassland, Forage Crops and the Conservation of Vegetation in the U.S.A., 915; [G. V. Jacks and], The Rape of the Earth: a World Survey of Soil Erosion (*Review*), 647
Wibaut (Prof. J. P.), and P. W. Haayman, Ozonization of *O*-Xylene and the Structure of the Benzene Ring, 290
Wichterman (Dr. R.), Cytogamy: a New Sexual Process in Joined Pairs of *Paramecium caudatum*, 123
Widdowson (Dr. E. E.), [Dr. S. J. Gregg and], Evaporation of Built-up Molecular Films, 666
Wigglesworth (Dr. V. B.), Source of the Moulting Hormone in Rhodnius (Hemiptera), 753; The Principles of Insect Physiology (*Review*), 800
Wilbraham (Anne), [Prof. J. C. Drummond and], The Englishman's Food: a History of Five Centuries of English Diet (*Review*), 264
Wilcock (C. C.), [C. M. Whittaker and], Dyeing with Coal-Tar Dyestuffs: the Principles Involved and the Methods Employed. Third edition (*Review*), 740
Wild (Commdr. F.), [obituary article], 578
Wildman (Dr. A. B.), and H. B. Carter, Fibre-Follicle Terminology in the Mammalia, 783
Wildt (R.), Chemistry of the Coloration in Jupiter's Cloud Forms, 602
Wilkerson (Prof.), Special Problems of Negro Education, 937
Wilkie (J.), Museums and Education, 626
Wilkins (W. H.), Parasitism of the Pitch-Crust Fungus, 253; White Rot of the Elm, 518
Wilkinson (B. G.), appointed Frank Smart student of botany in Cambridge University, 762
Williams (Dr. C. B.), Insects Collected in Traps at Rothamsted Experimental Station, 85
Williams (C. H.), and H. J. G. Hines, Toxicity of *Salvia reflexa*, 118
Williams (Sir Evan), Utilization of Coal, 106
Williams (E. F.), [Prof. A. C. Chibnall, M. W. Rees, G. R. Tristram, Dr. E. Boyland and], The Glutamic Acid of Tumour Proteins, 71
Williams (F. C.), Fluctuation Voltages, 485
Williams (G.), appointed lecturer in zoology in Queen's University, Belfast, 47
Williams (G. E.), Severe Mortality of *Mactra corallina cinerea* (Montagu) off the Lancashire Coast, 1049

Williams (N.), Population Problems of Housing Estates, 166

Williams (R. D.), Chlorophyll Deficiencies in Red Clover, 253; Inheritance of Cyanogenesis, 837

Williams (R. Wilson), [Prof. E. A. Owen and], Effect of Temperature on the Intensity of X-Ray Reflections from Gold, 477

Williams (Dr. S.), and Dr. G. Bond, Practical Botany: a first year course for University and Intermediate Science Students (*Review*), 739

Wilson (Dr. Andrew), appointed assistant lecturer in pharmacology in Sheffield University, 168

Wilson (Dr. D. C.), Distribution of Fluorosis in India and in England, 155

Wilson (E. P.), and F. W. Ambler, Revision Notes in Inorganic Chemistry: to Higher School Certificate (*Review*), 1079

Wilson (J. G.), [Dr. A. C. B. Lovell and], Investigation of Cosmic Ray Showers of Atmospheric Origin, using two Cloud Chambers, 863

Wilson (J. K.), Nodule Organisms of the Leguminosae, 335

Wilson (Mrs. Margaret), Sir Frank Dyson, 869

Wilson (W. C.), appointed regius professor of surgery in Edinburgh University, 628

Wimperis (Dr. H. E.), The Future of Flying, 430; 538

Winge (O.), and O. Lausteen, Hybridization in Yeast, 253

Winant (J. E.), The World of Industry and Labour, 1939, 683

Winton (Dr. A. L.), and Dr. Kate Barber Winton, The Structure and Composition of Foods. Vol. 4 (*Review*), 366

Winton (Prof. F. R.), The Living Body (*Review*), 228

Wishart (Dr. J.), Tables for Statisticians (*Review*), 533; 788

Witherby (H. F.), Rev. F. C. R. Jourdain, N. F. Ticehurst and B. W. Tucker, The Handbook of British Birds. Vol. 3 (Hawks to Ducks) (*Review*), 691

Wodzicki (Prof. K.), [Dr. H. Liche and], Vaginal Smears and the Œstrous Cycle of the Cat and the Lioness, 245

Wolf (Dr. B.), Animalium Cavernarum Catalogus, Part 14, 974

Wolkov (N. F.), [W. G. Chlopin, M. A. Passwik-Chlopin and], A Particular Mode of Fission of the Uranium Nucleus, 595

Wollaston (C. Hyde), Foundations and Earth Pressures (*Review*), 898

Woloszyn (Mme. M.), [Dr. N. Bessonoff and], Platinum Potential of Vitamin C Solutions in Contact with Molecular Oxygen, 289

Wood (Prof. F. C.), Third International Cancer Congress, 839

Wood (Prof. G. L.), [Prof. S. M. Wadham and], Land Utilization in Australia (*Review*), 647

Wood (J. M.), [death], 185

Wood (Prof. R. W.), Fire-Fly 'Spinthariscope', 381

Woodman (Prof. J. E.), [death], 65

Woods (H.), awarded the Wollaston medal of the Geological Society of London, 1044

Woodward (Sir A. Smith), Some Early Ganoid Fishes (*Review*), 615; awarded the Hayden Memorial geological medal of the Academy of Natural Sciences, Philadelphia, 1010

Woodward (I.), [Dr. A. R. Ubbelohde and], Isotope Effect in Potassium Dihydrogen Phosphate, 632

Woodward (Dr. L. A.), appointed fellow and tutor in chemistry of Jesus College, Oxford, 301

Wooldridge (S. W.), and D. L. Linton, Structure, Surface and Drainage in South-East England, 121

Woolley (Sir Leonard), Further Archæological Excavation in Syria, 277; A Report on the Work of the Archæological Survey of India, 758; Indian Archæology and Indian Problems (Birdwood Memorial Lecture), 1006

Woolley (Dr. V. J.), Prof. J. Mellanby, 358

Work (C. E.), [M. M. El-Sadr, H. G. Hind, T. F. Macrae, B. Lythgoe, Prof. A. R. Todd and], Vitamin B Requirements of the Rat, 73

Worley (Prof. F. P.), Loaded Dice, 712

Wormald (Dr. H.), Diseases of Fruit and Hops (*Review*), 687

Worthington (Dr. E. B.), Research in Freshwater Biology, 590

Wortley (W. R. S.), [Dr. R. N. Salaman and], Potential Hosts of Potato Viruses in Garden and Field, 1049

Wright (Prof. E. M.), [Prof. G. H. Hardy and], An Introduction to the Theory of Numbers (*Review*), 347

Wright (G. P.), [F. D'Arcy Hart and], Tuberculosis and Social Conditions in England, 447

Wright (Johnstone), The Electrical Grid in Great Britain, 778

Wright (Dr. W. B.), [death], 700; [obituary article], 775; Tools and the Man (*Review*), 737

Wrinch (Dr. Dorothy), The Tuberculin Protein T.B.U.-Bovine (523), 77

Wyse (A. B.), Origin of the λ 4932 Emission in the Spectra of Novæ, 1090

Yamaguchi (Shigeto), [Ichirô Iitaka and], Electron Diffraction Examination of Oxide Films on Light Metals, 1090

Yamaguti (S.), Earthquakes and Crustal Structure near Japan, 602

Yamashita (H.), [M. Miwa, K. Mori and], Lethal Action of Alpha-Rays on Sea-Urchin Eggs, 378

Yapp (W. B.), An Introduction to Animal Physiology (*Review*), 766

Yasaki (T.), [Dr. Y. Nishina, H. Ezoe, Prof. K. Kimura, M. Ikawa and], Fission of Thorium by Neutrons, 547

Yates (F.), [Prof. R. A. Fisher and], Statistical Tables for Biological Agricultural and Medical Research (*Review*), 533

Yonge (Prof. C. M.), Protobranchiate Mollusca, 601

Yoshioka (M.), [N. Shinohara, Y. Hirano and], Extensions of Carrier Telephone Systems, 545

Young (Prof. A.), [death], 185; [obituary article], 407

Young (Mrs. Edna Hill), [Dr. Sara M. Stinchfield and], Children with Delayed or Defective Speech: Motor-Kinesthetic Factors in their Training (*Review*), 744

Young (H.), [obituary article], 660

Young (J. Z.), Giant Fibres in Squids, 557

Young (Dr. M.), and W. T. Russell, Appendicitis: a Statistical Study, 452

Zakrzewski (K.), and Dr. A. Piekara, On the Theory of Dielectric Polarization in Liquids, 250

Zanstra (H.), Supernovæ, 122

Zechmeister (Prof. L.), and O. Frehden, Achromatographic Study of Lignite, 331; [Dr. G. Tóth and], Chitin Content of the Mandible of the Snail (*Helix pomatia*), 1049

Zeiger (Prof. K.), Physikochemische Grundlagen der histologischen Methodik (*Review*), 1079

Zemansky (Prof. M. W.), Heat and Thermodynamics (*Review*), 196

Zia (Y.), Fruit Flies of China, 209

Zimmern (Sir Alfred), The League of Nations and the Rule of Law, 1918–1935. Second edition (*Review*), 742; The Prospects of Civilization (*Review*), 1031

Zinner (E.), Leben und Wirken des Johannes Müller von Königsberg genannt Regiomontanus (*Review*), 223

Zlotowski (I.), [M. Lecoin and], Microcalorimetric Measurement of the Mean Energy of Disintegration of Radium E, 440

Zondek (Prof. B.), and Dr. F. Sulman, Inactivation of Diethylstilbœstrol in the Organism, 596

Zunz (Prof. Edgar), [obituary article], 104

TITLE INDEX

Aberdeen University, conferment of honorary doctorates on Prof. C. L. Burt and Prof. A. Law, 127
Abortion, Report on, 19
Academy of Natural Sciences, Philadelphia, award of the Hayden Memorial Geological medal of the, to Sir Arthur Smith Woodward, 1010
Accidents, Toll of, 504
Acclimatisation, Reactions of, and of Non-Adaptation, Prof. M. Piery and Prof. J. Enselme, 731
Acetate Oxidation, Vitamin B_1 and, by Bacteria, Dr. J. H. Quastel and D. M. Webley, 633
Acetone, Thermal Decomposition of, J. G. Davoud and Prof. C. N. Hinshelwood, 909
Acetylphosphate and Pyruvate Oxidation, Dr. S. Ochoa, Prof. R. A. Peters and Dr. L. A. Stocken, 750
Acoustics of Buildings, [1839], 526
Actinium K, β Spectrum of, Mlle. M. Perey and M. Lecoin, 326
Activation, Co-operative, Prof. W. E. Garner, 287
Adelaide: Institute of Medical and Veterinary Science, opening of new laboratories, Sir Charles Martin, 392
Adenosinetriphosphatase, Myosine and, Prof. W. A. Engelhardt and M. N. Ljubimowa, 668
Adsorption, Very Slow, A Possible Explanation of, K. S. Gururaja Doss, 448
Adventure, The Spirit of, 580
Aequanimitas, with other Addresses to Medical Students, Nurses and Practitioners of Medicine, late Sir William Osler. Reprinted from the third edition. Biographical note by Sir Walter Langdon-Brown (*Review*), 899
Aeronautical: Research: Wind Tunnels, Old and New, Dr. G. W. Lewis (Wilbur Wright memorial lecture), 229; Computation, Use of Matrices in (*Review*), 650
Africa: Tropical West, The Birds of, with special reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria, Dr. D. A. Bannerman. Vol. 5 (*Review*), 364; Central and Southern, Physiographical Development of, F. Dixey, 676; Capital Investment in, its Course and Effects, Prof. S. H. Frankel (*Review*), 686; Commercial Development of (*Review*), 686
African: Linguistics, 437*; Women: a Study of the Ibo of Nigeria, Mrs. Sylvia Leith-Ross (*Review*), 737; Studies, Research on, 779; Genesis, Dr. L. Frobenius and D. C. Fox (*Review*), 894
Ageing: Problems of, Biological and Medical Aspects, Edited by E. V. Cowdry (*Review*), 995
Agricultural Economics, International Bibliography of, No. 1, 68
Agricultural: Research Institutes, Reports on work of, 241; Education Association: Annual Conference at Belfast, 257; Libraries, International Directory of, 546
Agriculture: Modern, Science in, 49; and Fisheries, Minister of, W. Gavin appointed agricultural adviser designate to the, 410; Scientific Research and, Sir Thomas Middleton, 616
Airplane Structures, Prof. A. S. Niles and Prof. J. S. Newell. 2 Vols. Second edition (*Review*), 898
Air: Raid Defence League, Second Bulletin of the, 66; Liner, New Long-Distance, 105; *Raid Defence*, June, 145; Sterilisation, Evaporation of Mist Particles and its bearing on, S. R. Finn and E. O. Powell, 864
Aka Hills, Assam, Vegetation of the, N. L. Bor, 39
Akwarium, The Warsaw, 591
β-Alanine, Activity of, in Stimulating Growth of Young Rats in a Diet Deficient in 'Filtrate Factor', M. Hoffer and Prof. T. Reichstein, 72
Alcohol and Crime, Dr. W. N. East, 703
Alcoholism and Mental Disease, Dr. A. Le Gall, 543; and Suicide, Dr. M. Moore, 1040
Alga, Triploid Red, Kathleen M. Drew, 209
Alkali and Alkaline Earth Metals, Chemistry of the (*Review*), 1064
Alkyl: Halides, Hydrolysis of, R. A. Ogg, jun., 519; Chain Length, Dipole Moment and, Dr. H. O. Jenkins, 667
Alsea Ethnography, P. Drucker, 714
Alternating Currents: Essentials of, Prof. W. H. Timbie and Prof. H. H. Higbie. Second edition (*Review*), 585; for Long-Distance Transmission, Possibilities of, H. Rissik, 988
Aluminium Alloys, Selective Oxidation of, Prof. S. Dobiński and M. Niesluchowski, 510
Amarah West, Sudan, Excavations at, 1938–39, 43
America: The Royal Visit to, 15; Central, Early Cultural Relations in, 505
American: Museum Methods, Miss Ruth Weston, 19; Geographical Society: awards made to Prof. E. de Martonne, Prof. H. J. Fleure, J. R. Rymill, Sir Wilfred Grenfell, Prof. H. Baulig, and Prof. G. Dainelli, 199; E. Antévs, Prof. L. L. Mecking, W. E. Rudolph, P. G. Schott, and Dr. L. Dudley Stamp elected corresponding members of the, 199; award of the David Livingstone centenary gold medal to, J. Rymill, 546; Genetic Association, award of the Meyer medal of the, to Dr. D. Fairchild, 236; *Journal of Anatomy*, Prof. G. W. Corner appointed editor of the, 508; Association, Dr. A. B. Sabin presented with the Theobald Smith award of the, 546; Society of Plant Physiology, award of the Charles R. Barnes honorary life membership of the, to Prof. L. Jost, 282; Mineral Deficiencies, Sir Thomas Holland (*Review*), 921; Congress of Physical Therapy, award of a gold key of the, to Dr. J. B. Mennell, 976; Public Health Association, presentation of the Sedgwick medal of the, to Dr. T. Parran, 1010; Women's Chemical Honor Society, Iota Sigma Pi, Dr. Mary Evelyn Laing McBain elected national president of the, 1044; Scientific Congress, Eighth, preparations for the, 1056
α-Amino Acid Esters, Poly-condensation of, Dr. M. Frankel and E. Katchalski, 330
α-Amino-Acid Esters, Carbamates of, and their Polycondensation, Dr. M. Frankel, O. Neufeld, and E. Katchalski, 832
α-Amino-Acid Oxidase Content of Rat Tissues in Riboflavin Deficiency, Reduction of the, A. E. Axelrod, H. A. Sober and Prof. C. A. Elvehjem, 670
l-Amino-Acid Dehydrogenase ('*l*-Deaminase'), A Cell-free Enzymatic Model of, Prof. A. E. Braunstein and S. M. Bychkov, 751.
l- and *d*-Amino Acids, Trans-amination of, in Normal Muscle and in Malignant Tumours, Prof. A. E. Braunstein and R. M. Azarkh, 669
Amino: -Acids and Rooting of Cuttings, B. W. Doak, 379; and Bisamino-Methylenecamphors, Difference in Odour of *d*-, *l*- and *dl*-derivatives of, Dr. Bawa Kartar Singh and Awadh Behari Lal, 910; Acids and Proteins, The Chemistry of the, edited by Prof. C. L. A. Schmidt (*Review*), 923
Ampere, The Absolute, H. L. and R. W. Curtis and C. L. Critchfield, 294
Amphioxus, Amylase in, Prof. W. L. Doyle, 867
Anæsthetic Practice, Modern, edited by Sir Humphry Rolleston and Dr. A. A. Moncrieff (*Review*), 370

Analyse mathématique, P. Appell. Cinq. édition. Tome 2 (*Review*), 369
Analysis: Theoretical Qualitative, Prof. J. H. Reedy (*Review*), 365; Organic, Systematic Qualitative, H. Middleton (*Review*), 366; Volumetric, including the analysis of Gases, with a chapter on Simple Gravimetric Determinations, A. J. Berry. Fifth edition (*Review*), 366; Qualitative, Introductory, Prof. W. C. Vosburgh. Revised edition (*Review*), 367
Anatomy: Practical, A Manual of, a Guide to the Dissection of the Human Body, Prof. T. Walmsley. Second edition. In 3 Parts. Part 2 (*Review*), 896; Inspector of, in England, Scotland and Wales, Dr. E. Ellice Henderson appointed, 1088
Anavysos Kouros, The, Dr. A. Philadelphus, 278
Ancient House Types in Arizona, Dr. F. H. H. Roberts, jun., 556
'Anderson' Shelters, Official Tests of, 238
Andesite, Melting of Granodiorite by, E. S. Larsen and G. Switzer, 676
Anglo-Saxon Burials in Rutland, 146; Ship Burial, 239; Tradition, The, Prof. G. Catlin (*Review*), 398; –Egyptian Sudan, appointment of G. Andrew as Government geologist in the, 1010
Animal: Behaviour, D. Seth-Smith, 85; Tissue Cells, Nature of the Growth-accelerating Substance of, Dr. A. Fischer, 113; and Bird Painting: the Outlook and Technique of the Artist, C. Simpson (*Review*), 373; Ecology and Taxonomy, A Laboratory Introduction to, Prof. O. Park, Prof. W. C. Allee and Prof. V. E. Shelford (*Review*), 583; Physiology, An Introduction to, W. B. Yapp (*Review*), 766; Breeding in the light of Genetics, Dr. J. E. Nichols, 818; Welfare, Science and, 827; Families and where they live, Arnrid Johnston (*Review*), 1078
Animalium Cavernarum Catalogue, pars 14, 974
Animals: The Social Life of, Prof. W. C. Allee (*Review*), 5; and Air Raids, 503; during War-time, 661; without Backbones: an Introduction to the Invertebrates, Dr. R. Buchsbaum (*Review*), 847
Anopheles Mosquito, Female, Mouth-parts of the, G. G. Robinson, 870
Anserine in Muscle: Possibility of Determination by Titration, Dr. E. C. Bate Smith, 1015
Antarctic: Expedition, Projected, 825; History, On some Misrepresentations of, A. R. Hinks, 901
Ant-hill, Temperature Rhythm in an, M. Katô, 385
Anthologia Anthropologica (*Review*), 698
Anthropoid Apes, Taste-testing the, Prof. R. A. Fisher, Dr. E. B. Ford and Dr. J. S. Huxley, 750
Anthropological: Studies, Cultural Significance of, Prof. H. J. Fleure, 697; Studies in India, 721; Periodical in India, New, 745
Anthropology: Physical, Scope and Limitations of, Prof. W. E. Le Gros Clark, 430; 804; Physical, and Problems of Modern Society, 797
Anthropometry and the War, Capt. A. G. Pape, 933
Antiquities in British Dependencies, Conservation of, 261
Antiquity, Dec., 1040
Antirrhinum Rust, Dr. A. Fikry, 913
Aphidophagous Syrphidæ, Hymenopterous Parasites of, M. Kamal, 639
Apia Observatory, Report for 1935, 828
Appendicitis: a Statistical Study, Dr. M. Young and W. T. Russell, 452; Causation of, 452
Apple: Market Economics of the, J. R. Raeburn, 385; Roots, Anatomy of, A. B. Beakbane and E. C. Thompson, 447; Canker, R. W. Marsh, 913; Vascular Anatomy of the, Mary MacArthur and R. H. Wetmore, 1053
Aquatic Plants of India and Burma, C. E. C. Fischer (*Review*), 727
Aqueous Solutions, The Oxidation States of the Elements and their Potentials in, Prof. W. M. Latimer (*Review*), 367
Arabian Sea, Marine Deposits of the, Dr. H. G. Stubbings, 841
Archæological: Survey of India, A Report on the Work of the, Sir Leonard Woolley, 758; finds in Staffordshire, Recent, 936
Archæology in Peru: Recent Progress, H. J. Braunholtz, 841; and Society, Dr. Grahame Clark (*Review*), 1077
Arctic: Ice and Snow, Life in, E. Kol, 39; Plants in the British Isles, Dr. N. Polunin, 352
Argentine National Department of Health, Dr. J. J. Spangenberg nominated president of the, 938
Armadillidium vulgare Latr., Monogenic broods in, H. W. Howard, 979
Armaments Race, Mathematics of the, Prof. H. T. H. Piaggio (*Review*), 692
Aromatic Polynitro Compound–Hydrocarbon Complexes, Structure of, H. M. Powell and G. Huse, 77
Artesian Well in Paris, [1839], 720
Arthritis in Wild Mammals, H. Fox, 638
Artists' and Decorators' Materials, The Scientific Aspects of, Dr. R. S. Morrell (*Review*), 175
Ascorbic Acid, Role of Manganese in the Biological Synthesis of, M. N. Rudra, 868
Asia and Europe: The Native Races of, A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer. Arranged and edited from the MSS, by R. A. Downie (*Review*), 688
Assam, Flora of. Vol. 3, U. N. Kanjilal, A. Das, P. C. Kanjilal and R. N. De (*Review*), 894
Assomption Sash, The, M. Barbeau, 756
Astrolabe, Dumont d'Urville's Voyage in the, [1839], 219
Astronomical Navigation, An Introduction to, P. H. Legg (*Review*), 586
Astronomy: a Textbook for University and College Students, Prof. R. H. Baker. Second edition (*Review*), 899; Old and New, Sir Richard Gregory, Bt. (*Review*), 1028; in Ancient Egypt, 1041
Astrophysics, Analytical, Prof. W. H. McCrea (*Review*), 130
Athens, Medical School at, [1839], 644
Atlantic Submarine Valleys, R. A. Smith, 1042
Atmosphärische Turbulenz, Dr. H. Lettau (*Review*), 651
Atmospheric: Pollution, Twenty-fourth Report on, 167; Turbulence, Prof. D. Brunt (*Review*), 651
Atomes, radioactivité, transmutations, M. de Broglie (*Review*), 689
Aurora Islands, Re-discovery of the, [1839], 127
Australia: Wild Flowers of, Thistle Y. Harris (*Review*), 7; Fisheries Research in, Sir David Rivett, 312; Arnhem Land, Totemic Ceremonial in, Dr. D. F. Thomson, 319; Central, The Native Tribes of, late Sir Baldwin Spencer and late F. J. Gillen. New edition (*Review*), 363
Australian Wild Flowers, Some Eastern, Prof. T. G. B. Osborn (*Review*), 7
Australasia; including Australia, New Zealand, Oceania, New Guinea and Indonesia: The Native Races of, A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer. Arranged and edited from the MSS. by R. A. Downie (*Review*), 688
Australasian Antarctic Expedition, Reports of the, 589
Australopithecus (Plesianthropus), Dentition of, Dr. W. K. Gregory and M. Hellman, 451
Autocatalysis and Blood Coagulation, Dr. T. Astrup, 76
'Auto-parasitism' by *Nemeritis canescens* (Grav.) (Ichneumonidæ), E. S. Narayanan, 207
Auxiliary Territorial Service, Army Branch, Dame Helen Gwynne-Vaughan appointed director of the, 70
Avian Sternum, The, Honor B. Fell, 557

Baade and Zwicky's theory of Cosmic Rays, and the Helium content of Beryls, Dr. J. Read, 1046
Bacteria of the Throat and Nose, Drs. Edith Straker, B. Hill and R. Lovell, 1017
Bagh Caves in Gwalior State, Technique of the Painting Process in the, S. Paramasivan, 554
Balloon Experiments in High Latitudes, H. Carmichael and E. G. Dymond, 294

Bananas, Cercospora Leaf Spot Disease of, Dr. C. W. Wardlaw, 11
Bantu, Southern, Cattle and Marriage among, J. D. Krige, 912
Barbary Coast, A Vicarious Trip to the, Mrs. Mary Berenson (*Review*), 585
Barnacle Communities, F. Hiro, 1017
Basque Origins, R. Gallop, 946
Bedford College for Women, A History of, 1849–1937, Dr. Margaret J. Tuke (*Review*), 132
Bees, North American, of the Genus Osmia, Grace A. Sandhouse, 870
Beit Memorial Fellowships for Medical Research, 215
Belfast, Queen's University, Dr. R. H. Sloane appointed lecturer in Experimental Physics and G. Williams lecturer in zoology, 47
Belgium, Industry and Agriculture in, P. Beghin, 188
Benares Hindu University, Pharmaceutical Association of, Dr. G. Domagk elected an honorary member of the, 938
Benzedrine and Brain Metabolism, P. J. G. Mann and Dr. J. H. Quastel, 943
Benzpyrene Tumour Strain, a, in Hamsters with Tendency to Metastasis Formation, L. Halberstaedter, 377
Bern University, award of the international prize for researches on encephalitis to Dr. B. Disertori, 1044
Beryls, Helium content of, Baade and Zwicky's theory of Cosmic Rays, and the, Dr. J. Read, 1046
Beta Upper Energy Limits, Evaluation of the, with simple absorption data, J. B. R. Rajam, P. C. Capron and Prof. M. de Hemptinne, 202
Betsileo (Madagascar), Monographie des, H.-M. Dubois (*Review*), 894
Bibliographies, World Bibliography of, forthcoming, 69
Bile Production in Tumour-bearing Mice and the use of Bile in Filtration, Dr. L. Dorothy Parsons, 75
Binocular Stereoscopic Vision, Sir Richard Paget, Bt., 153; Rev. W. McEntegart, 154
Biochemistry: for Medical Students, Dr. W. V. Thorpe (*Review*), 268; Outlines of, the Organic Chemistry and the Physicochemical Reactions of Biologically Important Compounds and Systems, Prof. R. A. Gortner. Second edition (*Review*), 268; The Realm of (*Review*), 268
Biological Principles, Introducing, T. H. Hawkins (*Review*), 847
Biologists, Applied, Society of, 240
Biology: Supply and Training of Teachers in, Prof. J. Ritchie, 129; 140; School, and Citizenship, 129; The School and Society, T. H. Hawkins, 140; Everyday, An Introduction to the Study of Life, Dr. G. Pugh Smith (*Review*), 191; Rhythmic Processes in, Dr. K. Mellanby, 560; General Science, A. Spencer White (*Review*), 896; Philosophical, Essays in, late Prof. W. M. Wheeler, selected by Prof. G. H. Parker (*Review*), 1078
Biotin, Thiamin and, Excretion of, by the Roots of Higher Plants, P. M. West, 1050
Birds: Wild, Protection of, 590; British, The Handbook of, Vol. 3 (Hawks to Ducks). H. F. Witherby (Editor), Rev. F. C. R. Jourdain, N. F. Ticehurst and B. W. Tucker (*Review*), 691; of Britain: (*Review*), 691; Rev. F. C. R. Jourdain; S. G., 942
Birmingham: University, Prof. B. L. Goodlet appointed professor of Electrical Engineering; Gifts from Rubery Owen, Ltd., J. R. H. Sumner and the Birmingham Small Arms Co., Ltd., 87; Mechanics' Institution [1839], 1024
Birth Customs in East Anglia, Miss Barbara Newman and L. Newman, 412
Births, Deaths and Marriages, Statistics of, [1839], 87
Black-out, Factories and the, H. W. Cremer and others, 1023
Blenny, The Four-eyed, C. M. Breder and E. B. Gresser, 675
Blood: Coagulation, Autocatalysis and, Dr. T. Astrup, 76; Group Tables, Dr. W. C. Boyd, 321; -group Tests of Paternity, Report of House of Lords Select Committee on; Dr. V. Friedenreich and others, 542; Groups: among Primitive Peoples, 714; in Africa, Dr. R. Elsden-Drew, 789; Groups, Surnames and, Prof. R. A. Fisher and Miss Janet Vaughan, 1047
Borden Company, Dr. Icie Nacy-Hoobler awarded the gold medal and prize of the, 781
Borneo Jungle: An Account of the Oxford Expedition to Sarawak, J. Ford, C. M. Hartley, T. Harrisson, P. M. Synge and E. Shackleton. Edited by T. Harrisson (*Review*), 742
Bose-Einstein Gas, Non-Ideal, Effect of an Excitation Energy on the Specific Heat of Liquid Helium II and its relation to the Exchange Effect in a, Dr. A. Michels, Dr. A. Bijl and Dr. J. de Boer, 594
Botany: An Introduction to: Prof. A. W. Haupt (*Review*), 492; with special reference to the structure of the Flowering Plant, Prof. J. H. Priestley and Lorna I. Scott (*Review*), 492; University, First Year (*Review*), 492; Economic, Application of, in the Tropics, Sir Frank Stockdale, 563; Intermediate, L. J. F. Brimble. Second edition (*Review*), 739; Practical, A First Year Course for University and Intermediate Science Students, Dr. S. Williams and Dr. G. Bond (*Review*), 739
Brain: Pyruvate Oxidation System of, Necessity of Magnesium in the, Dr. S. Ochoa, 834; Metabolism, Benzedrine and, P. I. G. Mann and Dr. J. H. Quastel, 943
Brass, Impurities in, H. B. Gardner and C. M. Saeger, 386
Brazil, Anthropological Expedition to, Preliminary Report of an, 626
Britain, A National Atlas of, Prof. E. G. R. Taylor, 929
British: Museum (Natural History), Acquisitions, 18; Philosophy: A Century of, Dr. T. Greenwood (*Review*), 51; A Hundred Years of, Dr. R. Metz. Translated by Prof. J. W. Harvey, Prof. T. E. Jessop, H. Sturt. Edited by Dr. J. H. Muirhead (*Review*), 51; Non-Ferrous Metals Research Association, Dr. H. Moore, 83; Museum (Bloomsbury), Recent additions to the, 106; Empire Cancer Campaign, Grants from the, 109; Standards for A.R.P. Requirements, 109; Empire Naturalists' Association, H. Main elected national president of the, 185; Museum (Natural History), recent acquisitions, 188; School of Archæology at Athens, 1935–36, 278; Islands, The, and their Vegetation, Prof. A. G. Tansley (*Review*), 305; Speleological Association, Annual Conference of the, presidential address of Dr. R. R. Marett, 319; Association: at Birmingham [1839], 342; The Dundee meeting of the, General Arrangements and Sectional Programmes, 387; Democracy, Traditions and Future of, Harold Macmillan (*Review*), 398; Association: 1839, 453; election of Sir Richard Gregory, Bt., as president for 1940, 472; in War-Time, 579; Museum (Natural History), Recent acquisitions, 779; 937; Empire, The, H. V. Hodson (*Review*), 1031; University Thesis Literature, Accessibility of, Col. L. Newcombe, 1041; Plant Diseases, List of Common Names of, 1043; Social Hygiene Council. 1086; Sir Walter Langdon-Brown appointed president of the, 1088
Broad Bean Roots, Growing Tips of, Comparison of the Lethal Effect of Fast Neutrons and Gamma-Rays on the, Dr. L. H. Gray, Dr. J. Read and Dr. J. C. Mottram, 478
Broadcasting: and Television, Progress made in, Sir Noel Ashbridge, 322; over the Power Mains, 361
Broccoli, Food Value of, E. Vanstone and C. E. H. Knapman, 335
Brompton Hospital Reports. Vol. 7, 1938 (*Review*), 371
Bronze Age Cairns in Wales, Two, Sir Cyril Fox, 518
Buddha, Reincarnated, at Lhasa, Arrival of the, 826
Budgerigar, 'Dominant Grey', The Colour-producing Structure in the, Dr. L. Auber, 157
Building: Research, Progress in, 339; Modern, Principles of, Vol. 1: Walls, Partitions and Chimneys, R. Fitzmaurice (*Review*), 459; Recommendations (*Review*), 459
Bulbs, Diseases of, W. C. Moore (*Review*), 1075
Bunas of Bengal, Minendra Nath Basu, 789
Bush Fires in Victoria, 97
Business Management Books, Guide to, G. E. Milward. Seventh edition (*Review*), 372

Caddis Flies, The (Trichoptera): A Collector's Handbook, M. E. Mosely (*Review*), 364

Caerleon, Excavations at, 473

Calcium: Superphosphate, Manufacture of (*Review*), 848; Superphosphate and Compound Fertilisers: their Chemistry and Manufacture, P. Parrish and A. Ogilvie (*Review*), 848; in Ciliary and Muscular Movement, Dr. G. S. Carter, O. Gatty, Dr. J. H. Schulman and Dr. H. Walston, 980

Calculus: Prof. F. H. Miller (*Review*), 585; A Critical and Historical Survey of the (*Review*), 802; The Concepts of the, a Critical and Historical Discussion of the Derivative and the Integral, C. B. Boyer (*Review*), 802

Calf Thymus Nucleohistone, Physical Characterization of, Dr. R. Owen Carter and Dr. J. L. Hall, 329

California: Crustal Structure of, P. Byerly, 639; Stratigraphical Studies of (*Review*), 1030

Californian Deserts: The, A Visitor's Handbook, E. C. Jaeger; with chapters by S. S. Berry and M. J. Rogers. Revised edition; Prof. J. S. Gardiner (*Review*), 460

Callendar Steam Tables, Abridged, late Prof. H. L. Callendar, revised by G. S. Callendar. Fourth edition (*Review*), 1069

Calochortus, Cytology and Taxonomy of, J. M. Beal, 335

Cambridge: Observatory, Report for 1938-39, 747; University: Prof. D. M. S. Watson appointed Herbert Spencer lecturer for 1940, 47; R. H. Whitby awarded the Busk studentship in aeronautics, 199; P. Vellacott elected Master of Peterhouse, 242; J. C. Colbeck elected John Lucas Walker student and A. F. Huxley Michael Foster student; Dr. K. C. Dixon awarded the E. O. Fearnsides scholarship, 301; E. S. Shire appointed lecturer in physics and B. G. Wilkinson Frank Smart student of botany, 762; Expedition to Jamaica, Dr. V. J. Chapman, 964; Dr. H. McCombie appointed temporary director of the laboratory of General and Organic Chemistry, 990

Camouflage (Advisory Committee), 745

Canada: Royal Society of, Annual Meeting, award of the Flavelle medal to the late Prof. J. P. McMurrich; presentation of the Lorne Pierce medal to Dr. W. Bovey and of the Tyrrell medal to Dr. E. Z. Massicotte, 255; House-Sparrow in, R. L. Weaver, 983; Scientific and Industrial Research in, 1020

Cancer: Research Fund: Imperial, New Laboratories, 16; 41; Congress, Third International, Prof. F. C. Wood, 839

Carbohydrate and Potassium Metabolism in Normal and Adrenalectomized Animals, Connexion between, Prof. F. Verzár and J. C. Somogyi, 1014

Carbon: Disulphide, Anomalous Thermal Expansion of, at Low Temperatures, Dr. J. Mazur, 328; Compounds Chemistry of the, V. von Richter. Edited by the late Prof. R. Anschutz. Vol. 2 translated by Prof. A. Butenandt and others. Revised by T. W. J. Taylor and Dr. A. F. Millidge. Third edition (*Review*), 349; Disulphide Vapour, Detection of, 386; Reaction of Fluorine with, J. H. Simons and L. P. Block, 947

Carbonic Anhydrase, Prof. D. Keilin and Dr. T. Mann, 442

Cardigan Bay, Sand and Shingle formation in, J. A. Steers, 946

Caridea of the John Murray Expedition, Dr. W. T. Calman, 715

Carnegie: United Kingdom Trust, Report for 1938, 187; Institution, Washington, Prof. G. W. Corner appointed director of the Department of Embryology of the, 1088

Carrier Telephone Systems, Extensions of, N. Shinohara, Y. Hirano and M. Yoshioka, 545

Casein and its Industrial Applications, E. Sutermeister and F. L. Browne. Second edition (*Review*), 584

Cat: and the Lioness, Vaginal Smears and the Œstrous Cycle of the, Dr. H. Liche and Prof. K. Wodzicki, 245; Female, Neural Mechanism of Sexual Behaviour in the, Dr. J. P. Maes, 598

Catalase, Dr. R. Lemberg, M. Norrie and J. W. Legge, 551

Cataract, Inheritance of, M. C. Bourne and H. Grüneberg, 38

Cattle Fodder and Human Nutrition, with special reference to Biological Nitrogen Fixation, Prof. A. I. Virtanen (*Review*), 134

Celestine, Colour of, Dr. J. Newton Friend and T. P. Allchin 633

Cell: Surface, The Biology of the, Dr. E. E. Just; Dr. J. F. Danielli (*Review*), 879; The, and Protoplasm: symposium at Stanford University, Prof. C. V. Taylor, 884

Cellulose: Industry, with special reference to the Paper and Allied Industries, J. Grant, 217; Textile Industry, H. A. Thomas, 217

Cement and Concrete, R. Friedland (in Hebrew) (*Review*), 367

Cements, Solubility of, 294

Central: Nervous System: Integration in the (*Review*), 50; The Form and Functions of the, an Introduction to the Study of Nervous Diseases, Prof. F. Tilney and Prof. H. A. Riley. Third edition (*Review*), 50; Register: The, Section for Scientific Research, 625; Midwives Board, Annual Report of the, 975

Centromere, Crossing-over near the, K. Mather, 161

Cerambycidæ, Biology of the, C. F. C. Beeson and B. M. Bhatia, 120

Cercospora Leaf Spot Disease of Bananas, Dr. C. W. Wardlaw, 11

Ceylon, Forest Trees in, Check-Lists of, 664

Champignons, bons, Ce qu'il faut savoir pour manger les, G. Portevin (*Review*), 893

Charcoal Iron Industry, H. Gwyn Jones, 916

Charophyta, British Purbeck, Prof. T. Maxwell Harris (*Review*), 1077

Chasmogamic, Cleistogamic and, Flowers in Wild Violets as a Photoperiodic Response, Formation of, G. Borgstrom, 514

Chemical: Formulary, The, Editor-in-chief, H. Bennett. Vol. 4 (*Review*), 193; Thermodynamics, The Fundamentals of, Part 1: Elementary Theory and Electrochemistry, Dr. J. A. V. Butler. Third edition (*Review*), 584; Society, resignation of Prof. J. W. Cook of the honorary secretaryship; appointment of Prof. W. Wardlaw as his successor, 627; Engineering, A Practical Manual of, H. Tongue (*Review*), 727; Engineering, Some Aspects of (*Review*), 727; Calculations, Intermediate, Prof. J. R. Partington and Kathleen Stratton (*Review*), 740; Society, Advisory Research Council of the, 745; Club, Activities of the, 781; Analysis, Standard Methods of, Dr. W. W. Scott. Fifth edition, edited by Prof. N. H. Furman. 2 Vols. (*Review*), 803; Principles, A course of Study in, Prof. A. A. Noyes and Prof. M. S. Sherrill. Second edition (*Review*), 897; Warfare, Chemistry of, A. Marshall (*Review*), 996

Chemie, physikalischen, Kurzes Lehrbuch der, Prof. H. Ulich. Unter mitarbeit von Dr. K. Cruse (*Review*), 194

Chemistry: Crystal: An Introduction to, Dr. R. C. Evans (*Review*), 6; Dr. O. W. Stillwell (*Review*), 6; F. I. G. Rawlins (*Review*), 6; and Genetics, A. F. Blakeslee, 120; Annual Reports on the Progress of, for 1938. Vol. 35 (*Review*), 194; Technical, Trends of Progress in, 216; Organic: and Bio-, Prof. R. H. A. Plimmer. Sixth edition (*Review*), 268; Growing-points of, Prof. J. Read (*Review*), 349; Pharmaceutical: (*Review*), 402; Bentley and Driver's Text-Book of, Revised by Dr. J. E. Driver. Third edition (*Review*), 402; An Encyclopædia of (*Review*), 491; Applied, Thorpe's Dictionary of, Vol. 3: Chemical Calculations-Diffusion, Sir Jocelyn Thorpe and Dr. M. A. Whiteley. Fourth edition (*Review*), 491; Inorganic, A Higher School Certificate, Dr. E. J. Holmyard (*Review*), 584, Mellor's Modern Inorganic, revised and edited by Dr. G. D. Parkes in collaboration with Dr. J. W. Mellor (*Review*), 584; Inorganic: F. A. Philbrick (*Review*), 740; Factual Tests in (Post School Certificate Standard), F. A. Philbrick; Answers to Factual Tests in Inorganic Chemistry, F. A. Philbrick (*Review*), 897; Protein (*Review*), 923; Physical, New Technique in, Dr. H. W. Melville, 925; of the

Alkali and Alkaline Earth Metals (*Review*), 1064; Inorganic, Revision Notes in, to Higher School Certificate, E. P. Wilson and F. W. Ambler (*Review*), 1079
Chemotherapy, Recent Advances in, Dr. G. M. Findlay. Second edition (*Review*), 194
Cherries, Duke, Origin of the, K. Hruby, 757
Chick, Evocation in the, M. Abercrombie, 1091
Children with Delayed or Defective Speech: Motor-Kinesthetic Factors in their Training, Dr. Sara M. Stinchfield and Mrs. Edna Hill Young (*Review*), 744
China: Peasant Life in, a Field Study of Country Life in the Yangtze Valley, Dr. Hsiao-Tung Fei (*Review*), 267; Early Man in, Recent Researches on, I, 1054: North, Late Cenozoic History of, P. Teilhard de Chardin, 1054; Fossil Man in, Duration of Life in, Prof. H. Vallois, 1055; Early Man in, Recent Researches on, II, 1097
Chinese: Peasant, The (*Review*), 267; Order of the Brilliant Jade, conferment of the, on Dr. H. Chatley, 938
Chloral: Hydrate, Elimination of Administered, in the Urine as a test for Liver Function, Dr. B. Mukerji and R. Ghose, 112; Free, Blood Clearance of, in Normal and Liver-damaged Dogs, Dr. B. Mukerji and Dr. R. Ghose, 636
Chloronaphthalenes, Metabolism of, R. V. Cleary, J. Maier and G. H. Hitchings, 122
△3, 5-Cholestadiene from Cholesteryl Oleate and its possible bearing upon the Formation of Carcinogenic Substances in Heated Fats, Dr. H. Veldstra, 246
Cholinesterase and Electrolytes, Prof. B. Mendel, Dorothy Mundell and Frida Strelitz, 479
Chorthippus bicolor and *Ch. biguttatus*, Crossing of, H. Klingstedt, 161
Choukoutien, Upper Cave Industry of, W. C. Pei, 1097
Christianity and Morals, late Prof. E. Westermarck (*Review*), 173
Chromosome: Structure, Prof. R. R. Gates, 81; Gene and, Theory, Dr. H. J. Muller, 814
Chromosomes: Heterochromatic Regions of, D. Kostoff, 38; affected by X-Rays, Effect of Temperature on, K. Sax and E. V. Enzmann, 790; Abnormal, Genetical Analysis of, B. McClintock, 837
Chrysanthemum Midge, Control of the, 280
Ciliary and Muscular Movement, Calcium in, Dr. G. S. Carter, O. Gatty, Dr. J. H. Schulman and Dr. H. Walston, 980
Cinema, Sociological aspects of the, O. Bell, 520
Cirripedes, Parasitic, of the John Murray Expedition, K. A. Pyefinch, 601
City and Guilds of London Institute, conferment of fellowship on L. B. Atkinson, C. R. Fairey, E. Fawssett, Dr. L. F. Goodwin, Sir Follett Holt, Sir Gilbert T. Morgan, F. Handley Page and Sir Leonard Pearce, 242
Civil Engineers, Institution of, award of a Charles Hawksley prize to D. H. May and a grant of £50 to A. J. Francis, 29; formation of a Railway Engineering Section, 70
Civilization, The Future of, 489; The Prospects of, Sir Alfred Zimmern (*Review*), 1031
Civilizations: Ancient, The Collapse of, S. Casson, 404;
Cleistogamic and Chasmogamic Flowers in Wild Violets as a Photoperiodic Response, Formation of, G. Borgstrom, 514
Climate and Man, Dr. C. E. P. Brooks (*Review*), 1066
Clover, Red, Chlorophyll Deficiencies in, R. D. Williams, 253
Club-root, Control of, Margaret J. Smieton, 1053
Coal: Utilization of: Sir Evan Williams, 106; by Electricity, M. Anderson, 505; Bursting, A. Harvey, 872
Coals, Commercial, Analyses of, 790
Coenzymes I and II, Synthesis of, Drs. S. P. and R. W. Vilter and Prof. T. D. Spies, 943
Coffee Endosperm, Genetical Proof of the Existence of, C. A. Krug and A. Carvalho, 515
Cohnheim, Prof. Julius, centenary of the birth of, 105
Colchicine, Polyploidy induced by, and its Economic Possibilities, Dr. G. H. Bates, 315
College of Physicians of Philadelphia, award of the Alvarenga prize to Prof. H. Goldblatt, 375
Colonial: Office appointments, 110; 324; 665; 862; 1009; Policy, New Tendencies in, 240
Colonies and Raw Materials, H. D. Henderson (*Review*), 1031
Colour: in Theory and Practice, H. D. Murray and Dr. D. A. Spencer. Vol. 1: General Theory (*Review*), 227; The Science of, Dr. S. Clay (*Review*), 227
Comet: 1939*d*, Spectrum of, F. Hinderer, 254; Kamensky 558; Tuttle, Periodic, 558; Giacobini–Zinner, Discovery of, 748
Comets, Recent, 862
Complex Variable: The Theory and Use of the, an Introduction, S. L. Green (*Review*), 741
Composts: Seed and Potting, with special reference to Soil Sterilization, W. J. C. Lawrence and J. Newell (*Review*), 581
Compression Modulus, Differential Threshold for, Dr. G. W. Scott Blair and Miss F. M. V. Copper, 286
Computation and Trigonometry, H. J. Gay (*Review*), 585
Comte, Auguste, méthode et intuition chez, Dr. P. Ducassé (*Review*), 587
Concrete: Reinforced, Research, 716; 'Vibrated', R. F. Irving. 904
Consumer–Buyer, The, and the Market, Jessie V. Coles (*Review*), 195
Contraceptive Advice by Local Authorities, 149
Coolidge Tube Target, Extremely Bright Spots on, I. Koga and M. Tatibana; J. Forman, 511
Copper: Early, H. H. Coghlan, 484; Conductors, Origin of Defects in, J. E. Deering, 950 . Electro-deposition of, [1839], 990
Cornish Promontory Forts, 361
Correlation, Mathematical Theory of, Principles of the, A. A. Tschuprow. Translated by Dr. M. Kantorowitsch (*Review*), 799
Cosmetics, Trend of Progress in, H. S. Redgrove, 217
Cosmic: Radiation, Hard and Soft Component of, Directional Distribution of the, Dr. J. Barnóthy and Dr. M. Forró, 116; Ray: Particles, Heavy, at Jungfraujoch and Sea-level, Dr. W. Heitler, Dr. C. F. Powell and Dr. G. E. F. Fertel, 283; Ionization Bursts, Dr. H. Carmichael and Chang-Ning Chou, 325; Data, Dr. E. Hubble; Prof. H. N. Russell, 507; Rays at High Altitude, T. H. Johnson and J. G. Barry, 677; Ray Showers of Atmospheric Origin, Investigation of, using Two Cloud Chambers, Dr. A. C. B. Lovell and J. G. Wilson, 863; Machinery in an Electro-Magnetic Universe, Capt. H. A. Staples (*Review*), 900; Rays, Baade and Zwicky's theory of, and the Helium Content of Beryls, Dr. J. Read, 1046
Cotton: Mycorrhiza, Y. Sabet, 37; Industry, Reorganization of the, 409; Blackarm Resistance in, Genetics of, R. L. Knight and T. W. Clouston, 676; Multiple Allelomorphism in, R. A. Silow, 757; Sea-Island, Transplants of, Dr. Nazir Ahmad, 785
Country Life, Reminiscences of, J. G. Cornish. Edited by Dr. Vaughan Cornish (*Review*), 896
Cowper, Edward, at King's College, London, [1839], 720
Cowries, Geographical Distribution of the, 642
Cows, Dairy, Feeding of, J. Mackintosh, 257
Crab Nebula: The, A Probable Super-Nova, 874
Creatine as a Product of Methylation, C. J. Kelly and H. H. Beard, 162
Crepis, American Species of, E. B. Babcock and G. L. Stebbins, jun., 45
Crete: Santorin and, N. A. Critikos, 558; India and, J. G. Aravamuthan, 1095; Minoan, Volcanic Action in, S. Marinatos, 1095
Critical: and Co-operative Phenomena, 793; Phenomena in Gases, Prof. J. E. Lennard-Jones and Dr. A. F. Devonshire, 793
Cromer Forest Bed Implements, The, J. Reid Moir, 205
Crop Production, Sir John Russell, 217
Crotoxin, Prof. K. H. Slotta and H. Fraenkel-Conrat, 290

Crystallo-Chemical Analysis: The Barker Index at Oxford, Dr. M. W. Porter and R. C. Spiller, 298
Crystal Formation During Embedding of Plant Material in Paraffin Wax, Avoidance of, Dr. P. Brough, 250
Crystals, The Nature of, A. G. Ward (*Review*), 587
Cucumis Melo, Polyploid Cells in, C. D. Ervin, 946
Cushing, late Harvey, A Bibliography of the Writings of, Prepared on the Occasion of his Seventieth Birthday, April 8, 1939, by the Harvey Cushing Society (*Review*), 900
Cyanogenesis, Inheritance of, R. D. Williams, 837
Cyclo-Octatetrene, Structure of, C. D. Hurd and L. R. Drake, 448
Cyclotron: The, and Biological and Medical Research, 278; A new, 1087
Cypræidæ, Prodrome of a Monograph on Living, Drs. F. A. and M. Schilder, 642
Cyprus, Tuberculosis in, 663
Cytochrome, Oxidase in Tea Fermentation, J. Lamb and E. A. Houghton Roberts, 867
Cytogamy: A New Sexual Process in Joined Pairs of *Paramecium caudatum*, Dr. R. Wichterman, 123
Cytology, Dr. C. D. Darlington, 816

Daffodil, White Mould Disease of the, P. H. Gregory, 253
Daguerre's Discovery Described, [1839], 341
Dahlia Varieties, Origin of, A. J. Cobb, 209
Dalai Lama, Reincarnation of a, 779
Dalmatian Dogs, Preference of, for Particular Positions in Coach Running, and Inheritance of this Character, Prof. H. C. Trimble and C. E. Keeler, 671
Danubian Basin, The, C. A. Macartney, 1031
Daruma Volcano, Japan, H. Kuno, 485
Datura, Fifteen Years' Research on, A. F. Blakeslee and A. G. Avery, 253
Deafness, Causes of, Drs. W. Hughson, A. Ciocco and C. Palmer, 160
Decimal Classification, Universal, 147
Delinquency and Psychology, C. Mullins, 626
Demes: A Suggested New Terminology, J. S. L. Gilmour and Dr. J. W. Gregor, 333
Democracy: Educating for, Planned and Edited by J. I. Cohen and R. M. W. Travers (*Review*), 132; and Leadership, 221
Demotic Papyri in the British Museum, Catalogue of, Vol. 1: A Theban Archive of the Reign of Ptolemy I, Soter, Prof. S. R. K. Glanville (*Review*), 582
Dendochronology in the Eastern United States, Prof. C. J. Lyon, 1086
Deserts, Dr. G. Pickwell (*Review*), 460
Determinantal Loci, The Geometry of, Prof. T. G. Room (*Review*), 960
Deuteron: The Electric Quadrupole Moment of the, and the Field Theory of Nuclear Forces, Dr. C. Møller and Dr. L. Rosenfeld, 476; Bombardment of Silver, Dr. R. S. Krishnan and D. H. T. Grant; Dr. N. Feather, 547
Development Commission, Twenty-eighth Report, 49
Dew Ponds: A Study of (*Review*), 135; in Fable and Fact, A. J. Pugsley (*Review*), 135
Diabetogenic Anterior Pituitary Extracts, Histological Effects of, Prof. A. W. Ham and Dr. R. E. Haist, 835
Diacetone Dulcitols, Structures of, R. M. Hann, W. D. Maclay and C. S. Hudson, 757
Dice, Loaded, Prof. F. P. Worley, 712
Dielectric Polarisation in Liquids, On the Theory of, K. Zakrzewski and Dr. A. Piekara, 250
Diethylstilbœstrol in the Organism, Inactivation of, Prof. B. Zondek and Dr. F. Sulman, 596
Differentialgleichungen, Gewohnliche, Prof. G. Hoheisel (*Review*), 370
Differentiation, Growth and, Problems of, 561
Diffusion: Velocity and Molecular Weight, L. Friedman and P. G. Carpenter, 386; Processes, Study of, by Electrolysis with Microelectrodes, H. A. Laitinen and Prof. I. M. Kolthoff, 549
Dinosaurs, The Last of the, 335
Diode, The, As a Frequency-changer for Measurements at Ultra-high Frequencies, G. F. Gainsborough, 548
Dioscorea in the East, An Account of the Genus, Part 2: The Species which Twine to the Right; with Addenda to Part 1, and a Summary, Sir David Prain and I. H. Burkill (*Review*), 895
p-Diphenylbenzene, Structure of, and its Raman Spectrum, Prof. S. K. Mukerji and L. Singh, 382
Dipole Moment and Alkyl Chain Length, Dr. H. O. Jenkins, 667
Dipterous Larvæ and Wound Treatment, Dr. A. D. Imms, 516
Discovery, Saga of the, Comdr. L. C. Bernacchi (*Review*), 198
Discovery and Invention in War-time, 954
Disease: Classic Descriptions of, with Biographical Sketches of the Authors. Prof. R. H. Major. Second edition (*Review*), 195; Experimental Method in the Conquest of, Sir Edward Mellanby (Stephen Paget memorial lecture), 504; -Resistance, Inheritance of, L. T. Webster, 870
Dissociation Energy and Inter-Nuclear Distance, Inter-relation of, for Some Simple Di-Atoms in Ground States, Dr. C. H. Douglas Clark, 285
Documentation, International Co-ordination of, 559
Dogons: Jeux, M. Griaule (*Review*), 738; Masques, M. Griaule (*Review*), 738
Dolphin's Backbone, Adaptation in a, E. Lonnberg, 675
Double Star Orbits, Catalogue of, B. Ekenberg, 211
Dragonflies, A Reclassification of the, late Dr. R. J. Tillyard, 160
Drainage of Lands by Steam Power, [1839], 259
Drosophila: *melanogaster*: Chromosome Rearrangements in, B. P. Kaufmann and Ruth C. Bate, 121; Hairy Wing (*Hw*) in, M. Demerec and M. E. Hoover, 121; Chromosome Rearrangements in, B. P. Kaufmann, 385; Sterility in, S. Prabhu, 557; Development, Dr. C. H. Waddington, 561; Genetics of, Bibliography of the, Dr. H. J. Muller, 781; *pseudoobscura*, Wild, Genetic Differences in, T. Dobzhansky, 870; Development of Wings in, Dr. C. H. Waddington, 912
Drugs and Galenicals: Their Quantitative Analysis, Dr. D. C. Garratt (*Review*), 402
Dual Policy, The, Sir Arthur Salter (*Review*), 1031
Dublin, Demography of, 1043
Ducks, Game, Food of, A. C. Martin and F. M. Uhler, 1007
Du Fay, Charles François de Cisternay, Bicentenary of the Death of, 105
Dundee and District, Scientific Survey of, 438
Dunstan's Law, A. H. Nissan, 383
Durham University, conferment of honorary degrees on Sir Charles Peers and C. A. Linge, 875
Dust: Particles: Visibility of, Effect of Tube-length on the, with an Oil-immersion Objective, D. G. Beadle and H. S. Patterson, 327; F. E. J. Ockenden, 516; and Disease, Dr. A. Assémat, 662
Dutch Colonial Institute, work of the, 190
Dyeing with Coal-Tar Dyestuffs: The Principles Involved and the Methods Employed, C. M. Whittaker and C. C. Wilcock. Third edition (*Review*), 740
Dye-Wood, [1839], 720
Dynamics, Fluid, Modern Developments in. Edited by Dr. S. Goldstein. 2 Vols. (*Review*), 529
Dyson, Sir Frank, Mrs. Margaret Wilson, 869

Earth: The Central Core of the, Gutenberg and Richter, 210; Rotation of the, Rate of, Dr. H. Spencer Jones, 254; Architecture of the, Prof. R. A. Daly (*Review*), 403; The Rape of the, A World Survey of Soil Erosion, G. V. Jacks and R. O. Whyte (*Review*), 647; Tremor: near Ottawa, 748; in New England, 904
Earthquake: on the Gold Coast, 18; Insurance, E. Tillotson, 297; near the New Hebrides, 544; near Smyrna; other Recent Earthquakes, 589; in Bulgaria, 748; in Turkey, 938; Belgian, of June 11, 1938, O. Somville, 950; in the New Hebrides, 975; near Seattle, 1009; in New England, 1043

Earthquakes: in California, 66; Registered During February 1939, E. Peterschmitt, 81; During April 1939, 109; Registered at De Bilt During 1936, Dr. G. Van Dijk, 241; Long-wave Phase of, Stoneley, 254; During May 1939, 323; During June 1939, 567; and Crustal Structure near Japan, S. Yamaguti, 602; Recent, 780; Disastrous, January–June 1938, J. P. Rothé, 871; in Central America and Canada, 904; Registered at Kew During October 1939, 904; Registered at Kew, 1043

Earth's: Upper Atmosphere, Nitric Oxide in the, Prof. J. Kaplan, 152; Atmosphere, Evolution of the, Dr. H. Spencer Jones, 161; Green Mantle: Plant Science for the General Reader, Prof. S. Mangham (*Review*), 364; Crust: The, Its Fabric and Foundations, Prof. P. G. H. Boswell (*Review*), 403; in the East Indian Archipelago, Contributions to the Knowledge of the Chemical Composition of the, Dr. W. van Tongeren. Parts 1 and 2 (*Review*), 652; the Rare (*Review*), 959

East: Indian Rocks, Spectrographic Analysis of, Dr. J. Newton Friend (*Review*), 652; Indies, Oceanography of the (*Review*), 651

Ecological Glossary, An, Dr. J. R. Carpenter (*Review*), 1030

Economic: Co-ordination, Adviser on. Appointment of Lord Stamp as, 665; Self-Sufficiency, Prof. A. G. B. Fisher (*Review*), 1031

Economics, International, Planned, 683

Edinburgh University: J. Brough appointed lecturer in the zoology of vertebrates and J. E. G. Raymont lecturer in the zoology of invertebrates, 47; conferment of honorary doctorates on H. B. Butler, F. C. Nicholson, Prof. G. N. Watson and Prof. J. C. Webster, 87; conferment upon Dr. F. H. A. Marshall of an honorary doctorate, 219; W. C. Wilson appointed regius professor of surgery, 628

Education: in Democracy, The Function of (*Review*), 132; Modern, Teachers on, 186; A Californian School of, 281; in Germany, Dr. A. Lindegren, 321; Homemaking, Programs for Adults, 412: for Industry, Dr. A. P. M. Fleming, 433; Museums and, Earl De La Warr; J. Wilkie, 626; The Informative Content of, 759; and Industry, W. O. Lester Smith and others, 760; for Industry, Dr. A. P. M. Fleming, 852

Eelworm (*Heterodera marioni*), Oligodynamic Control of, J. W. H. Hovy, 672

Egg Storage, 545

Egypt, Recent Archæological Excavations in, 296

Egyptian Picture of the Sky, Dr. O. Neugebauer, 1042

Eiderdown Industry and Protection of Eider Ducks, 409

Elastic Waves, Dispersive, 'Packet Velocity' of, K. Sezawa and K. Kanai, 448

Electric: Discharge, Chemical Reaction in the, Dr. R. W. Lunt (*Review*), 93; Fuses, Testing of, J. A. M. van Liempt and J. A. de Vriend, 122; Tariffs, 'Time-of-Day', 126; Heating of Domestic Hot Water Supply, A. E. McKenzie, 280; Polarisation, Spontaneous, Specific Heat of a Substance Showing, Drs. J. and K. Mendelssohn, 595; Battery Vehicle, The, 627; Lighting in a Modern Store, 704; Discharge in Engineering Science, The, L. S. Harley and Dr. R. W. Lunt (*Review*), 769; Propulsion at Sea, A. C. Hardy, 780

Electrical: Units, Adjustment of, Dr. P. Vigoureux, 32; Interference in Flying, T. H. Kinman, 211; Progress in Poland, 341; Equipment of Buildings, 681; Grid in Great Britain, Johnstone Wright, 778; Resistance, Absolute Measurement of, Dr. H. R. Nettleton, 782; Supply Engineer in War-time, Function of the, J. W. Beauchamp, 914; Equipment of Ships, Regulation for the. Third edition, 936

Electricity: Industrial, Direct-Current Practice, Prof. W. H. Timbie. Second edition (*Review*), 368; Olfactory, 437; Dr. T. F. Wall (*Review*), 588; in Mining, D. J. Thomas, 937

Electro-Acoustics, Prof. E. Meyer (*Review*), 741

Electrochemistry of Gases and other Dielectrics, Prof. G. Glockler and Prof. S. C. Lind (*Review*), 93

Electrolytes: Cholinesterase and, Prof. B. Mendel, Dorothy Mundell and Frida Strelitz, 479; Strong, Activity Coefficients of, P. van Rysselberghe and S. Eisenberg, 1053

Electromagnetic Microbarographs, Observations with, Dr. H. Benioff and Dr. B. Gutenberg, 478

Electromagnetics: A Discussion of Fundamentals, Prof. A. O'Rahilly (*Review*), 91; Fundamental Concepts of, Dr. C. V. Drysdale (*Review*), 91

Electro-Magnetism as a Motive Power, [1839], 643

Electromechanical Transducer, An, J. J. Delvin, 39

Electron: -Microscope, The, and the Investigation of Viruses, von Borries and E. Ruska, and others, 40; Point Charge, A New Model of the, and of other Elementary Particles, Prof. E. C. G. Stueckelberg, 118; Optics: L. Jacob (*Review*), 401; O. Klemperer (*Review*), 401; Theoretical and Practical, J. M. Myers (*Review*), 401; Tubes, Theory and Applications of, Prof. H. J. Reich (*Review*), 401

Electronics, Fundamental, and Vacuum Tubes, Prof. A. L. Albert (*Review*), 401

Elektrischen Nachrichtentechnik, Vierpoltheorie der, Einführung in die, Prof. R. Feldtkeller (*Review*), 311

Elm, White Rot of the, W. H. Wilkins, 518

Embryology: Experimental, Dr. G. R. de Beer (*Review*), 493; Genetics and, Prof. C. Stern, 561

Empire Broadcasts on Scientific Topics, 239

Empires: Buried, The Earliest Civilizations of the Middle East, P. Carleton (*Review*), 893

Emulsions, Action of Copper Salts on, Stabilised by Sodium Oleate, A. R. Martin and R. N. Hermann, 479

Encirclement, J. L. Brierly (*Review*), 1031

Engineer, The, and the Steelmaker, D. Taylor, 793

Engineering Biography (*Review*), 690

Engineers: Training: in Management for, Importance of a, T. G. Rose, 218; of: 218; Dr. B. H. Knight, 673; the Writer of the Article, 674; Great, Prof. C. Matschoss. Translated by Dr. H. S. Hatfield (*Review*), 690; in War-time, Sir Clement Hindley, 825

England: South-East, Structure, Surface and Drainage in, S. W. Wooldridge and D. L. Linton, 121; and Wales, Quarterly Report of Births in, 976

Entomological Society of Southern Africa, *Journal* of the, Vol. 1, 108

Entomology, Medical, Dr. W. A. Riley and Dr. O. A. Johannsen. Second edition, 191

Environmental Conditions and Physical Characters, Prof. F. Wood Jones (*Review*), 177

Enzymes, Respiratory, University of Wisconsin Biochemists, under the direction of C. A. Elvehjem and P. W. Wilson (*Review*), 997

Equations, Theory of. Introduction to the, Prof. L. Weisner (*Review*), 370

Error, Law of, and the Combination of Observations, H. R. Hulme and L. S. T. Symms, 558

Ethics? Does Science Afford a Basis for, Prof. E. G. Conklin, 935

Ethyl: Alcohol, Pure, for Absorption Spectrophotometry, Dr. A. Clow and G. Pearson, 208; -Thioglucosides, The, and a New Monoacetoneglucose, Brigl, Gronemeier and Schultz, 680

Ethics in Modern Art, Marjorie Bowen (Conway Memorial Lecture) (*Review*), 1082

Eugenic Policy, Positive, Dr. C. G. Darwin (Galton lecture), 67

Europe, New, Science and the, 919

European Order and World Order, 934; 948

Europium, Salts of, H. N. McCoy, 791

Eutheria: The Ancestors of the, Dr. A. A. Abbie, 523; Prof. W. E. Le Gros Clark, 600

Evacuation: Sociological Aspects of, 529; War-time, Social Problems of, 1025

Everest: The Last Thousand Feet on, Possible Bacterial Factor, Dr. J. A. Campbell, 113; Mount, Scientific Research in the Region of, Dr. R. Greene, 158

Evolution: Perspectives in, Prof. J. Ritchie, 428; 534; and Systematics, Genetics in Relation to, Dr. W. B. Turrill, 822

Excavations: at Brundon, Suffolk, J. Reid Moir; A. T. Hopwood, 556; at Mas d'Azil, France, Marthe and Saint-Just Péquart, 556
Eye Colour, Bacterial Synthesis of an, E. L. Tatum, 1017
Ezion-Geber, Excavations at, Dr. N. Glueck, 278

Factories and the Black-out, H. W. Cremer and others, 1023; Chief Inspector of, Report of the, for 1938, 486
Factory without Windows, 322
Fan Memorial Institute of Biology, Bulletin of the, July–Aug. 1938, 69
Farm: Electrification, A. G. H. Dent, 663; Forestry, W. A. Ross and W. R. Mattoon, 828
Farmer's Position, The, and the Scientific Workers' Programme, Sir Thomas Middleton, 434
Fauna of the Seaside, The (*Review*), 997
Fern: Common Male, in Britain, Cytology of the, Dr. I. Manton, 291; Vegetative Propagation of a, E. E. Kemp, 294
Ferromagnetism: The Development of a General-Equation to Magnetism, Dr. J. R. Ashworth (*Review*), 399
Fibre-Follicle Terminology in the Mammalia, Dr. A. B. Wildman and H. B. Carter, 783
Field Archæology in War-Time, 589
Film: Reactions as a New Approach to Biology, Prof. E. K. Rideal, 427; Areas, Measuring, Comparison of the Adsorption, Electrolytic, and Interference Methods of, Prof. F. H. Constable, 630
Films: Scientific, List of, 190; Built-up, Thickness of, Dr. G. I. Jenkins and A. Norris, 441; Reactions as a New Approach to Biology, Prof. E. K. Rideal, 693
Finland, Invasion of, 971
Fireclay, Peaty, Occurrence of Wax-like Substances in, V. L. Bosazza, 835
Fire-Fly 'Spinthariscope', Prof. R. W. Wood, 381
Firemen, Vocational Training for, 361
First Aid Posts and Workers, 661
Fish Movements and Fishpasses, Dr. P. Nemenyi (*Review*), 567
Fisheries Research in Australia, Sir David Rivett, 312
Fishery: Statistics, Sir D'Arcy W. Thompson, 445; Research in Scotland, 487
Fishes: Scales of, [1839], 169; Some Early Ganoid, Sir A. Smith Woodward (*Review*), 615; Deep-Sea, of Bermuda, Dr. W. Beebe and Jocelyn Crane, 638; Palæozoic, J. A. Moy-Thomas (*Review*), 1078
Flavin-Adenine-Dinucleotide in Tissues of Rats on Diet Deficient in Flavin, Dr. S. Ochoa and R. J. Rossiter, 787
Flavoprotein from Liver, Isolation of a Catalytically Active, V. Subrahmanyan, Dr. D. E. Green and A. H. Gordon, 1016
Fleas, Embryology of, E. L. Kessel, 160
Flocculi, Small Chromospheric, Motion Pictures of, R. R. McMath, 336
Flora: of Britain, Concise, for the Use of Schools, with Explanatory Illustrations and Keys to Identification, F. K. Makins (*Review*), 365; of Devon: Phanerogams, Vascular Cryptograms, Charophyta, Edited by Rev. W. K. Martin and G. T. Fraser, with the Assistance of Rev. T. Stephenson and F. M. Day (*Review*), 583
Floral Morphology: A New Outlook with Special Reference to the Interpretation of the Gynæceum, Miss E. R. Saunders. Vol. 2 (*Review*), 350
Flour Beetle *Tribolium confusum* Duv., A Peculiar Phenomenon Observed in Larval Populations of the, Prof. J. Stanley, 753
Flower, Morphology of the, Dr. W. B. Turrill (*Review*), 350
Fluid Dynamics, Modern Developments in, Edited by Dr. S. Goldstein. 2 Vols. (*Review*), 529
Fluidity and Temperature, E. C. Bingham and S. D. Stookey, 448
Fluorides, Complex, Structure of, J. L. Hoard and W. B. Vincent, 984
Fluorine: from Potable Waters, Removal of, Dr. P. K. van der Merwe, 668; with Carbon, Reaction of, J. H. Simons and L. P. Block, 947
Fluorite in Somerset, A New British Locality for, A. W. G. Kingsbury, 1013
Fluorosis in India and in England, Distribution of, Dr. D. C. Wilson, 155
Flying, The Future of, Dr. H. E. Wimperis, 480; 538
Fog in the Netherlands, Dr. C. Braak, 947
Folsom Man: Further Investigation in Colorado, Dr. F. H. H. Roberts, jun., 902
Food: The Englishman's, A History of Five Centuries of English Diet, Prof. J. C. Drummond and Anne Wilbraham (*Review*), 264; Production in War-Time; Constitution of an Advisory Panel, 580; Commercial Irradiation of, 746
Foods: and Food Products, The Chemical Analysis of, Dr. M. B. Jacobs (*Review*), 194; The Structure and Composition of, Dr. A. L. Winton and Dr. Kate Barber Winton. Vol. 4 (*Review*), 366
Foot-and-Mouth Disease Research Committee, Dr. I. Galloway appointed scientific superintendent of research at the Pirbright Research Station of the, 705
Forbes, J. D.: Travels of, in 1839, 259; Baden Powell and Melloni [1839], 1058
Foreign Politics: Generalized, A Study in Group Psychology, Dr. L. F. Richardson (*Review*), 692
Forensic Science Laboratory, New, 259
Forest Administration, The Colonies and, Prof. E. P. Stebbing, 949
Forestry: in India (*Review*), 494; American, An Introduction to, Prof. S. W. Allen (*Review*), 614; An Outline of, T. Thomson and M. R. K. Jerram (*Review*), 614; Introductory (*Review*), 614; Commission, Nineteenth Annual Report of the, 761; *Abstracts*, 780
Forests, The Nation's, W. A. Du Puy (*Review*), 614
Form and Causality in Early Development, Prof. A. M. Dalcq (*Review*), 493
Forsythia, A Bacterial Disease of, Dr. G. Metcalfe, 1050
Forty Acres and Steel Mules, H. C. Nixon (*Review*), 586
Fossil: Fishes of the Yorkshire Coalfields, [1839], 876; Bones, Markings on, Pei Wen-Chung, 1017
Fossils from the London Clay [1839], 1024
Foundations and Earth Pressures, C. Hyde Wollaston (*Review*), 898
Founders Company Fellowship, award of the, to E. J. Ludlow, 242
Four-Terminal Networks (*Review*), 311
Fox Indians: Ethnography of the, late Dr. W. Jones, Edited by Margaret Welpley Fisher, 914; Tribal Origins and Culture Among the, 914; Sacred Feasts of the, 951
French: Association for the Advancement of Science: Liège Meeting; Prof. Pieron elected president of the 1940 meeting, 449; Academy, award of the Grand Prix Prince Albert I de Monaco to J. Lefèvre, 474
Freshwater Biology, Research in, 590
Fruit: Breeding in the U.S.A., M. A. Blake, 209; Flies of China, Y. Zia, 209; Juices, Value of, 590; Growing, Science and, 663; and Hops: Diseases of, Dr. H. Wormald (*Review*), 687; Pathological Problems of, D. E. Green (*Review*), 687
Fuel: Powdered, Progress and Prospects, 774; Industry in Great Britain, Col. W. A. Bristow, 825; House, Economizing on, E. S. Draper, 1041
Fuels, Home-produced, Sir Harold Hartley appointed honorary adviser on the development of, to the Secretary for Mines, 1088
Fuller, Anna, Fund of New Haven, Conn., award of the prize of the, to Prof. E. Kennaway, Prof. J. W. Cook, Dr. C. L. Hewett, Dr. I. Hieger and Dr. W. Mayneord, 150
Fulmar (*Fulmarus glacialis*), Distribution of the Colour Phases of the, J. Fisher, 941
Functions, The Theory of, Prof. E. C. Titchmarsh. Second edition (*Review*), 898

Fungal Hyphæ, Vacuolar Strain in, S. R. Bose, 80
Fungi: and Scale Insects, Symbiosis between, Prof. A. H. R. Buller (*Review*), 531; Entomogenous, T. Petch, 557
Fungicides, H. Martin, 217
Fur-trade in Northern Manchuria, W. N. Schernakow, 936

Galactose-1-Phosphoric Acid in Galactose Metabolism. Dr. H. W. Kosterlitz, 635
Gallium, Oxides and Hydroxide of, A. W. Laubengayer and H. R. Engle, 162
Gamma-Rays, Emission of, Resonance Capture of Slow Neutrons and, I. Nonaka, 831
Gannet, New Breeding Place of, Rev. J. M. McWilliam and Lord David Stuart, 675
Garden Plants, The Genetics of, M. B. Crane and W. J. C. Lawrence. Second edition (*Review*), 94
Garner Principle of Co-operative Activation, The, Prof. F. G. Donnan, 446
Gas: Industry in Great Britain, The, Prof. J. W. Cobb, 10; Reactions, Experimental Methods in, Dr. A. Farkas and Dr. H. W. Melville (*Review*), 268; Research Board, Sir David Milne-Watson elected president of the, 375; Producers for Motor-Cars, 855; Mask, An Early, 1040
Gaseous Electrical Conductors, Prof. E. L. E. Wheatcroft (*Review*), 769
Gases: Rare, Manufacture of, H. C. A. Holleman, 241; The Manipulation of (*Review*), 268; Critical Phenomena in, Prof. J. E. Lennard-Jones and Dr. A. F. Devonshire, 793; Non-Uniform, The Mathematical Theory of, An Account of the Kinetic Theory of Viscosity, Thermal Conduction, and Diffusion in Gases, Prof. S. Chapman and Dr. T. G. Cowling (*Review*), 993
Geiger Counter, Time Lags in a, A Determination of the Half-value Periods of Radium C' and Thorium C', with a Note on, J. V. Dunworth, 152
Gems and Gem Materials, Prof. E. H. Kraus and Prof. C. B. Slawson. Third edition (*Review*), 372
Gene and Chromosome Theory, Dr. H. J. Muller, 814
General Analysis, R. W. Barnard, 295
Genetic Systems: Come About, How, Dr. H. J. Muller (*Review*), 648; The Evolution of, Dr. C. D. Darlington (*Review*), 648
Genetica, Elementi di, G. Montalenti (*Review*), 364
Genetical: Aspects of Growth, Normal and Abnormal, Dr. A. Haddow, 823; Symbolism, Standardizing, 935
Genetics: "Modern", Introduction to, Prof. J. B. S. Haldane, Dr. J. S. Huxley, and Dr. H. J. Muller, 78; Dr. F. W. Sansome, 79; in the Garden (*Review*), 94; of Man, Prof. J. B. S. Haldane and U. Philp, 557; of the Rex Mouse, Prof. F. A. E. Crew and C. Auerbach, 557; and Embryology, Prof. C. Stern, 561; The Seventh International Congress of, 813; Physiological, Dr. C. H. Waddington, 817; Animal Breeding in the Light of, Dr. J. E. Nicholls, 818; Plant Breeding in the Light of, Dr. K. Mather, 820; Human, Prof. R. R. Gates, 821; in Relation to Evolution and Systematics, Dr. W. B. Turrill, 822; A Synopsis of, Dr. P. C. Koller (*Review*), 1067; An Introduction to, Prof. A. H. Sturtevant and Prof. G. W. Beadle (*Review*), 1067
Geodesy and Geophysics, International Union of, Prof. S. Chapman, 717
Geographical Region, The Natural, A. Stevens, 653
Geography, Method in, A. Stevens, 429
Geological: Time-Scale, Kinematical Relativity and the Dr. G. J. Whitrow, 706; Society [1839], 796; Society of London, Awards of the, to H. Woods, Prof. A. Holmes and Prof. H. L. Hawkins, 1044
Geology and Allied Sciences: A Thesaurus and a Co-ordination of English and German Specific and General Terms, W. Huebner. Part 1: German-English (*Review*), 368;
Geometry: Drawing-Board, 101 Problems in, Prof. F. G. Higbee (*Review*), 369; for Schools, A New, C. V. Durell (*Review*), 585
Geophysics, Geodesy and, International Union of, Prof. S. Chapman, 717
Geothermic: Power in Italy, 218; Generating Plant, A, 747
German: Culture in Prague, 778; -English Science Dictionary: For Students in the Agricultural, Biological and Physical Sciences, Prof. L. de Vries and others (*Review*), 900
Germanization and the University of Prague, 892
Germany: Education in, Dr. A. Lindegren, 321; Politics and Academic Qualifications in, 860; Marriages and Births in; 1010 Tuberculosis Mortality in, 1088
Germany's Oil Supplies, Dr. A. J. V. Underwood, 901
Giacobinid Meteors in 1939 and 1940? Dr. Fletcher Watson, 482
Gilbert, Davies, F.R.S., 1769–1839 [1839], 1058
Glaciers, Structure of, M. F. Perutz and G. Seligman, 757
Glossina morsitans, Physiology and Behaviour of, R. W. Jack, 714
Gloucester Museum, The, 411
Glutamic Acid: of Tumour Proteins, The, Prof. A. C. Chibnall, M. W. Rees, G. R. Tristram, E. F. Williams, and Dr. E. Boyland, 71; Prof. F. Kogl and Dr. H. Erxleben, 111; as a Hydrogen Carrier in Animal Tissues. Dr. H. A. Krebs and Dr. P. P. Cohen, 513;
Glutamine, Influence of, on the Growth of *Streptococcus hæmolyticus*, M. Landy, 512
Glycine: Crystal Structure of, G. Albrecht and R. B. Corey, 40; Condensation of the Hexapeptide Ester of, into the 96- and Higher (3×2^n) Peptide Esters, Prof. E. Pacsu, 551
Glycogen in the Liver, Formation and Breakdown of, P. Ostern and Dr. E. Holmes, 34
Gmelins Handbuch der anorganischen Chemie. Achte Auflage. System-Nummer 63: Ruthenium (*Review*), 897; Achte auflage. System-Nummer 39, Lief 1 (*Review*), 959; System-Nummer 22: Kalium, Lief 4: Verbindungen bis Kaliumacetat. System-Nummer 22: Kalium, Lief 5: Verbindung bis Kalium und Wismut; System-Nummer 24: Rubidium; System-Nummer 25: Caesium, Lief 1: Vorkommen, Darstellung und Eigenschaften des Metalls; System-Nummer 25: Caesium, mit einem Anhang uber Ekacaesium, Lief 2: Verbindungen des Caesiums, Ekacaesium; System-Nummer 27: Magnesium, Teil B, Lief 1: Verbindungen bis Magnesium und Jod; System-Nummer 27: Magnesium, Teil B, Lief 2: Verbindungen bis Magnesiumcarbonat; System-Nummer 27: Magnesium, Teil B, Lief 3: Verbindungen bis Magnesium and Wismut (*Review*), 1065
Goethe: medal for Art and Science, award of the, to Prof. T. Vahlen, 242; prize for Art and Science, award of the, to Prof. E. Fischer, 324; medal for Art and Science, award of the, to Prof. A. Schmidt and Dr. K. Frik, 508
Golden Gate Bridge, San Francisco, C. E. Paine, 146
Goose Lake Siderite, Prof. F. C. Leonard, 913
Gould, Schomburgk and, Travels of, [1839], 606
Government Laboratory, Work of the, for the Year Ending March 31, 1939, 663
Graham Land (*Review*), 54
Grain Weevil, Effects of γ-Radiation on the, An Experiment on the, L. G. Grimmett and G. V. B. Herford, 939
Granodiorite, Melting of, by Andesite, E. S. Larsen and G. Switzer, 676
'Granosan', Effect of the Fungicide, on A Typical Growth and Chromosome Doubling in Plants, Prof. D. Kostoff, 334
Graphite, Electrical Conductivity of, Large Anisotropy of the, Prof. K. S. Krishnan and N. Ganguli, 667
Grasping Movement in Man, Origin of the, Prof. D. Hooker, 1052
Grass: Leviathan from East Africa, A, Dr. I. B. Pole Evans, 34; Drying, E. J. Roberts, 545
Grassland and Forage Crops in the United States, 915
Gravitational Constant, Instability of the Mesotron and the, Prof. P. M. S. Blackett, 30

Great Britain, Laying the Keel of the, [1839], 127
Great Britain: The Littoral Fauna of, A Handbook for Collectors, Dr. N. B. Eales (*Review*), 997
Greek: Measures, Ancient, and Athletic Records, E. Kalfarentzos, 360; Bronze Coins, Ancient, Composition of, E. R. Caley, 1096
Greenkeeping Research, Board of, Report for 1938, 627
Greenockite in the Mendips, Occurrence of, A. W. G. Kingsbury and Dr. J. Newton Friend, 1013
Gregory, James: Tercentenary Memorial Volume, Edited by Prof. H. W. Turnbull (*Review*), 1062; (1638–1675), Prof. H. C. Plummer (*Review*), 1062
Grenoble, University of, sixth centenary of the, Prof. P. Vaillant, 42
Grid System, The, 190
Ground Vibrations Near Dynamite Blasts, L. Don Leet, 791
Growth: and Differentiation, Problems of, 561; Normal and Abnormal, Genetical Aspects of, Dr. A. Haddow, 823; Stimulating Effects of Extracts of Normal Adult Tissues and Tumours, Dr. R. S. Hoffman, Dr. E. Tenenbaum and Dr. L. Doljanski, 1092

Hæmocyanin Molecule, Dissociation of the, S. Brohult and S. Claesson, 111
Hair-Dyes and Hair-Dyeing Chemistry and Technique, H. Stanley Redgrove and the late G. A. Foan. New edition completely revised by H. Stanley Redgrove and J. Bari-Woollss (*Review*), 740
Harvard University, Physics Research at, 294
Hawaiian Bivalves, W. H. Dall, P. Bartsch, and H. A. Rehder, 484
Health: Perfect, The Leader to, Dr. E. F. Armstrong (*Review*), 264; Services, Control of, 300; The Building of a Nation's, Sir George Newman (*Review*), 345; and Safety in Industry, 486; Ministry of, Twentieth Annual Report of the, 678; Public, in Great Britain, 678
Hearing: its Psychology and Physiology, Dr. S. S. Stevens and Dr. H. Davis (*Review*), 570; Theories of, Prof. H. Hartridge (*Review*), 570
Heat: and Thermodynamics, Prof. M. W. Zemansky (*Review*), 196; Textbook of, Dr. R. W. Stewart and Dr. J. Satterly. Revised by C. T. Archer. Second edition (*Review*), 374; in Liquids, Propagation of, [1839], 488; Entropy Diagram for Steam, The 1939, Plotted from the 1939 Callendar Steam Tables, based on Research by Prof. A. C. Egerton and G. S. Callendar (*Review*), 1069
Hebrew University, Jerusalem, Progress of the, 187
Helium: Gas, Adsorption of, on Active Charcoal between 4·2° and 1·78° K., Prof. A. van Itterbeek, W. van Dingenen and J. Borghs, 249; II: Heat Flow in, Forces Associated with, Dr. J. F. Allen and Dr. J. Reekie, 475; Liquid, Effect of an Excitation Energy on the Specific Heat of, and its Relation to the Exchange Effect in a Non-Ideal Bose-Einstein Gas, Dr. A. Michels, Dr. A. Bijl and Dr. J. de Boer, 594; Ratios of Igneous Rocks, Evans, Goodman, Keevil, Lane and Urry, 677; -Neon Content of Sea Water, N. W. Rakestraw, C. E. Herrick and W. D. Urry, 838
(*Helix pomatia*), The Snail, Chitin Content of the Mandible of, Dr. G. Tóth and L. Zechmeister, 1049
Herd, Instincts of the, Dr. W. T. Calman (*Review*), 5
'Hermanation', H. Weltzel, 789
Hibernation, Artificial, Dr. P. Suomalainen, 443
High Resistance Resistors, 148
Himalayan Village: An Account of the Lepchas of Sikkim, G. Gorer (*Review*), 96
Histamine in Biological Extracts, Determination of, M. R. e Silva, 252
Histologischen Methodik, Physikochemische Grundlagen der, Prof. K. Zeiger (*Review*), 1079
Hitler's, Herr, Self-Disclosure in "Mein Kampf", R. C. K. Ensor (*Review*), 1031
Holland, Average Duration of Life in, 110
Holz als Rohstoff: Das, Seine Entstehung, stoffliche Beschaffenheit und chemische Verwertung, Dr. R. Trendelenburg (*Review*), 924
Homogeneous Fluids, The Flow of, through Porous Media, Dr. M. Muskat. With an Introductory Chapter by R. D. Wyckoff (*Review*), 197
Homo sapiens: The Fate of, An Unemotional Statement of the Things that are Happening to Him Now, and of the Immediate Possibilities Confronting Him, H. G. Wells (*Review*), 397
Honey Bee, Choice of Water by the, C. G. Butler, 984
Hops: Fruit and, Diseases of, Dr. H. Wormald (*Review*), 687; Fruit and, Pathological Problems of (*Review*), 687
Hormone Standards, New International, 934
Hormones, Intercellular, Production of, by Mechanical Injury, Prof. J. R. Loofbourow, E. S. Cook, Sister Cecelia Marie Dwyer and Sister Mary Jane Hart, 553
Hormonforschung, Methodik der, Dr. C. Bomskov. Band 2 (*Review*), 192
Hospital Schools in the United States, 975
Host and Parasite in Higher Plants, Union between, Schumacher and Halbsguth, 258
House-Sparrow in Canada, R. L. Weaver, 983
Housing, Social and Technical Aspects of, 1040; Urban and Rural, M. B. Holger, 1041
Human: -Birth Weights, H. P. Donald, 38; Relations, A Study of, Dr. K. Mather (*Review*), 310; Uterine Gland Cell, Cytology of the, Prof. J. B. Gatenby and Miss Olive E. Aykroyd, 331; Anatomy, Introducing, Prof. F. Wood Jones (*Review*), 351; Ability, The Factorial Analysis of, Prof. G. H. Thomson (*Review*), 532; Genetics, Prof. R. R. Gates, 821; Personality and its Survival after Bodily Death, late F. W. H. Myers. 2 Vols. (*Review*), 1027; Origins and Taboo, J. C. McKerrow, 1048
Humoral Immunity among Plants, A. F. Parker-Rhodes, 907
Humus: Origin, Chemical Composition and Importance in Nature, Prof. S. A. Waksman. Second edition, (*Review*), 893
Hyæna, Spotted, Reproduction of the, L. H. Matthews, 983
Hybrid, An Inter-Generic, B. O. Mulligan, 160
Hybridization, Increased Mutation Due to, A. H. Sturtevant, 912
Hydraulics: for Engineers and Engineering Students, Prof. F. C. Lea. Sixth edition (*Review*), 584
Hydrogen: and Oxygen Sensitized by Nitrogen Peroxide, Reaction between, Prof. R. G. W. Norrish and F. S. Dainton, 30; Atomic Weight of, J. A. Swartout and M. Dole, 485; Peroxide: Decomposition of, by Catalase, F. H. Johnson and Dr. K. L. van Schouwenburg, 634; Mechanism of Decomposition of, by Catalase, Prof. D. Keilin and Dr. E. F. Hartree, 787; Decomposition of, by Catalase, Dr. J. Weiss and Dr. H. Weil-Malherbe, 866; Showers in the Auroral Region, Prof. L. Vegard, 1089; Peroxide, Decomposition of, by Catalase, Prof. D. Keilin and Dr. E. F. Hartree, 1091
Hypertension: The Substance Causing Renal Hypertension, J. M. Muñoz, E. Braun-Menéndez, J. C. Fasciolo and L. F. Leloir, 980

Ice Age in India and Associated Human Cultures, Studies on the, Dr. H. de Terra and T. T. Paterson (*Review*), 738
Iceland Papers, Vol. 1: Scientific Results of Cambridge Expeditions to Iceland, 1932–38 (*Review*), 373
Identity, Evidence of, K. Richmond (*Review*), 372
Igneous Action, Metamorphism and, Prof. H. H. Read, 729; Prof. H. H. Read, 772
'*Illænus*' *proles* var. *shelvensis* Whittard, Cranidial Muscle Scars of, Dr. A. Lamont, 206
Illegitimate Child, Legal Position of the, 322
Illumination, Progress of, 604
Imperial Cancer Research Fund: New Laboratories, 16; 41

Incentives and Contentment; a Study made in a British Factory, Patricia Hall and H. W. Locke (*Review*), 1082

Indene, Toxicity of, G. R. Cameron and Cecile R. Doniger, 1095

India: Greater, Forthcoming International Exhibition of the Art of, 20; Imperial Veterinary Research Institute of the Government of, Prof. F. C. Minett appointed director of the, 105; Higher Education in, Objectives of, 148; Pasteur Institute of, Kasauli, Annual Report for 1936, Dr. R. O. A. Smith, 148; Southern, Pasteur Institute of, Annual Report for 1937, Lt.-Col. K. R. K. Iyengar, 148; Public Health Statistics of, 281; Aboriginal Races of, B. S. Guha, 293; Hygiene and Public Health in, 362; Health of the Army in, During 1937, 506; Government of, Industrial Research Bureau, Report for the Year 1938–39, 625; Anthropological Studies in, 721; and Burma, Common Water and Marsh Plants of, 1936, Hand-Book of the, K. Biswas and C. C. Calder (*Review*), 727; New Anthropological Periodical in, 745; Archæological Survey of, A Report on the Work of the, Sir Leonard Woolley, 758; British, Health in, During 1937, 974; National Institute of Sciences of, election of fellows, 976; and Crete, J. G. Aravamuthan, 1095

Indian: *Bee Journal*, No. 1, 109; Association for the Cultivation of Science, Annual Report for 1938, 412; Silviculture, Part 1: General Silviculture, H. G. Champion; Part 2· Silvicultural Systems, Sir Gerald Trevor (*Review*), 494; Medical Institutes, Work of, 506; *Journal of Entomology*, Parts 1 and 2, 780; Archæology and Indian Problems, Sir Leonard Woolley (Birdwood Memorial Lecture), 1006; Medical Review, An, Major-Genl. Bradfield, 1087

Industrial: Health Research Board, Dr. D. Hunter and H. E. Clay appointed members of the, 242; 375; Councils, Joint, 319; Health Research Board, Nineteenth Annual Report, 1008

Industry: and Society, Science, 1; Health and Safety in, 486; and Labour, The World of, 1939, J. E. Winant, 686; Education: and, W. O. Lester Smith and others, 760; for, Dr. A. P. M. Fleming, 852

Infant Brain, Respiratory Metabolism of, H. E. Himwich, Z. Baker and J. E. Fazekas, 38

Influenza, Periodicity of, D. Webster, 756

Information, Ministry of, 700; 745

Ingénieurs Civils de France, Société des, presentation of the gold medal of the, to W. T. Halcrow, 70

Innes, John, Horticultural Institution, Twenty-ninth Annual Report of the, 68

Inorganic: Esters, Mechanism of Hydrolysis of, J. B. M. Herbert and E. Blumenthal, 248; Compounds, Complex, Stereochemistry of, J. C. Bailar and J. P. McReynolds, 1096

In Principio erat Verbum (*Review*), 1030

Insect: Size and Temperature, Dr. W. H. Golightly and Dr. Ll. Lloyd, 155; Legion, The, Dr. M. Burr (*Review*), 789; Physiology, The Principles of, Dr. V. B. Wigglesworth (*Review*), 800

Insecticides: J. T. Martin and F. Tattersfield, 217; Toxicity of Certain, G. R. Cameron and Cecile R. Doniger, 790

Insects: Collected in Traps at Rothamsted Experimental Station, Dr. C. B. Williams, 85; in Aircraft, Dr. F. G. S. Whitfield, 158; Col. F. P. Mackie, 250; in the Upper Air, Dr. A. D. Imms, 406; Physiology of, Dr. A. D. Imms (*Review*), 800

Institute of Medical and Veterinary Science, Adelaide, first annual report of the, 1088

Instruments in Science and Industry, R. S. Whipple, 461

Insulin Crystals, Wet, X-Ray Measurements on, Dr. Dorothy Crowfoot and D. Riley, 1011

Intensive Cultivation, History of, R. J. G. Hopp, 1086

Intercellular Wound Hormones, Local Growths in Animals Produced by Injection of, Prof. J. R. Loofbourow, A. A. Cueto, D. Whalen and Sister Mary Michaella Lane, 939

Interfacial Tension Curves, 'Breaks' in, C. C. Addison, 249

Internal Strains in Solids, Conference on, 165

International: Geological Congress, 1940, Arrangements for the, 149; Congress of Americanists in Mexico City, 319; Seismological Summary, July, August and September 1938, 474; Genetical Congress, Seventh, Prof. F. A. E. Crew, 496; Co-ordination of Documentation, 559; Society of Leather Trades' Chemists, election of Prof. P. Chambard as president, 603; Congress of Genetics, The Seventh, 813; Economics, Planned, 683; Union of Geodesy and Geophysics, Prof. S. Chapman, 717; Cancer Congress, Third, Prof. F. C. Wood, 839; Seismological Summary, Oct., Nov. and Dec. 1938, 903; Society of Medical Hydrology, Dr. J. Barnes Burt elected interim chairman of council, 1087

Invention, Discovery and, in War-time, 954

Inventions and Patents in Great Britain, 641

Iodine, Spark Spectrum of, Hyperfine Structure in the, Dr. S. Tolansky, 754

Ionization, Region F_2, throughout the Year, Characteristic Variation of, Prof. E. V. Appleton, 151

Ions: Electrons and Ionizing Radiations, Prof. J. A. Crowther, Seventh edition (*Review*), 374; Mercuric Halide Complex, A. B. Garrett, 1018

Iranian Petroleum, A Solid Naphthenic Acid from, Dr. T. Kennedy, 832

Iraq, Electrical Development in, W. H. Peters, 605

Iris Bulbs, Hot Water Treatment of, W. Buddin, 716

Iron Smelting: in Britain, Transition from Charcoal to Coke in, 916; in India, [1839], 952

Islamic Decorative Technique, Early, B. Gray, 912

Isomers, Short-Chain Interfacial Activity of, Dr. C. C. Addison, 783

*o-Iso*propenyl-phenols, Structure of the Dimeric Forms of, Wilson Baker and D. M. Besly, 865

Isotope Separation, New Prospects in, Prof. H. S. Taylor, 8

Italy: Geothermic Power in, 218; Order of Commendatore of the Crown of, conferment of the, on Prof. J. R. D'Aunoy, 665

Jamaica: Biological Expedition to, 17; Cambridge University Expedition to, Dr. V. J. Chapman, 964

Japan: National Research Council of, Report, Volume 2, No. 7, 149; The Population of, 508; National Research Council of, Report of the, 1008

Japanese Earthquake Research Institute, Prof. K. Terazawa appointed director of the, 628

Jardine's, Sir William, "British Salmonidæ", [1839], 682

Jena, Society of Medicine and Natural History of, presentation of the bronze memorial medal to Prof. R. Spanner, 29; Prof. O. Grossern awarded the silver medal of the, 199

Jenner and Napoleon, Dr. J. A. Nixon, 278

Jewish Hospital, Cincinnati, May Institute for Medical Research of the, Dr. A. Froehlich appointed pharmacologist to the, 976

Johannesburg Municipal Bus and Tram Sheds, 704

Johns Hopkins University School of Medicine, grants to the, by the Rockefeller Foundation, 749

Jungle Yellow Fever and other Diseases, 790

Jupiter: Planet, Rapidly Moving Spots on the, 748; The Great Red Spot on, B. M. Peek, 987

Jupiter's Cloud Forms, Chemistry of the Coloration in, R. Wildt, 602

Juvenile Delinquency, Dr. Rhodes; C. P. Hill; J. H. Bagot, 703

Kala-Azar, The Antimony Treatment of, Sir Leonard Rogers, 1003

Kansas, Lower Permian Insects of, F. M. Carpenter, 641

Kantian Philosophy of Space, The, Prof. C. R. Garnett, jun. (*Review*), 587

Kelley Statistical Tables, The, Prof. T. L. Kelley (*Review*), 741

Kent Zoological and Botanical Gardens, [1839], 259

Kenya, Report on a Visit to, Dr. I. B. Pole-Evans, 255

Kenya's Pastoral Needs, 255

Kepler: Johannes, Gesammelte Werke, Band 1: Mysterium Cosmographicum. De Stella Nova, Herausgegeben von Max Caspar (*Review*), 223; Regiomontanus and, Prof. H. C. Plummer (*Review*), 223; Johannes, Gesammelte Werke. Band 2: Astronomiæ Pars Optica, Herausgegeben von F. Hammer (*Review*), 306
Kepler's: Approach to Optics, Prof. H. C. Plummer (*Review*), 306; Law of Refraction, Dr. R. A. Houstoun, 441
Keto-Acids in Green Plants, Estimation and Occurrence of, Prof. A. I. Virtanen, Dr. A. A Arhimo and Dr. H. Suomalainen, 597
Kidney Function, Role of the Renal Innervation in, Dr. N. S. Rustum Maluf, Dr. R. W. Clarke and Dr. K. W. Thompson, 292
Kiliwa Indians of Lower California, P. Meigs, 675
Kinetic Theory, Growth of the, Prof. R. H. Fowler (*Review*), 993
Klima, Wetter, Mensch, E. Brezina, W. Hellpach, R. Hesse, E. Martini, B. de Rudder, A. Schittenhelm, A. Seybold and Prof. L. Weickmann. Herausgegeben von H. Woltereck (*Review*), 1066
Knowledge, Useful, Society for the Diffusion of, [1839], 219
Kristallstrukturlehre, Angewandte, Dr. E. Brandenberger (*Review*), 587

Labour, Ministry of, Report for 1938, 107
Lamellibranchia, Reduction of the Ctenidia in the, R. D. Purchon, 206
Lancashire and Cheshire Fauna Committee, twenty-fifth annual report of the, 1042
Land: Drainage, Steam Applied to [1839], 301; -Speed Record, New, J. Cobb, 438; Utilization in Australia, Prof. S. M. Wadham and Prof. G. L. Wood (*Review*), 647
Lantana, Entomological Control of, 18
Latitude at Greenwich, Variation of, Tidal Effect on the, Dr. H. Spencer Jones, 162
Lavoisier, Priestley and, The Newer Views on, Sir Philip Hartog, 232
Lawn Craft, Practical, R. B. Dawson (*Review*), 581
Lawns, Research on, 627
Leadership: The Basis of, 343; The Price of, J. Middleton Murry (*Review*), 343; in Democracy, Lord Lloyd (Walker Trust lecture), 359
Leaf Cuttings, W. Ll. McCaskie, 161
League: The, from Year to Year (1938), 239; of Nations: Annual Report on Child Welfare, 281; Health Organization of the, 412; and the Rule of Law, 1918–1935, The, Sir Alfred Zimmern, Second edition (*Review*), 742
Least Squares, Some Notes on, Dr. W. E. Deming (*Review*), 585
Leather Chemists, Conference of, 603
Leeds University: election of Dr. M. G. Evans as professor of physical chemistry, and Dr. J. B. Speakman, professor of textile industries, 15; 47; Dr. R. G. S. Hudson as professor of geology, 16; 47; F. Whalley appointed lecturer in anæsthetics, H. Agar tutor in obstetrics and gynæcology, A. S. Johnstone lecturer in radiology, and R. V. Riley research assistant in fuel, 47; Report of the Department of Pathology and Bacteriology, for 1937 and 1938, Profs. M. Stewart and J. W. McLeod, 109; Dr. E. C. Stoner elected professor of theoretical physics, Dr. N. H. Chamberlain appointed lecturer in textile chemistry, A. Johnson assistant lecturer in weaving mechanism, Dr. C. S. Whewell assistant lecturer in finishing and research assistant in the textile department, J. W. Roderick and W. A. Linning lecturers in engineering, J. F. Gaunt research assistant in dyeing and Dr. J. Stubbs temporary research assistant (for bracken investigation), 219; Prof. F. A. Crew invited to deliver the Clive Behrens lectures in 1939–1941, 219; Diploma in Fuel and Refractory Materials, 242; Donation by the West Yorkshire Coal Owners' Association to the Mining Department, 762
van Leeuwenhoek: Alle de brieven (The Collected Letters of Antoni van Leeuwenhoek), Deel (part) 1, (*Review*), 956; The Complete Correspondence of, Prof. F. J. Cole (*Review*), 956
Legume Nodule Metabolism and Nitrogen Fixation, F. E. Allison, C. A. Ludwig, S. R. Hoover and F. W. Minor, 711
Leguminosæ, Nodule Organisms of the, J. K. Wilson, 335
Leguminous Symbiosis, Utilization of Carbohydrates in, Dr. G. Bond, 906
Leonardo da Vinci Exhibition at Milan, The, 337
Lepchas of Sikkim, The (*Review*), 96
Leptospiroses, Dr. Walch-Sorgdrager, 412
Lettuce, Ring Spot Disease of, Greta B. Stevenson, 120
Ley Farming, The Case for (*Review*), 263
Library Education, Professional, Nora E. Beust, 240
Light: from Extra-Galactic Nebulæ, Interpretation of the Red-Shifts of the, M. E. J. Gheury de Bray, 285; Chemical Powers of, [1839], 526; Coloured, Velocity of, J. S. Hall, 871; Velocity of, Measurements of the, Earl Kitchener, M. E. J. Gheury de Bray, 945; from Plants [1839], 1024
Light Elements, Beta-decay of, Connexion between the Life-time of the Meson and the, Dr. C. Møller, Prof. L. Rosenfeld and Dr. S. Rozental, 629;
Lighting, Ultra-Violet, R. H. Finch, 437
Lightning: Flashes and High Tension Mains, 239; Flash, A "Hot", 323
Lignite, A Chromatographic Study of, Prof. L. Zechmeister and O. Frehden, 331
Lily Year-Book, Royal Horticultural Society's, No. 8, 1042
Limb Primordia, Reciprocal Hetero-Transplantation of, between Duck, Turkey, Guinea and Chick Embryos, Dr. H. L. Eastlick, 380
Lime Sulphur Injury, N. F. Childers, 210
Ling Cod Liver Oil, Vitamin A in, Dr. L. B. Pett, Marian Lipkind and G. A. Le Page, 634
Lingard Festival, The, 591
Liquids, Viscosity of, Effect of an Electric Field on the, S. Sosinski, Prof. E. N. da C. Andrade and C. Dodd, 117
Lister Institute of Preventive Medicine, Forty-fifth Report, 20
Liverpool University, Population Problems of New Estates, with Special Reference to Norris Green, 166
Livers of a Hundred Healthy Dogs, Vitamin A Content of the, R. G. Linton and A. Brownlee, 978
Liverwort *Riccia Himalayensis*, A Fungus upon the, K. S. Srinivasan, 210
Living Body, The, Prof. F. R. Winton (*Review*), 228
"Living-Space" and Population Problems, R. R. Kuczynski (*Review*), 1031
Local: Scientific Societies and the Community, Prof. H. L. Hawkins, 435; Government, The Mechanism of, 1059
Locust Problem in 1937, Dr B. P. Uvarov and Miss W. Milnthorpe, 86
Logarithms, Tables of Addition and Subtraction, with Six Decimals, Dr. B. Cohn, Second edition (*Review*), 369
Logic: Pragmatical, K. Britton (*Review*), 880; the Theory of Inquiry (*Review*), 880
L.C.C. as an Electricity Consumer, F. Jackson, 146
London: Hospital, Research in the, 282; County Council, resignation of Sir Frederick Menzies as Medical Officer of Health and School Medical Officer; appointment of Dr. W. A. Daley, 705; Tubes, Flooding in the, Precautions against, 746; The Government and Misgovernment of, Dr. W. A. Robson (*Review*), 846; The Planning of (*Review*), 846; Statistics, 1936–38, 861; University: Prof. F. Horton elected vice-chancellor for 1939–40; H. Stobie appointed professor of dental surgery and pathology at the Royal Dental Hospital of London School of Dental Surgery and Dr. H. Heywood reader in mechanical engineering at the Imperial College of Science and Technology, 47; conferment on Dr. H. J. Emeléus of the title of reader in inorganic

chemistry; Prof. R. G. Collingwood appointed Creighton lecturer for 1939–40, 87; Report of Principal, 108; W. G. Barnard appointed professor of pathology at St. Thomas's Hospital Medical School; conferment upon Dr. E. F. Scowen of the title of reader in medicine; R. M. Calder reappointed Graham scholar in pathology, 219; conferment on Dr. F. Barrow of the title of reader in chemistry, 762; conferment of honorary doctorates on Prof. N. Bohr, Sir Robert Robinson, R. G. Hawtrey and S. Marks, 875
Longitude, Difference of, between Greenwich and New York, [1839], 796
"Lost Atlantis", The, C. P. Chatwin, 86
Lower Permian Insects of Kansas, F. M. Carpenter, 641
Lucilia cuprina, Aseptic Cultivation of Larvæ of, Development of a Synthetic Medium for, F. G. Lennox, 676
Lycopersicum Crosses, Heterosis in, in Relation to Seed Weight, Dr. L. C. Luckwill, 908
Lynch's Explorations in Mesopotamia, [1839], 917

McDonald Oberservatory, The, Fort Davis, Texas, Prof. O. Struve, 136
Macromolecules, Prof. H. Staudinger, 300
Mactra corallina cinerea (Montagu), Severe Mortality of, Off the Lancashire Coast, G. E. Williams, 1049
Madeira: The Climate of, with a Comparative Study, Vice-Admiral H. C. de Lacerda Castelo Branco. Translated by Dr. A. F. Jardim (*Review*), 742
Maeterlinck: Maurice, Bibliographie de, Littérature, Science, Philosophie, M. Lecat (*Review*), 1081
Magic in Mexico, Dr. R. Gessain, 1038; 1039
Magnesium in the Pyruvate Oxidation System of Brain, Necessity of, Dr. S. Ochoa, 834
Magnetic: Observatories, Equipment of, [1839], 47; Observations in Sweden, Dr. K. Molin, 519; Testing, R. L. Sanford and E. G. Bennett, 838; Disturbances, Sunspots and, H. G. Archenhold, 985
Magnetism: Modern, Prof. L. F. Bates (*Review*), 399; Old Problems and New Methods (*Review*), 399
Magnetite (Fe_3O_4), Electronic Conduction of, and its Transition Point at Low Temperatures, Dr. E. J. W. Verwey, 327
Magnetograph, A Sensitive Induction, H. Nagaoka and T. Ikebe, 827
Maize, Stamen Lodicules in, Dr. B. C. Sharman, 1093
Malaya: and India: Early Cultural Relations, 65; Soil Destruction in, Sir Lewis L. Fermor, 901
Maleic Anhydride, *p*-Benzoquinone, a Colour Reaction of, and their Partially Substituted Derivatives, Prof. A. Schönberg and Abdel Fattah Aly Ismail, 910
Malta, Mortality in, [1839], 952
Mammals, Hereditary Size in, and Glutathione Content of the Tissues, Dr. P. W. Gregory, 561
Mammoth, Contemporaries of the, Prof. P. Kapterev, 702
Mammoth's Tusk, Discovery of a, [1839], 260
Man: the Slave and Master, Dr. M. Graubard (*Review*), 310; against: Microbe, Prof. J. W. Bigger (*Review*), 371; Himself, Dr. K. A. Menninger (*Review*), 744
Management: Rational Industrial, The Principles of, J. J. Gillespie (*Review*), 53; Theory and Practice (*Review*), 53
Manchoukuo, Invertebrates from, 838
Manganese, Role of, in the Biological Synthesis of Ascorbic Acid, M. N. Rudra, 868
Mangifera indica, Effect of Ethylene on, Dr. B. K. Kar and H. N. Banerjee, 597
Mankind; The Future of (*Review*), 397; The Cultural History of (*Review*), 569; Origin of, Prof. F. Weidenreich, 1054
Man-Power and the Needs of Youth, 843
Marat, Dr. Jean Paul, Scientific and Medical Aspects of the work of, Dr. H. Candiani, 1007
Maria Gonds of Bastar, The, W. V. Grigson (*Review*), 1076
Marihuana: America's New Drug Problem: a Sociologic Question with its Basic Explanation dependent on Biologic and Medical Principles, Prof. R. P. Walton (*Review*), 611; Problem, The, Prof. A. R. Todd (*Review*), 611
Marine Deposits of the Arabian Sea, Dr. H. G. Stubbings, 841
Marquesas Islands, Fauna of the, A. M. Adamson, 1007
Mars: Close Approach of, 238; at the Recent Opposition, Surface Features of, M. Geddes and I. L. Thomsen, 944
Mascarene Islands, Lepidoptera of the, J. Vinson, 38
Maskelyne's Observations at Greenwich, [1839], 169
Materials, Tests of, R. L'Hermite, 189
Mathematical: Tables, Forthcoming New Publication of, 508; *Reviews*, 544; Tables, New, Dr. L. J. Comrie, 871
Mathematics, Advanced, for Engineers, Prof. H. W. Reddick and Prof. F. H. Miller (*Review*), 369
Matière et le Rayonnement, Le Principe de Correspondance et les Interactions entre la, Prof. L. de Broglie, 544
Matrices, Elementary, and some Applications to Dynamics and Differential Equations, Dr. R. A. Frazer, Dr. W. J. Duncan and A. R. Collar (*Review*), 650
Matter, Structure of, X-Ray Analysis and the, Sir William Bragg, 961
Maya: Mounds of British Honduras, late Dr. T. W. Gann, 252; Ancient, Cranial Deformation among the, A. J. E. Cave, 447
Measles in the Fertile Hen's Egg, Propagation of the Agent of, Dr. G. Rake and M. F. Shaffer, 672
Mechanical Force due to an Electron Stream, Dr. P. Selényi, 838
Mechanics: and Chemistry, Practical, Proposed Society for, [1839], 488; Applied: (*Review*), 728; Fifth International Congress for, Proceedings of the, edited by J. P. Den Hartog and H. Peters (*Review*), 728; The Teaching of, J. H. Awbery, 792
Medical: Scientific and, Research, Fellowships for, 168; Research Council, Prof. A. J. Clark and Prof. T. R. Elliott appointed members of the, 282; Schools in America, A Discourse upon the Institution of, Dr. John Morgan. With an introduction by A. Flexner (*Review*), 308; and Veterinary Science, Institute of, Adelaide: Opening of New Laboratories, Sir Charles Martin, 392; *Journal of Australia*, Silver Jubilee No., 508; Books, Rare, 704; Research Council, Prof. E. D. Adrian appointed a member of the, 905
Medicina aborigen americana, Dr. R. Pardal (*Review*), 308
Medicine: Early Medieval, with Special Reference to France and Chartres, Prof. L. C. MacKinney (*Review*), 308; History of, Dr. J. D. Rolleston (*Review*), 308; State-Craft and (*Review*), 345; Forensic, Recent Advances in, Dr. S. Smith and Dr. J. Glaister, Second edition (*Review*), 371; in Modern Society, D. Riesman (*Review*), 371; in Ancient Ireland, Dr. T. P. C. Kirkpatrick, 543
Medium High Velocities, A New Method of Determining *e/m* for, Dr. J. Aharoni, 203
Melandrium, Sex-determination in, H. E. Warmke and A. F. Blakeslee, 252
Mellon Institute: Dr. R. S. Tipson and Dr. W. Carlson appointed fellows in the department of research in pure chemistry of the, 507; Dr. G. O. Ebrey appointed Fleming fellow in the, 592
Mellor's Modern Inorganic Chemistry, revised and edited by Dr. G. D. Parkes in collaboration with Dr. G. W. Mellor (*Review*), 584
Mental: Disease and War, Prof. O. Kinberg, 409; Tests, Natural Variances of, and the Symmetry Criterion, Prof. G. H. Thomson, 516
Merseyside Naturalists' Association, appointments of the, 1042
"Merton Catalogue", The, Pamela F. Maude, 120
Mesolithic Settlement in Surrey, A, 525
Mesomerism and Orientation, Dr. G. Baddeley, 444
Meson: Classical Dynamics of the, Prof. D. Iwanenko, 77; and Cosmology, The, Dr. D. S. Kothari, 548; Connexion between the Life-time of the, and the Beta-Decay of Light Elements, Dr. C. Møller, Prof. L. Rosenfeld and Dr. S. Rozental, 629; Pairs, Evidence for Occurrence of, Dr. H. J. J. Braddick and G. S. Hensby, 1012

Mesotron: Instability of the, and the Gravitational Constant, Prof. P. M. S. Blackett, 30; Life-time of the, Prof. I. M. Freeman, 667
Mesotrons in the Upper Atmosphere, Intensity of, Dr. E. G. Dymond, 782
Metal Objects, Ancient, 675
Metallurgical Research, Modern, Development and present state of, Prof. F. Wever, 45
Metals: and their Alloys, Sir Harold Carpenter and Dr. J. M. Robertson, 2 Vols.; Prof. A. M. Portevin (*Review*), 612; Institute of, Election of Officers, 905
Metamorphism and Igneous Action, Prof. H. H. Read, 427; 729; 772
Metaplasia and Adenoma-like changes in the Uterus of Rats injected with Sex Hormones, Dr. V. Korenchevsky and K. Hall, 1048
Meteorites, Age of, Dr. F. A. Paneth, 639
Meteors, August, seen at Breslau [1839], 301
Methane under Pressure, Specific Heat of, O. N. Trapeznikowa and G. A. Miljutin, 632
Methyl: Radicals, Reactions of, H. S. Taylor and J. O. Smith, 336; Esters of Monocarboxylic Fatty Acids, Oxidation of, by Normal and Neoplastic Tissue, Dr. E. Ciaranfi, 751
Methylamine, Gaseous, Raman Spectrum of, Kirby-Smith and Bonner, 1018
Mexican: Loggerhead in Europe, The, D. Deraniyagala; H. W. Parker, 156; Mummies [1839], 169; Mosaic, R. Gallop (*Review*), 883
Mexico: An Eye-witness of, R. H. K. Marett (*Review*), 883; Present and Past (*Review*), 883; Magic in, Dr. R. Gessain, 1033
Miasmata and Contagia, On, J. Henle, Translated by Dr. G. Rosen (*Review*), 896
Mice, Hybridization and Tumour Formation in, C. C. Little, 1052
Microbes: by the Million, H. Nicol (*Review*), 998; More about, Prof. R. T. Hewlett (*Review*), 998
Microscopy: One Hundred Years of, the Royal Microscopical Society, Prof. R. T. Hewlett, 850
Migration and Environment, Prof. H. L. Shapiro, with the field assistance of F. S. Hulse (*Review*), 177
Military Service and the Professional Institutions, 749
Milk for Mothers and Children, 474
Milne-Shaw Seismograph, Attachment for a, J. H. Peters, 81
Mind, The Factors of the (*Review*), 532
Mineralogical Society, Election of Officers, 862
Mineral: Tables: for the determination of Minerals by their Physical Properties, Prof. A. S. Eakle. Third edition, revised by Prof. A. Pabst (*Review*), 742; Supplies, Strategic, G. A. Roush (*Review*), 921; Names (*Review*), 958
Minerals, New, Descriptive List of the, 1892–1938, G. L. English (*Review*), 958
Mines: Research Board, Safety in, Seventeenth Annual Report of the, 840; Department of, G. M. Harvey Appointed Electrical Inspector; J. A. B. Horsley to Undertake Special Duties relating to Electrical Supplies, etc., 862
Miocene Stratigraphy of California, R. M. Kleinpell (*Review*), 1030
Mist Particles, Evaporation of, and its bearing on Air Sterilization, S. R. Finn and E. O. Powell, 864
'Modern Man' in Eastern Asia, Prof. F. Weidenreich, 1097
Mohs, Friedrich (1773–1839), 564
Molecular Films, Built-up, Evaporation of, Dr. S. J. Gregg and Dr. E. E. Widdowson, 666
Mollusca of the John Murray Expedition, N. B. Eales; H. G. Stubbings, 484
Molluscs, Larval Trematodes in, Dr. Annie Porter, 715
Monoacetoneglucose, a new, The Ethyl-Thioglucosides and, Brigl, Gronemeier and Schultz, 680
Monolayers, Reactions with, and their Biological Analogues, Prof. E. K. Rideal and Dr. J. H. Schulman, 100
Monosilane, New-Iodine and Fluorine Derivatives of, A. G. Maddock, G. Reid and Dr. H. J. Emeléus, 328
Montserrat, the Volcano-Seismic Crisis at, 1933–1937, F. A. Perret, 677
Moral Rearmament, Science and, 303
Morphogenetic Forces, Order of Magnitude of, Dr. C. H. Waddington, 637
Motion Picture Sound Engineering (*Review*), 374
Mountain Building, A Theory of, D. Griggs, 602
Mud Bricks, Acoustic Properties of, F. H. Constable and M. K. Mahas, 33
Municipal Self-Government in Britain, G. M. Harris, 1060
Murdock, William (1754–1839), 842
Muscle: Experimental Verification for, A Mechanism for the Concentrating of Potassium by Cells, with, Prof. E. J. Conway and P. J. Boyle, 709; Electrolytes in, Localization of, Prof. E. J. Conway, Dr. F. Kane, P. J. Boyle and H. O'Reilly, 752; Anserine in, Possibility of Determination by Titration, Dr. E. C. Bate Smith, 1015
Museum: The, and the School, 89; as an Aid to the Encouragement of Arts, Manufactures and Commerce, Lord Amulree, 124
Museums: and Education, Earl De La Warr, 124; 626; and World Peace, Don Salvador de Madariaga, 124; Association: Jubilee Conference at Cheltenham, 124; of the Past and Needs of the Future, Viscount Bledisloe, 124; Natural History, Function of, Dr. W. E. Swinton, 125; of Ipswich, Report 1929–1938, 281; and Education, J. Wilkie, 626; and the War, 778
Music in Mental Diseases, Dr. A. H. Harrington, 1008
Mycenean: Athens discovery, Prof. T. L. Shear, 188; Greece, Further discoveries in, 360
Myers, F. W. H., The Life-work of My Friend, Sir Oliver Lodge (*Review*), 1027
Myosine and Adenosinetriphosphatase, Prof. W. A. Engelhardt and M. N. Ljubimowa, 668
Myristicin, Synthesis of, V. M. Trikojus and D. E. White, 1016
Myzus ornatus a Vector of Potato Viruses, J. B. Loughnane, 785

Names, Place and Personal, Changing Fashions in, L. F. Salzman, 85
Narcissus Mosaic, Studies on, F. A. Haasis, 448; Leaf Diseases, Indirect Damage by, P. H. Gregory, 984
Nasturtium, Garden, Genetics of the, Eileen Sutton, 838
National: Physical Laboratory: Annual Inspection and Visit of the Universities, 163; Trust, 1938–39, 359; Physical Laboratory Collected Researches. Vol. 24: Standards (*Review*), 458; Central Library, Twenty-third annual report of the, 507; Register, The, 609; Tuberculosis Association, Dr. G. B. Webb awarded the Trudeau medal of the, 628; Atlas of Great Britain, Proposed, 702; Service, Youth and, R. Brightman (*Review*), 723; Central Library, 974; University of Ireland, Conferment of an honorary doctorate on Prof. F. G. Donnan, 1044; Institute for Research in Dairying, Annual Report of the, 1087
Natural Resources, Conservation of, Prof. J. Stanley Gardiner (*Review*), 310
Nature: An Architect of, being the Autobiography of Luther Burbank. With biographical sketch by W. Hall (*Review*), 896
Naval Architects, Institution of, award of the Martell scholarship to N. W. Honey and the Earl of Durham prize to P. E. Bish, 546
Neanderthal Man in Italy, Discovery of, Dr. A. C. Blanc, 106
Nebular Red-Shift, Nature of the, Prof. E. Schrödinger, 593
Negro Education, Special Problems of, Prof. Wilkerson, 937
Nerve Fibre, Action Potentials Recorded from Inside a, A. L. Hodgkin and A. F. Huxley, 710
Nervous System, Physiology of the, Prof. J. F. Fulton (*Review*), 133
Neurohumour Production, Role of Dietary Choline in, Prof. D. Y. Solandt and Prof. C. H. Best, 376
Neuro-Physiology (*Review*), 133

Neutron : Dose in Biological Experiments, Measurement of, Dr. L. H. Gray and Dr. J. Read, 439 ; Emission, Delayed, accompanying Uranium Fission, Dr. K. J. Bostrøm, Dr. J. Koch and Dr. T. Lauritsen, 830

Neutrons : High-velocity, Energy of, by the photographic method, Dr. C. F. Powell and Dr. G. E. F. Fertel, 115 ; from Uranium, Possible delay of the emission of, D. F. Gibbs and Prof. G. P. Thomson, 202 ; and other Ionizing Radiations, Quantitative comparison of the Biological Effects of, Dr. L. H. Gray and Dr. J. Read, 509 ; D-D-, Scattering of, W. D. Allen and C. Hurst, 509 ; Fission of Thorium by, Dr. Y. Nishina, T. Yasaki, H. Ezoe, Prof. K. Kimura and M. Ikawa, 547 ; and Radio-elements and their Biological Applications, Dr. J. Lawrence, Dr. W. B. Lewis, Dr. J. Read and Dr. L. H. Gray, 657 ; Slow, Resonance Capture of, and Emission of Gamma-Rays, I. Nonaka, 831

Newcomen Society, Annual meeting of the, Col. C. E. Davies elected president, 861

New Lamps for Old, Dr. H. W. Melville, 604

Newton's : Correspondence, 65 ; Unpublished Letters, J. Pelseneer, 901

New : York Cancer Committee, award of the Clement Cleveland medal to Mlle. Eve Curie, 324 ; Zealand : Centenary Celebrations in, 859 ; Department of Scientific and Industrial Research, Thirteenth Annual Report, 873

Nicotiana, Trisomic, T. H. Goodspeed and P. Avery, 1095

Nicotinic Acid, Pentose-nucleotides and Anæmia, Dr. J. P. McGowan, 244

Night Sky in : July, 29 ; August, 199 ; September, 362 ; October, 591 ; November, 748 ; December, 938 ; January, 1087 ; Mechanism of Nitrogen Excitation in the, Prof. J. Cabannes and Rose Aynard, 442

Nile Basin, The, Vol. 5 : The Hydrology of the Lake Plateau and Bahr El Jebel, Dr. H. E. Hurst and late Dr. P. Phillips (*Review*), 495

Nitric Oxide in the Earth's Upper Atmosphere, Prof. J. Kaplan, 152

Nitrogen : Peroxide, Reaction between Hydrogen and Oxygen Sensitized by, Prof. R. G. W. Norrish and F. S. Dainton, 30 ; Fixation and Nutrition (*Review*), 134 ; Can Rusts Fix, Dr. B. d'Oliveira, 480 ; Fixation, Legume Nodule Metabolism and, F. E. Allison, C. A. Ludwig, S. R. Hoover and F. W. Minor, 711 ; Isotopes on Metal Surfaces, Exchange between, Taylor and Jungers, 1053

Nobel : Prizes for Physiology and Medicine, Award of, to Prof. C. Heymans and Prof. G. Domagk respectively, 777 ; Laureates, Award of the Chemistry Prize for 1938 to Prof. R. Kuhn, that for 1939 to Prof. A. Butenandt and Prof. L. Ruzicka, 858 ; the Physics Prize of 1939 to Prof. E. O. Lawrence and that for Literature to N. F. E. Sillanpää, 859

"Nomenclator Zoologicus", 279

Nomogram : The, The Theory and Practical Construction of Computation Charts, H. J. Allcock and J. R. Jones. Second edition (*Review*), 369

Non : -Adaptation, Reactions of Acclimatization and of, Prof. M. Piery and Prof. J. Enselme, 731 ; -Ferrous Metals Research Association, British, Dr. H. Moore, 83

North : American Indian Music, Miss Frances Densmore, 837 ; -East Coast Institution of Engineers and Shipbuilders, awards of the, made to Dr. T. W. F. Brown, A. Emerson, Dr. S. F. Dorey, J. Boele, W. T. Atkinson and J. Dawson, 665 ; of England Institute of Mining and Mechanical Engineers, F. P. Mills appointed honorary secretary of the, 150 ; Africa, Rock Art in, R. Vaufrey, 1052

Nose, Human, Ontogeny and Phylogeny of the, C. B. Benedict, 252

Nova Herculis, 1934, Nebular Spectrum of, The Forbidden $^{3}P_{2}$-$^{1}D_{2}$ Line of O III in the, Dr. J. Dufay and Dr. M. Bloch, 593

Novæ, Spectra of, Origin of the λ 4932 Emission in the, A. B. Wyse, 1090

Nuclear : Reactions in the Continuous Energy Region, Prof. N. Bohr, Prof. R. Peierls and Dr. G. Placzek, 200 ; Isomerism, Recent Experimental Results in, Dr. B. Pontecorvo, 212 ; Matter, Phase Transitions of, Dr. I. Gurevich, 326 ; Forces, Field Theory of, The Electric Quadrupole Moment of the Deuteron and the, Dr. C. Møller and Dr. L. Rosenfeld, 476 ; Reactions in Stellar Evolution, Prof. G. Gamow, 575 ; 620

Nucleoli, Satellites and Sex Chromosomes, Prof. R. R. Gates, 794

Nucleolus, Relation of the, to Secondary Constrictions, Miss A. M. Melland ; Prof. R. R. Gates, 980

Nudibranchiate Mollusca, Nomenclature of, Prof. W. Garstang, 481

Number Symbolism : Mediæval, Its Sources, Meaning and Influence on Thought and Expression, Prof. V. F. Hopper (*Review*), 586

Numbers, Theory of, An Introduction to the, Prof. G. M. Hardy and Prof. E. M. Wright ; Dr. H. Davenport (*Review*), 347

Nutrition : and the Public Health, 186 ; Elements in, W. Godden, 556 ; during War-time, Sir John Boyd Orr, 733

Oceanographical Results from Central America, 545

Œnothera, Position effect in, D. G. Catcheside, 837

Œstrogen Depot Formation, Dr. P. G. 'Espinasse, 1013

Œstrone, Isolation of, from the Adrenal Gland, D. Beall, 76

Oil : -Water Interfaces, Potentials at, R. B. Dean, 32 ; Fires in Power Stations, Preventing, 147 ; and its Uses, 1039 ; Lord Cadman appointed honorary adviser on, to the Secretary for Mines, 1088

Oils, Fats and Detergents, Progress in, P. W. Tainsh, 216

Old Age : Mental Hygiene in, Dr. G. Lawton, 902 ; Studies of (*Review*), 995

One Day Telleth Another, Stephen A. and Margaret L. Ionides (*Review*), 1028

Ontario Research Foundation, Report for 1938, 279

Opossum, Common Australian, Ambisexual Action of Progesterone as observed in the, A. Bolliger and A. Carrodus, 671

Optical Lever Method, Determination of Growth-Rates by the, Dr. W. A. Beck, 786

Orchids, Hybrid Wild, of Great Britain, P. M. Hall, 85

Ordnance Survey Plans, Brig. A. B. Clough, 590

Organizer Phenomena, Chemical aspects of, Dr. J. Needham, 561

Organs : in Vitro, The Culture of (*Review*), 95 ; The Culture of, A. Carrel and C. A. Lindberg (*Review*), 95

Oriental : Peach Moth in Australia, G. A. H. Helson, 913 ; and African Studies, School of, Annual Report, 1938–39, 1006

Ornithology, British Trust for, Fifth annual report of the, 108

Osmunda regalis, Spiral Structure in, I. Manton, 716

Ospedale del Perdono, Milan, Prof. G. Sollazzo nominated director of the, 905

Outlaw of the Air, Leslie Brown (*Review*), 1079

Oxaloacetic Acid in the Leguminous Plants, Prof. A. I. Virtanen and A. A. Arhimo, 36

Oxford University : School of Forestry, 67 ; Dr. L. A. Woodward appointed fellow of Jesus College and tutor in chemistry, 301 ; T. K. Penniman appointed curator of the Pitt-Rivers Museum, 701 ; R. S. G. Rutherford appointed a research officer in the Institute for Research in Agricultural Economics, 875 ; H. G. Champion appointed professor of forestry ; Miss A. Pellew awarded the Edgell Sheppee scholarship in engineering science, 990

Oxide Films on Light Metals, Electron Diffraction Examination of, Ichirô Iitaka and Shigeto Yamaguchi, 1090

Oxygen : Hydrogen and, Sensitized by Nitrogen Peroxide, Reaction between, Prof. R. G. W. Norrish and F. S. Dainton, 30 ; Apparatus, Open type, P. J. H. Unna, 114

Oysters (*Ostrea edulis*), Breeding of, in Tanks, H. A. Cole, 642

Pacific : South, Currents in the, 148 ; Science Congress, Sixth, 640 ; Entomological Survey, 826 ; Tides, Between, E. F. Ricketts and J. Calvin (*Review*), 1078
Pain, The Problem of, Prof. P. T. Herring, 770
Paiute Bands, Northern, O. C. Stewart, 601
Palaeobotanical Retrospect, A, 395
Palaemonetes varians (Leach), Osmotic Behaviour of, N. Kesava Panikkar, 866
Paleobotany, Textbook of, W. C. Darrah (*Review*), 226
Palestine, Population Statistics, 1010
Palladium-Deuterium Equilibrium, L. J. Gillespie and W. R. Downs, 757
Panama Canal as a Fish Highway, S. F. Hildebrand, 756
Papain essential to its Activity, Nature of a Group in, Prof. A. K. Balls and H. Lineweaver, 513
Paracelsus, Forthcoming celebration of the quatercentenary of the death of, 29
Paramecium, An Increase in the Rate of Growth of, subjected to the Blastogenic Hydrocarbon 3 : 4-Benzpyrene, J. C. Mottram, 154
Paris : Academy of Sciences : election of Prof. W. L. Bragg as a *correspondant*, 150 ; Prof. S. Timoshenko elected a *correspondant*, 199 ; Pasteur Institute, award of the gold Pasteur medal to Dr. H. Plotz and Prof. A. Saenz, 474
Parliamentary and Scientific Committee of the House of Commons, L. F. Plugge elected chairman of the, 1009
Parthenogenesis, Artificial, and Chromosome Constitution, T. Kawamura, 209 ; Experimental, Recent Work on, Prof. A. D. Peacock, 1036
Patent Medicines, Marking of, 186
Patents : in War Time, 580 ; Designs and Trade Marks, Fifty-sixth Report of the Comptroller-General, 1938, 641
Pathological Processes, Adaptation in, Dr. W. H. Welch. With an Introduction by Dr. S. Flexner (*Review*), 308
Pawnee Archaeology, W. R. Wedel, 983
Peace : Seeking and Securing the, 607 ; Aims, 701
Pea Leaves, An Inhibitor of Growth extracted from, Dr. R. Snow, 906
Peintures, conservation et de la restauration des, Manuel de la (*Review*), 586
Peking, National University of, Monlin Chiang, 242
Pelargoniums, Sir Arthur W. Hill, 639
Penaeids of the John Murray Expedition, Dr. Ramadan, 518
Pepsin Preparations, Crude, Existence of several Active Components in, V. Desreux and R. M. Herriott, 287
Periodic Action, An easily arranged, E. E. and Dr. I. W. Wark, 833
Personality in Formation and Action, Dr. W. Healy (Thomas W. Salmon memorial lectures), (*Review*), 588
Peru : Institute of Cotton Technology of the National Agricultural Society of, Dr. S. C. Harland appointed director of the, 705 ; Archaeology in, Recent Progress, H. J. Braunholtz, 841
Petrol, Substitutes for, 622
Pétrole ; Les Gisements de, Géologie, Statistique, Economie, Prof. G. Macovei (*Review*), 1080
Petroleum Production Engineering : Oil Field Exploitation, Prof. L. C. Uren. Second edition (*Review*), 1080
Petroleum, No. 1, 905
Pharmaceutical Society of Great Britain, award of the Hanbury medal to T. E. Wallis, 144
Pharmacognosy, A Textbook of, T. C. Denston. Third edition (*Review*), 192
Pharmacopoeia, The Extra, Martindale. Twenty-first edition. In 2 vols. Vol. 2 (*Review*), 195
Philippine Pagans : the Autobiographies of Three Ifugaos, R. F. Barton (*Review*), 1077
Philosophies, Natural and Political, Sir Richard Gregory, Bt. (*Review*), 764
Phoronis hippocrepia Wright, A new record of, E. W. Knight Jones, 836
Phosphatide Exchange between Plasma and Organs, Dr. L. Hahn and Prof. G. Hevesy, 204
Phosphatides of the Plasma and the Corpuscles, Interaction between the, Dr. L. Hahn and Prof. G. Hevesy, 72
Phosphorus Halides, Fluorination of, H. S. Booth, S. G. Frary and F. B. Dutton, 1017
Photography : to Astronomy, Application of, [1839], 87 ; in Scientific Research, 356
Physical : Laboratory, Apparatus for the, 190 ; Fitness, Assessment of, Prof. D. Burns, 431 ; 466 ; Development in School Boys, Standards of, H. B. Norman, 518 ; Size and Proportions, Factors Determining, J. I. Cohen, 944
Physico-Chemical Experiments, Prof. R. Livingston (*Review*), 897
Physics : On Understanding, Prof. W. H. Watson (*Review*), 196 ; Demonstration Experiments in, edited by Prof. R. M. Sutton (*Review*), 197 ; for Technical Students : Sound, Electricity and Magnetism, Light, Prof. W. B. Anderson. Third edition (*Review*), 373 ; To-day, J. A. Clark, F. R. Gorton and F. W. Sears (*Review*), 588 ; Practical : Higher School Certificate, E. Armitage (*Review*), 743 ; W. F. F. Shearcroft and J. H. Avery (*Review*), 743 ; Elementary Survey of, a Non-mathematical Presentation with a special supplement for Pre-medical Students, Prof. A. E. Haas and Prof. I. M. Freeman (*Review*), 744 ; The Psychology of, B. Stevens (*Review*), 1081
Physik, chemischen, Lehrbuch der, Prof. A. Eucken. Zweite Auflage. Band 1 (*Review*), 193
Physiological Genetics, An Experimental Attack on some Problems of, Dr. W. Braun, 114
Physiology, Human, A Text in, Prof. C. H. Best and Prof. N. B. Taylor (*Review*), 228
Phytohormones, Études et recherches sur les (*Review*), 192
Phytoferol : a Standardized Solution of Vitamin E, 1008
Pig : Chromosomes of the, Prof. F. A. E. Crew and P. C. Koller, 385 ; Growth of the Mandible in the, Prof. H. A. Harris, 552
Pilgrim Trust Lecture, Second, Sir William Bragg, 15 ; 21
Pitch-Crust Fungus, Parasitism of the, W. H. Wilkins, 253
Pithecanthropus and Sinanthropus, The Relationship between, Dr. G. H. R. von Koenigswald and Prof. F. Weidenreich, 926 ; 933
Plague and other Tropical Diseases, The Story of, Dr. Clayton Lane (*Review*), 801
Planetary Co-ordinates for the years 1940–60 referred to the Equinox of 1950·0 (*Review*), 899
Planets : and Sunspots (*Review*), 726 ; Minor, of the Hecuba Group, Prof. A. O. Leuschner (Halley lecture), 871
Plankton Culture, Large-scale, Dr. H. Pettersson, Dr. F. Gross and F. Koczy, 332
Plant : Taxonomists, Geographers and Ecologists, Address Book of, Forthcoming publication of an, 150 ; Phylogeny, Dr. H. Hamshaw Thomas (*Review*), 226 ; Living : Botany of the, Prof. F. O. Bower. Third edition. With the assistance of Prof. J. M. F. Drummond and Dr. G. Bond (*Review*), 400 ; Dr. C. R. Metcalfe (*Review*), 400 ; Structure, Interpretation of, Prof. D. Thoday, 432 ; 571 ; Physiology : Experiments in, a Laboratory Text-Book, Dr. W. E. Loomis and Dr. C. A. Shull (*Review*), 583 ; Geography, Principles of, Dr. W. B. Turrill, 715 ; Hormones and their Practical Importance in Horticulture, Dr. H. L. Pearse, 747 ; Breeding in the light of Genetics, Dr. K. Mather, 820 ; Growth-Substances, Experiments with, for the Rooting of Cuttings, Dr. C. R. Metcalfe and W. G. Templeman, 1043
Plantes des Montagnes, Ce qu'il faut savoir des, P. Du Manoir (*Review*), 893
Plants, Fecundation and Development of, [1839], 875
Pleistocene Bird's Egg, A, A. Wetmore, 790
Plough-up Policy, The, and Ley Farming, Sir George Stapledon (*Review*), 263
Plums, Stored, Breakdown in, W. H. Smith, 1006

Poisson de rivière, La mécanique du, G. Denil (*Review*), 567
Poland: Electrical Progress in, 341; The Fourth Partition of, 579; Abroad, Institution of a University of, 1044
Polarograph, The, 904
Political and Economic Planning, 144
Polychaete Worms, Intermittent Activity in, Dr. G. P. Wells, 940
Polymolecular Films, Absorption of, in the Infra-Red, Dr. G. B. B. M. Sutherland and W. T. Tutte, 707
Polyploids are more Variable than their Original Diploids, Prof. D. Kostoff, 868
Polyploidy induced by Colchicine and its Economic Possibilities, Dr. G. H. Bates, 315
Population: Decline of, Viscount Samuel, Lord Dawson of Penn, Lord Stamp, and others, 17; Growth, Factors in (*Review*), 55; the Natural History of, Prof. R. Pearl (*Review*), 55; of the World in 1937, 150; Problems of Housing Estates, N. Williams, 166; To-day's Question, G. F. McCleary (*Review*), 193; Improvement, Social Biology and, Prof. F. A. E. Crew and others, 521; The Pressure of, 991
Positivisme, origines intuitives du, Essai sur les, Dr. P. Ducassé (*Review*), 587
Potassium: Liberation of, by Acetylcholine in the Central Nervous System, Dr. W. Dulière and O. Loewi, 244; Dihydrogen Phosphate, Isotope effect in, Dr. A. R. Ubbelohde and I. Woodward, 632; A Mechanism for the Concentrating of, by Cells, with Experimental Verification for Muscle, Prof. E. J. Conway and P. J. Boyle, 709; Carbohydrate and, Metabolism in Normal and Adrenalectomised Animals, Connexion Between, Prof. F. Verzár and J. C. Somogyi, 1014; *Molybdocyanide Dihydrate, Structure of*, J. L. Hoard and H. H. Nordsieck, 1018
Potato Viruses, ***Myzus ornatus*** a Vector of, J. B. Loughnane, 785; Viruses in Garden and Field, Potential Hosts of, Dr. R. N. Salaman and W. R. S. Wortley, 1049; Root Eelworm, Control of the, J. Carroll, 1095
Poultry Advisory Committee of the Ministry of Agriculture and Fisheries, appointment to the, of Capt. G. Clifford and Prof. T. J. Dalling, 1010
Poznan University, Staff and Students of, held as hostages, 1044
Prague, University of, Germanization and the, 892
Pregnancy, Ancient Tests for, Dr. H. P. Bayon, 826
Préhistoire générale: Manuel de, Europe, Asie, Afrique, Amérique, Prof. R. Furon (*Review*), 737
Prehistoric: Society of Switzerland, Prof. V. Gordon Childe elected an honorary member of the, 65; *Indian Village, New Mexico, Dr. P. S. Martin*, 542; Rock Pictures in Dutch New Guinea, J. Röder, 946
President, The Steamship, [1839], 643
Priestley and Lavoisier, The newer views on, Sir Philip Hartog, 232
Primitive Man, The Mind of, Dr. F. Boas. Revised edition (*Review*), 738
Procter International Research Laboratory, Prof. D. McCandlish appointed honorary director and W. R. Atkin honorary research assistant of the, 938
Progesterone, Ambisexual Action of, as observed in the common Australian Opossum, A. Bolliger and A. Carrodus, 671
Prolactin, response of the Pigeon Crop-Gland to, Sex Difference in the, Dr. S. J. Folley, 834
de Prony, Baron, 1755–1839, 219
Protein: Fractions in Solutions particularly Poor in *Proteins*, Precipitation of, Dr. P. Ladewig, 76; Molecules, Apparent Shape of, H. Neurath, 386; Analysis of, by means of Deuterium-containing Amino-Acids, Dr. H. H. Ussing, 977
Proteins: Structure of, L. Pauling and C. Niemann, 336; A New Technique for the Spreading of, and the 'Spreading Number', Dr. D. Dervichian, 629; Amino Acids and, The Chemistry of the, edited by Prof. C. L. A. Schmidt (*Review*), 923
Protobranchiate Mollusca, Prof. C. M. Yonge, 601
Protons, Scattering of, by Protons, R. G. Herb, D. W. Kerst, D. B. Parkinson and G. J. Plain; and others, 254
Protoplasm: The Cell and, Symposium at Stanfor University, Prof. C. V. Taylor, 884
Proverbes et dictons Syro-Libanais; texte arabe, transcription, traduction, commentaire et index analytique, Prof. M. Feghali (*Review*), 582
Proverbs: Racial, A Selection of the World's Proverb arranged Linguistically, Dr. S. G. Champion (*Review*) 582
Prussian Academy of Sciences, election to the Physico-Mathematical Class, of Prof. A. Butenandt, Prof. K Meyer, Prof. A. Ludin, Dr. F. Seewald and Prof. J Bartels, 70
Pseudomonas aeruginosa, A Light-sensitive Strain of Miss Jane Meiklejohn, 908
Psychiatry in the Punjab, Lt.-Col. O. J. L. Patch, 662
Psychical Research: Fifty Years of, a Critical Survey Harry Price (*Review*), 1082
Psychologique, L'Année, Tome 1 and 2 (*Review*), 373
Psychology: Measurement in, R. J. Bartlett, 432; 498 A Manual of, Dr. G. F. Stout. Revised, in collaboration with the author, by C. A. Mace; with an Appendix by Dr. R. H. Thouless (*Review*), 588; Delinquency and, C. Mullins, 626; Introduction to E. G. Boring, H. S. Langfeld, H. P. Weld and collaborators (*Review*), 744; of War and Peace (*Review*), 84
Psychotherapy, Dr. P. Schilder (*Review*), 588
Public Health in relation to the Recognition, Definition, Standardisation and Controlled Supply of Medicaments, J. R. Hill, 185
Pulkowa Observatory, Completion of, [1839], 841
Purple, Visual, and Indicator Yellow, Cataphoretic Measurements on Solutions of, Dr. E. E. Broda, Dr. C. F. Goodeve, Dr. R. J. Lythgoe and C. Victor, 709
Pyrrhole, *Photo-oxidation of, Prof. F. Bernheim and* J. E. Morgan, 290
Pyruvate Oxidation: System in Brain, I. Banga, Dr. S. Ochoa, and Prof. R. A. Peters, 74; Acetylphosphate and, Dr. S. Ochoa, Prof. R. A. Peters and Dr. L. A. Stocken, 750
Pyruvic Acid Dehydrogenation, Role of Phosphate in, Prof. F. Lipmann, 381

Quantum Mechanics: Introductory, Prof. V. Rojansky (*Review*), 748; Limits of Validity of, Prof. G. Wataghin, 754
Quintuplets, The, J. W. MacArthur and A. R. Dafoe, 870

Rabbit Control by Virus Infection, 145
Rabbits: Damage by, 360; Destruction of, 662
Race *Questions in Europe* (*Review*), 767
"Race" in Europe, Dr. J. S. Huxley (*Review*), 1031
Races of Central Europe: The, a Footnote to History, Dr. G. M. Morant (*Review*), 767; Europe, The, Prof. C. S. Coon (*Review*), 767
Radcliffe Observatory, The New, Dr. H. Knox-Shaw, 10
Radio: Direction-finding, The Recent Trend of, 139; Interference Measurements, T. H. Kinman, 211; Engineering: Recent Advances in, Radio Meeting in Washington, 214; -Telegraphy and Radio-Telephony, Progress made in, C. E. Rickard, 339; for Short Distances, 361; Fundamentals of, Prof. F. E. Terman, with the Collaboration of Lt. F. W. Macdonald (*Review*), 368; Laboratory Handbook, M. G. Scroggie (*Review*), 368; Exhibition, Olympia, 450; Waves, Ultra-short, Diffraction of, Dr. J. S. McPetrie and J. A. Saxton, 631; Fade-out, Nature of, L. V. Berkner, 947; Sets for Export, Manufacture of, 1022; -Communication, The Elements of, O. F. Brown and E. L. Gardiner. Second edition (*Review*), 1068; Manual: for Radio Engineers, Inspectors, Students, Operators and Radio Fans, G. E. Sterling. Third edition (*Review*), 1068
Radioactive Gases *evolved in Uranium Fission*, Prof. L. Wertenstein, 1045
Radioaktivität: Künstliche: Experimentelle Ergebnisse, Dr. K. Diebner und Dr. E. Grassmann (*Review*), 689; und ihre kern-physikalischen Grundlagen, Prof. W. Hanle (*Review*), 689

Radioactivity, Artificial, Prof. L. F. Bates (*Review*), 689
Radium: C′ and Thorium C′, A Determination of the Half-value Periods of, with a note on Time Lags in a Geiger Counter, J. V. Dunworth, 152; C′, Application of the Coincidence Method to Testing the Lifetime and Level Scheme of, Dr. J. Rotblat, 248; E, Disintegration of, Microcalorimetric Measurement of the Mean Energy of, M. Lecoin and I. Zlotowski, 440
Railway: Progress in 1839, 169; Electrification at Home and Abroad, 506
Rajputs, Family Life of, Dr. D. N. Majumdar, 80
Raman Spectrum of Gaseous Methylamine, Kirby-Smith and Bonner, 1018
Raspberry, Genetics of the, D. Lewis, 601
Rat: Pleiotropic Gene-effects in the, H. Grüneberg and H. B. Fell, 293; Week, National, 661
Rates and Taxes, Prof. H. O. Meredith, 429
Rats, Skin Lesions in, Vitamin B_6 and, Dr. P. György and Dr. R. E. Eckardt, 512
Rattlesnakes, Fangs in, Replacement of, L. M. Klauber, 714
Rayleigh Waves in an inner stratum of the Earth, K. Sezawa and K. Kanai, 519
Rayon: Fibre, Structure of the, Prof. H. Mark, 313; Factory Hands, Employment Tests for, S. H. Kirihara and K. Nakamura, 789
Rays, Penetration of, Through the Skin, and Radiant Energy for the treatment of Wounds, Sir Leonard Hill, 973
Reagents, B.D.H., for Delicate Analysis including Spot-tests. Seventh edition (*Review*), 365
Rebirth, Skin of, Dr. M. Canney, 335
Recruiting Men with Technical Qualifications, 472
Rectangular to Polar Co-ordinates, Tables for Converting, Dr. J. C. P. Miller (*Review*), 1081
Refrigeration, Eighth International Congress of, forthcoming, 452
Refugee Question, The, Sir John Hope Simpson (*Review*), 1031
Regeneration, Dr. Schotté, 562
Regiomontanus: and Kepler, Prof. H. C. Plummer (*Review*), 223; Leben und Wirken des Johannes Muller von Königsberg genannt, E. Zinner (*Review*), 223
Register of Specialists, Central, 456
Regnum Animale, Dr. W. T. Calman (*Review*), 269
Reinforced Concrete Columns, 681
Relativity: Kinematical, and the Geological Time-scale, Dr. G. J. Whitrow, 706; of Time, The, Prof. H. Dingle, 888; “The, M. H. A. Newman, 1046; Prof. H. Dingle, 1047
Religion and Science, Contacts of, Sir Richard Gregory, Bt., 522
Renin, Properties of, O. M. Helmer and I. H. Page, 209
Research, Co-operation in, Staff Members and Research Associates of the Carnegie Institution of Washington; Prof. J. A. Crowther (*Review*), 174
Resistors, Four-Terminal, Comparing Resistances of: Prof. J. J. Dowling, 865; D. C. Gall, 982
Rhenium, Double Oxy-chlorides of, Jezowská and Iodko, 81
Rheology, Industrial, An Introduction to, Dr. G. W. Scott Blair (*Review*), 197
Rhodnius (Hemiptera), Source of the Moulting Hormone in, Dr. V. B. Wigglesworth, 753
Rhythmic Processes in Biology, Dr. K. Mellanby, 560
River Engineering: Principles and Practice, F. Johnstone-Taylor. Second edition (*Review*), 194
Road Development in the United States, E. L. Leeming, 719
Roads, New York and London, 323
Robin Redbreast Pigment in Fowls, Mary E. Rawles, 1052
Rockefeller Foundation: Fellowship in Natural Science, Dr. G. E. Harrison appointed to a, 278; Work of the, 320; Health Acitivites of the, 474
Roman: York: a recent discovery, 146; Wall, Appeal for a Museum of the, I. A. Richmond, 411; Temple at Albury, Surrey, 473; Scotland, Archæological Reconnaissance in, O. G. S. Crawford, 543; Causeway, [1839], 876
Root: Tips, Chromosome Structure as observed in, Dr. F. Resende, 481; Nodules, Nitrogenous Excretion from, G. Bond and J. Boyes, 946
Roots, Growing, Observation of, W. S. Rogers, 386
Rose: Powdery Mildew of the, K. Longrée, 485; Propagation, Dorothy Brandon, 1096
Rotating Bodies, Fission of: Lt.-Col. K. E. Edgeworth, 81; R. A. Lyttleton, 295
Rothamsted Experimental Station: Annual Field Day, 82
Royal: Academy of the Lincei, amalgamation of the, with the Royal Academy of Italy, 975; African Society, award of silver medals to the late C. F. N. Swynnerton, Dr. E. W. Smith, and Miss Margery Perham, 150; Agricultural: Show, The, Prof. W. B. Brierley, 61; *Soicety: Journal of the*, 189; award of the gold medal of the, to Sir George Stapledon, 237; Air Force, New Technical Branch for the, 276; Botanic Gardens, Kew: Closing of the, 504; Impending retirement of C. E. C. Fisher; appointment of K. N. Kaul as assistant for India, 829; Botanic Society [1839], 876; College of Physicians, award of the Moxon gold medal to Sir Arthur Hurst, the Baly gold medal to Prof. C. H. Best and the Weber-Parkes medal and prize to Sir Pendrill Varrier-Jones, 242; Commission Science Research Scholarships, appointments to, 69; Cornwall Polytechnic Society, [1839], 643; Gardens of Queen Anne, F. J. Chittenden, 974; Meteorological Society, award of the Howard prize to Cadet V. A. McMillan, 70; Microscopical Society: One Hundred Years of Microscopy, Prof. R. T. Hewlett, 850; Navy and Screw-Propulsion, [1839], 682; Society: History in the Archives of the, Sir William Bragg (Pilgrim Trust lecture), 21; award of the Copley medal to Prof. T. H. Morgan, the Davy medal to Prof. J. W. McBain and the Hughes medal to Prof. G. P. Thomson, 825; award of Royal medals to Prof. P. A. M. Dirac and Prof. D. Keilin, 859; Anniversary of the, [1839], 917; Election of officers, 976; Medal awards of the, 986; of Canada: Annual Meeting, award of the Flavelle medal to the late Prof. J. P. McMurrich; presentation of the Lorne Pierce medal to Dr. W. Bovey and of the Tyrrell medal to Dr. E. Z. Massicotte, 255; of Edinburgh: election as honorary members of Prof. Harvey Cushing, Prof. O. Loewi and B. Lyot, 70; election of officers, 749; Swedish Academy of Science: Bicentenary Celebrations, Dr. J. Ramsbottom, 270; award of the Verner von Heidstam gold medal of the, to P. R. Lowe, 749; Agricultural Society of England, presentation of the gold medal and certificate of honorary membership of the, to Sir George Stapledon, 1010; Meteorological Society, award of the Symons gold medal to Prof. J. Bjerknes, 1088
Rural Life, European Conference on, Documentation for the, 1008
Russian Possessions in America, Climate of, [1839], 564
Rutherford, late Lord, Memorial Tablet to, at McGill University, 1057

Sacred Twinned Vessels, M. D. W. Jeffreys, 638
‘Safe’ Fluid, A, for Museum use, Dr. A. D. Imms, 599
Sagitta as an Indicator of Water Movements in the Irish Sea, E. Lowe Pierce and Prof. J. H. Orton, 784
Sahara, Western Rock Paintings and Engravings of the, T. Monod; G. Marey, 38
St. Andrews University: conferment of the M.A. degree *ad eundem gradum* on Dr. E. F. Freundlich; resignation of Dr. F. L. Arnot, 127; United College, Dr. C. Dodd appointed lecturer in natural philosophy in the, 605; conferment of honorary doctorates on Prof. F. T. Brooks, Dr. C. G. Darwin, Sir Albert Seward, Prof. R. V. Southwell, Lord Stamp and Sir Aurel Stein, 605; conferment on Prof. A. McKenzie of an honorary doctorate, 660

Salamander, Polyploidy in the, G. Fankhauser, 1017
St. Louis Medical Society, award of the Award of Merit to Prof. W. W. Graves, 829
Salmacis (The Indian Sea-Urchin), Prof. R. G. Aiyar (*Review*), 363
Salmo salar Linn., Reproductive Cycle in, R. M. Neill, 332
Salmon, Habits of, 658
Salters' Institute of Industrial Chemistry, Awards of the, 199
Salvia reflexa, Toxicity of, C. H. Williams and H. J. G. Hines, 118
Salween, R. Kaulback (*Review*), 1076
Sandbag Revetments, Treatment for Rot-proofing, 874
Santa Crux, Ghost Figures of, Joyce Gillett, 870
Santorin and Crete, N. A. Critikos, 558
Saxon Time Measurement, Dr. A. H. Smith, 239
Schistosomiasis, Human, and its Intermediate Hosts, Dr. A. Moxley, 293
Schlesinger, Kathleen, research fellowship, Award of the, to Dr. Gwenvron M. Griffiths, 242
Schomburgk and Gould, Travels of, [1839], 606
Schools in War-time, 778
Science: Industry and Society, 1; in a Changing World, Prof. J. B. Bernal (*Review*), 3; Modern, A Study of Physical Science in the World To-day, Prof. H. Levy (*Review*), 3; Museum, Exhibition of new Textile Fibres, 18; in Modern Agriculture, 49; Museum: Acquisitions, 145; Review Broadcast, 145; Art and Design, F. I. G. Rawlins (*Review*), 175; A Short History of, Dr. F. Sherwood Taylor (*Review*), 196; Linguistic Aspects of, L. Bloomfield, 240; and Moral Rearmament, 303; and the National Ideal, Sir Arthur Keith, 408; Use and Misuse of, Prof. J. C. Earl, 409; and Industry, Instruments in, R. S. Whipple, 426; Social and International Relations of, 449; The Voice of, 455; Religion and, Contacts of, Sir Richard Gregory, Bt., 522; and Social Pioneering, Dr. I. Bowman, 565; and the Community, Prof. A. Findlay, 605; Meetings in War-time, 763; and Politics in the Ancient World, Prof. B. Farrington (*Review*), 764; *Advancement of*, Part 1, 892; and the New Europe, 919; and the War, 953; and Censorship, 971; and Political Theory under the Soviets, 971; Rights and Duties of, Prof. M. Polanyi, 972; News a Century Ago, 47; 87; 127; 169; 219; 259; 301; 341; 488; 526; 564; 606; 643; 682; 720; 762; 796; 842; 875; 917; 952; 990; 1024; 1058
Scientific: Workers, Salaries of, Mrs. Reinet Fremlin, 119; Medical Research, Fellowships for, 168; Profession, Conditions and Aspects of the, 320; Research, Photography in, 356; Gossip, [1839], 488; Research and Agriculture, Sir Thomas Middleton, 616; and Industrial Research in India, 625; and Industrial Research, Advisory Council to the Committee of the Privy Council, for, appointment of Sir Joseph Barcroft, Sir Harold B. Hartley and Sir Frank Smith as members of the, 665; Instruments, production of, Ministry of Supply, appointment of Sir Frank Smith as director and R. S. Whipple as deputy director of, 665; and Industrial Research in New Zealand, 873; and Technical Literature and Information, 877; Workers, Association of, Activities of the, election of officers, 934; and Industrial Research in Canada, 1020; Research and Technical Development, an Advisory Council on, set up, 1085; and Technical Literature and Information, Dr. P. Auger, 1089; and Technical Books, Recent, July 29, v; August 26, iii; September 30, iii; October 28, iii; November 25, iii; December 30, iii
Scotland, Fishery Research in, 487
Scottish Naturalist, Index of Entomological Contributions, 1871 to 1938, 1010
Seagull, H.M.S., A. Nicholls, 323
Sea: -Urchin Eggs, Lethal action of Alpha-Rays on, M. Miwa, H. Yamashita and K. Mori, 378; -Island Cotton, Transplants of, Dr. Nazir Ahmad, 785
Seale-Hayne Agricultural College, Annual of the, 68
Security: Collective and Economic, 107; Can We Retrieve It ?, Sir Arthur Salter (*Review*), 221; 105
Seismic Prospecting, Dr. R. Stoneley (*Review*), 881
Seismological: Observatory, New, at Bogotá, 20; Data from the Far East, 40
Seismology: Bibliography of, Vol. 12, No. 19, 68; Bibliography of, E. A. Hodgson, 189; Data of, 507; Progress in, 679; Practical, and Seismic Prospecting Prof. L. D. Leet (*Review*), 881; Bibliography of, Vol. 13, No. 1, 975; in the Antarctic, 975
Sensation, Theories of, Dr. A. F. Rawdon-Smith (*Review*) 94
Sensory Events, Quantitative Estimates of, 973
Septobasidium, The Genus, Prof. J. N. Couch (*Review*) 531
Sepulchral Urn, [1839], 127
Serbian Gypsies, Further concepts of, relating to disease, A. Petrović, 837
Sex Chromosomes, Nucleoli, Satellites and, Prof. R. R. Gates, 794
Sheep: 'Pine'-disease in, Dr. H. H. Corner, 257; Dips, Effect of Suint on, Dr. R. P. Hobson, 1093
Sheffield University: Dr. R. D. Haworth appointed professor of Chemistry, 144, 168; Dr. Wilson Smith professor of Bacteriology, Dr. Brynmor Jones lecturer in Organic Chemistry, F. G. Hannell assistant lecturer in Geography, Dr. Andrew Wilson assistant lecturer in Pharmacology and R. Halle a research assistant in Glass Technology, 168; Dr. Wilson Smith appointed professor of Bacteriology in, 185; Dr. A. H. Lamberton appointed assistant lecturer in Chemistry, 762; G. O. Jones appointed research fellow in the department of Glass Technology, 1010
Shellac, Hot Spraying of, K. E. Lalkaka, 936
Shield of Nobility of the Reich, award of the, to Dr. F. K. Kleine, 282
Ship-Burial and Treasure Trove in Suffolk, 318
Short-Circuit Testing Authorities, Association of, 125
Siberian Man and Mammoth, Dr. E. W. Pfizenmeyer. Translated by Muriel D. Simpson (*Review*), 198
Silver, Deuteron Bombardment of, Dr. R. S. Krishnan and D. H. T. Gant; Dr. N. Feather, 547
γ-Silver-Cadmium, Atomic Parameters of, Prof. H. Perlitz and R. Aavakivi, 708
Sinanthropus, Pithecanthropus and, The relationship between, Dr. G. H. R. von Koenigswald and Prof. F. Weidenreich, 926; 933; *Pekinensis*, Forerunner of, Prof. F. Weidenreich, 1055
Singing for Power: The Song Magic of the Papago Indians of Southern Arizona, Miss Ruth Murray Underhill (*Review*), 363
Skin Cancer due to Handling Coal Tars used for Preservation of Fishing Nets, J. M. Twort and R. Lyth, 446
Small Pocks, or Measels, A Brief Rule to guide the Common People of New England how to order themselves and theirs in the, Dr. Thomas Thacker, with an introductory note by Dr. H. R. Viets (*Review*), 308
Smallest Living Things, Towards the, J. E. Barnard, 80
Smallpox ?: Why, 437; Cases of, in 1938 in England, 705
Smith, William (1769–1839), The Father of English Geology, 354
Smoke Pollution, H. Trefor Jones, 258
Smut Fungi: Miss Kathleen Sampson, 210; of India, B. B. Mundkur, 294
Snellius Expedition, The, in the Eastern part of the Netherlands East-Indies, 1929–1930. Vol. 1 and Vol. 2, part 4, Dr. S. W. Visser (*Review*), 651
Social: and Economic Life, The impact of Christianity on (*Review*), 173; International Relations of Science, 449; Biology and Population Improvement, Prof. F. A. E. Crew and others, 521; Pioneering, Science and, Dr. I. Bowman, 565; Problems of War-time Evacuation, 1025
Société Philomathique of Paris, election as honorary members of Prof. E. Abderhalden and Prof. Max Planck, 110

Society: The Science of, an introduction to Sociology, Dr. J. Rumney (*Review*), 195; The Scientific Study of (*Review*), 685; The Study of, Methods and Problems, Edited by Prof. F. C. Bartlett, Prof. M. Ginsberg, Dr. E. J. Lindgren and Dr. R. H. Thouless (*Review*), 685; Modern Physical Anthropology and Problems of, 797
Sociological Aspects of the Cinema, O. Bell, 520.
Sodium Chloride, Influence of, on Glucose Absorption from the Intestine of Iodoacetate-poisoned Rats, L. Laszt, 244
Soil: in the Field, The Study of the, G. R. Clarke. Second edition (*Review*), 581; The, as the Basis of Prosperity (*Review*), 647; Science at Adelaide, 704; Problems in the Tropics, 892; Destruction in Malaya, Sir Lewis L. Fermor, 901
Soils of Palestine: The, Studies in Soil Formation and Land Utilisation in the Mediterranean, Dr. A. Reifenberg. Translated by Dr. C. L. Whittles (*Review*), 1075
Solar: Eclipses, Total, Computation of, M. Davidson, 162; Variation and the Weather, Commdr. W. R. Priston, 550; -Terrestrial Relationships, 677; Eclipse, Total, results of June 8, 1937, 791; and Terrestrial Relationships, 808
Solasonine (Solanine-*s*), Constitution of, Dr. L. H. Briggs, 247
Solids, Mechanics of, Contributions to the, Dedicated to Stephen Timoshenko by his friends on the occasion of his sixtieth birthday anniversary (*Review*), 882
"Sooty Moulds", Australian, Miss Eileen E. Fisher, 253
Sorghum, Kernel Smut of, Control of, Dr. A. F. El' Helaly, 1096
Sound: The Amplification and Distribution of, A. E. Greenlees (*Review*), 197; Synthetic, J. F. Schouten, 393; Velocity of, Formula for the change of, with Temperature, Dr. A. E. Bate, 479; Varying, Analysis of, Dr. K. Imahori, 708
South: -Eastern Union of Scientific Societies, Congress of the, 1939, 85; Australia, The Mollusca of, B. C. Cotton and F. K. Godfrey. Part 1: The Pelecypoda (*Review*), 193; Africa, Forestry in, 279; African Stone Age Cultures, New, Dr. E. G. N. van Hoepen, 385; Westmorland Fell, Vegetation of a, A. Bennett, 715; *Africa, Journal of the Entomological Society of*, Vol. 2, 905
Southern Lights: The Official Account of the British Graham Land Expedition 1934–1937, J. Rymill, with two chapters by A. Stephenson and an historical introduction by Dr. H. R. Mill (*Review*), 54
Soviets, Science and Political Theory under the, 971
Specialism, Departmentalism and Public Service, 1059
Spectral Lines, Pressure Broadening of, Influence of Temperature on the, Dr. H. Horodniczy and Dr. A. Jabłoński, 594
Spectrochemical Analysis, Communications on, F. Twyman, 827; Flame Method of, Dr. W. A. Roach, 1047
Spectrochimica Acta, No. 1, 438
Spectrographic Analysis in Great Britain, Edited by A. C. Candler (*Review*), 532
Spectroscopy: Chemical, A Course in, Dr. H. W. Thompson (*Review*), 366; in Industry, Dr. J. Newton Friend (*Review*), 532; and its Application, Proceedings of the Sixth Summer Conference on (*Review*), 587
Spiders, The Comity of, Dr. W. S. Bristowe. Vol. 1 (*Review*), 895
Spinach, Leaf-spot disease of, H. H. Glasscock and W. M. Ware, 602
Spinning, An Introduction to the study of, Prof. W. E. Morton (*Review*), 198
Sponge Mortality at British Honduras, Dr. F. G. Walton Smith, 785
Spore Discharge: in Land Plants, Dr. C. T. Ingold (*Review*), 959; in Terrestrial Plants, Mechanics of (*Review*), 959
Spray Fluid, Damage by, J. G. Horsfall, G. E. R. Hervey and R. F. Suit, 947
Spraying and Photosynthesis, R. A. Hyre, 447
Squids, Giant Fibres in, J. Z. Young, 557
Standards of Physical Measurement, Dr. L. J. Briggs (*Review*), 458
Stanford University, Micro-entomology at, 20
Starch Films, Hydrolysis of, by Polarised Infra-Red Radiation, Dr. Elizabeth Sidney Semmens, 379
Starling (*Sturnus v. vulgaris* L.), Spring Development of the Gonads of the, W. S. Bullough and Dr. R. Carrick, 33
Stars, The Evolution of the, F. Hoyle and R. A. Lyttleton, 1019
State-Craft and Medicine (*Review*), 345
Statistical: Mechanics: Ancient and Modern (*Review*), 348; The Principles of, Prof. R. C. Tolman (*Review*), 348; Tables for Biological Agricultural and Medical Research, Prof. R. A. Fisher and F. Yates (*Review*), 533; Analysis, Methods of, C. H. Goulden (*Review*), 799
Statistics in Theory and in Practice, Dr. M. S. Bartlett (*Review*), 799
Steam: -boat Accidents, Prevention of, [1839], 47; Navigation to the West Indies, [1839], 564; Water and, Thermal Properties of, N. S. Osborne, H. F. Stimson and D. C. Ginnings, 716; Engines in Cornwall, Duty of, [1839], 762; Engine: A Short History of the, Dr. H. W. Dickinson (*Review*), 849; The, and its Development (*Review*), 849; Hammer, Conception of the, [1839], 875; Data (*Review*), 1069
Steel: Metallurgy, New Researches in, Dr. W. H. Hatfield, 56; the Structure of, Simply Explained, E. N. Simons and Dr. E. Gregory (*Review*), 198; -maker, The Engineer and the, D. Taylor, 793; Mild, Torsional Effects of Torsional Overstrain in, Prof. H. W. Swift, 916
Steels, Electrically Manufactured, H. B. Sieveking, 1099
Steiner Composting Process, Modification of the, Miss Maye Bruce, 280
Stellar: Structure, An Introduction to the Study of, Dr. S. Chandrasekhar (*Review*), 130; Evolution, Nuclear Reactions in, Prof. G. Gamow, 575; 620; Energy, Stellar Structure and, Dr. W. H. McCrea, 985; Diameters, Determination of, by Interferometer, P. Lacroute and J. A. Carroll, 1018
Stilbene, Metabolism of, Preliminary Investigation of the, S. W. Stroud, 245
Stoneley Waves, Range of Possible Existence of, K. Sezawa and K. Kanai, 121
Stratosphere, Temperature of the, at High Latitudes, Drs. A. and E. Vassy, 284
Stream and Channel Flow (Hydraulic Graphs and Tables), E. E. Morgan (*Review*), 367
Streptocarpus, Genetics of, W. J. C. Lawrence, R. Scott-Moncrieff and V. C. Sturgess, 676
Streptococcus hæmolyticus, Influence of Glutamine on the Growth of, M. Landy, 512
Students and Military Training, E. Brown, 17
Subject Index to Periodicals, 1938 (*Review*), 372
Submarine Daylight, Angular Distribution of, N. G. Johnson and G. Liljequist, 44
Subterranean Forest, [1839], 644
Succinate, Oxidation of, by Heart Muscle, Dr. K. G. Stern and Dr. J. L. Melnick, 330
Suelos de la Peninsula Luso-Ibérica, Los (Soils of the Lusitano-Iberian Peninsula), (Spain and Portugal), Prof. H. del Villar. International edition in Spanish and English, the English text (somewhat abridged) by Prof. G. W. Robinson (*Review*), 1075
Sugar-cane: Seedlings, Discovery of, E. C. Stevenson, 36: Mosaic, Aphid Vectors of, H. D. Tate and S. R. Vandenberg, 984
Suicide, Alcoholism and, Dr. M. Moore, 1040
Sulphuric Acid Solutions, Vapour Pressures of, S. Shankman and A. R. Gordon, 716
Sun-fish, Evolution of a, H. C. Haven, 756
Sunspot: Activity, Recent, 362; A Big, 591; A Large, 748
Sunspots: Two Large, 109; 1917–1924, Magnetic Observations of, late Dr. G. E. Hale and Dr. S. B. Nicholson. 2 Parts (*Review*), 266; Magnetic Observations of,

Prof. S. Chapman (*Review*), 266; Recent, 508; Planets and (*Review*), 726; and Magnetic Disturbances, H. G. Archenhold, 985
Superficie razionali, Le, F. Conforto (*Review*), 370
Superimposed Control Applications with special references to Tariffs and Load-Levelling, D. J. Bolton, 126
Supernovæ, H. Zanstra, 122
Surnames and Blood-Groups, Prof. R. A. Fisher and Miss Janet Vaughan, 1047
Sutton Hoo Antiquities, Gift by Mrs. E. M. Pretty, of the, to the Nation, 410
Sveriges Skogsinsekter, Dr. I. Trägårdh (*Review*), 582
Swan Bands, Apparent Anomalous Isotopic effect in some Bands associated with the, C. H. Townes, 631
Switzerland, Anthropology and Ethnology in, 189
Sydney University, Dr. F. L. Arnot appointed a lecturer in, 127
Symbiosis between Fungi and Scale Insects, Prof. A. H. R Buller (*Review*), 531
Symbolism and Belief, E. Bevan (Gifford Lectures), (*Review*), 196
Symphyogenetic Development, Prof. W. P. Chase, 445
Syria: Furth Archæological Excavation in, Sir Leonard Woolley, 277; Northern, Archæological Excavations in, M. E. L. Mallowan, 702
Systema Naturae, Caroli Linnaei: Regnum Animale (*Review*), 269
Systematics, Associations for the Study of, 321

Tables for Statisticians, Dr. J. Wishart (*Review*), 533; 788
Taboo, Prof. A. R. Radcliffe-Brown (Frazer lecture), 562
Tanners' Research Laboratory of America, award of the Fraser Muir Moffat medal of the, to Dr. Dorothy Jordan Lloyd, 603
Tardenois Site in Western Scotland, Rev. W. Edgar, 1052
Tarsiers in Captivity, Dr. H. R. Catchpole and Dr. J. F. Fulton, 514
l-Tartaric Acid, Preparation of, W. T. Haskins, and C. S. Hudson, 211
Tea Fermentation, Cytochrome Oxidase in, J. Lamb and E. A. Houghton Roberts, 867
Technical: and Vocational Education in the U.S.A., G. A. Robinson, 84; Associations, Association of, 84; Education in the West Riding, Present position of, A. L. Binns, 84; Education ?, Whither, Dr. T. J. Drakeley, 84
Télégraphie et téléphonie sans fil, C. Gutton (*Review*), 1068
Television: Sets, Testing, J. H. Reyner (*Review*), 194; Water-cooled Lamps for, 506; Transmission over Telephone Cables, L. Weis, 903
Terminal Resistors, Comparison of Resistances of Four, A. Glynne, 596
Testis Extracts, A Mucolytic Enzyme in, E. Chain and E. S. Duthie, 977
Tetrachlorethylene Molecule, Structure of the, Dr. J. Duchesne and M. Parodi, 882
Thalassological Institute, Helsinki, Dr. E. Palmén appointed director of the, 592
Therapeutic Substances Act, Amendments to the, 938
Thermodynamics: Applied, Prof. V. M. Faires (*Review*), 176; A Textbook of, Dr. F. E. Hoare. Second edition (*Review*), 176; Elementary, Prof. V. M. Faires (*Review*), 176; Pure and Applied (*Review*), 176
Thiamin and Biotin, Excretion of, by the Roots of Higher Plants, P. M. West, 1050
Thorium: C′, Radium C′ and, A Determination of the Half-value periods of, with a note on Time Lags in a Geiger Counter, J. V. Dunworth, 152; Fission of, by Neutrons, Dr. Y. Nishina, T. Yasaki, H. Ezoe, Prof. K. Kimura and M. Ikawa, 547
Thrinax macula Kl., Cytology of, A. D. Peacock and Ann R. Sanderson, 121
Thurston: R. H., Engineer; Centenary Celebrations, 1021
Thyroxine from Casein treated with Iodine, Preparation of, Prof. C. R. Harington and Rosalind V. Pitt Rivers, 205
Tidal Forces in the Sun's Corona due to Planets, K. G. Meldahl (*Review*), 726
Time, The Relativity of, Prof. H. Dingle, 888
Timoshenko, Prof. Stephen, Contributions to the Mechanics of Solids. Dedicated to, by his friends on the occasion of his sixtieth birthday anniversary (*Review*), 882
Tissue Respiration, Prof. R. A. Peters and others, 1070
Tissues of the Body: The, an introduction to the Study of Anatomy, Prof. W. E. Le Gros Clark (*Review*), 851
Toad, Female Reproductive Organs of the, I. Lopez Colombo de Allende, 253
Tobacco: Necrosis Virus, N. W. Pirie, K. M. Smith, E. T. C. Spooner and W. D. McClement, 80; Plants, Abnormal Mitosis in, forming hereditary tumours, Prof. D. Kostoff, 599
Tokyo Imperial University Library, Catalogue of foreign books in the, 29
Tomatoes: Heterosis of, L. C. Luckwill, 121; Seed Weight and 'Adult' weight in, Correlation between, Prof. E. Ashby, 712
Tongan Colour-Vision, Ernest and Pearl Beaglehole, 983
Tools and the Man, late Dr. W. B. Wright (*Review*), 737
Torch Discharge, Spectrum of the, Prof. Yoshihiro Asami and Prof. Takeo Hori, 981
Torsional Effects of Torsional Overstrain in Mild Steel, Prof. H. W. Swift, 916
Totemic Ceremonial in Arnhem Land, Australia, Dr. D. F. Thomson, 319
Town Planning and Urban Concentration, Dr. T. Adams, 603
Traffic Signals at 'Bank Complex', 903
Trans-Atlantic Air Services, Major R. H. Mayo, 678
Travancore, Rajah of, Observatory of the, [1839], 952
Tredgold, Thomas [1839], 260
Tree: Ritual in Southern Rhodesia, F. Possett, 484; Rings and Cultures in the South-Western United States, Dr. F. H. H. Roberts, jun., 967
Trees, Radial Growth in, Water Movement and, W. R. C. Handley, 984
Triassic Fishes of Besano, Lombardy, The, J. Brough (*Review*). 615
Trichinosis in Pigs, T. W. M. Cameron, 756
Trichomonas eberthi in Tissue Culture, a pure strain of, Dr. E. Tenenbaum, 78
Trichosurus vulpecula, the Marsupial, Effect of Œstrogens on the Pouch of, A. Bolliger and A. Carrodus, 1049
Trigonometry, with Tables, Prof. H. K. Hughes and G. T. Miller (*Review*), 1081
Trinidad and Tobago, Annual Forest Administration Report for 1938, 949
Triticum: *sphaerococcum*, S. Ellerton, 601; Genetic Construction in, L. Smith, 716
Trolleybuses, Operation and design of, G. F. Sinclair, 989
Tropical: Fruits, Storage of, Dr. C. W. Wardlaw, 178; Medicine: A History of, based on the FitzPatrick Lectures delivered before the Royal College of Physicians of London, 1937–8, H. Harold Scott. 2 Vols. (*Review*), 801
Troposphere, Reflection of Medium and Short Radio Waves in the, Prof. R. C. Colwell and Prof. A. W. Friend, 31
Trypanosome in a Tigress, A, Dr. Z. Mohamed, 790
Tubercle Bacillus, Effect of Irradiating the, with Radon, Dr. P. Bonet-Maury and H. R. Olivier, 833
Tuberculin: Protein T.B.U.-Bovine (523), The, Dr. Dorothy Wrinch, 77; tests in Cattle, Prof. J. B. Buxton and R. E. Glover, 108
Tuberculosis: in Cyprus, N. D. Bardswell, 362; and Social Conditions in England, P. D'Arcy Hart and G. P. Wright, 447; Research on, gift by the Empress of Japan for, 665
Tumour Proteins, The Glutamic Acid of: Prof. A. C. Chibnall, M. W. Rees, G. R. Tristram, E. F. Williams and Dr. E. Boyland, 71; Prof. F. Kögl and Dr. H. Erxleben, 111
Tunnelling through the Alps, [1839], 526
Turkestan, Weather Periodicities in, V. A. Blagoveschensky, 791

Turkey: Eastern, Travels in, [1839], 990; Greece and the Eastern Mediterranean, G. F. Hudson (*Review*), 1031
Turtles, Atlantic Loggerhead, Names of some, P. Deraniyagala; H. W. Parker, 673
Tyōkō and his Seismoscope, A. Imamura, 340

Ubekendt Island, West Greenland, Two British Expeditions to, Dr. H. L Drever, 1073
U.F.A.W. Quarterly Journal, 974
Ultra-Violet, Reflectivities in the, G. B. Sabine, 295
Unemployment in the Learned Professions, W. M. Kotschni, 148
Universities: The, and War, 542; and Government Grants, 1086
University: Clinic and its Laboratories, Evolution of the, Prof. S. Flexner, 147; Statistics in Great Britain, 1937–38, 337; Education, Social Distribution of, Prof. Major Greenwood, 591
Upper White Nile, Hydrology of the, W. Allard (*Review*), 495
Uranium: Nuclei, Fission of, by Neutrons, Prof. O. Hahn, 46; Society, A, [1839], 127; Nuclei of Fast Neutrons, the Scattering by, and the Possible Neutron Emission resulting from Fission; Dr. L. Goldstein, A. Rogozinski and R. J. Walen, 201; Nucleus, Fission of the, a particular mode of, W. G. Chlopin, M. A. Passwik-Chlopin and N. F. Wolkov, 595; Fission: of, under Deuteron Bombardment, D. H. T. Gant, 707; Delayed Neutron Emission Accompanying, Dr. K. J. Bostrøm, Dr. J. Koch and Dr. T. Lauritsen, 830
Urmass und Schopfung: Neuentdeckte Gesetzlichkeiten, E. P. v. Schoen-Wildenegg (*Review*), 373
Ursa Major Cluster, A New Member of the, Prof. W. M. Smart, 558
U.S.A.: Typhus Fever in the, Surg.-Genl. H. S. Cumming, 149; Fruit Pest Control in the, W. P. Flint, 161; Geophysical Expedition to the Pacific Ocean, Prof. S. Chapman, 182; University and Professional Standards in the, 187; "Know Your School" Movement in the, 241; Public Health Service, National Cancer Institute, Dr. D. Burk appointed senior chemist in the, and associate professor of Biochemistry at Cornell University Medical College, 282; Negro Education in the, D. T. Blose and A. Caliver, 293; Conservation in the, Prof. A. F. Gustafson, Prof. H. Ries, Prof. C. H. Guise and Prof. W. J. Hamilton, Jr. (*Review*), 310; Educational Finance in the, 321; Industrial Research Laboratories, 438; Archæological Explorations in, 473; Road Development in the, E. L. Leeming, 719; Mortality Rates of Babies and Mothers in the, 781; Farm Forestry in the, 828; Land-Grant Colleges in the, 828; Coast Survey, [1839], 842; Wild-life Restoration in, A. M. Day, 902; Research on Grassland, Forage Crops and the Conservation of Vegetation in the, R. O. Whyte, 915; Negro Education in the, Prof. Wilkerson, 937; South-Western, Tree Rings and Cultures in the, Dr. F. H. H. Roberts, jun., 967; Weather Reports in the, 973; Hospital Schools in, 975; Infant Mortality in, 1088

U.S.S.R.: Census of the, 67; Centenary of the Pulkovo Observatory, 67; Electric Power Supplies in, Extension of, 746; Award of the Order of Lenin to Prof. V. L. Komarov, 777; The World's Largest Generating Station, 828
Vaccinia Virus: Effect of Lipoid Solvents on, Dr. A. S. McFarlane and M. G. Macfarlane, 376; Effect of Ultrasonic Vibration on, Prof. F. L. Hopwood, M. H. Salaman and Dr. A. S. McFarlane, 377
Vacuolar Sap, Expression of, Prof. T. A. Bennet-Clark and Miss Dorothy Bexon, 243
Vāgbhaṭa's Aṣṭāṅgahṛdayasaṃhitā, Dr. L. Hilgenberg und Prof. W. Kirfel. Lief. 5, 6, 7 (*Review*), 370
Variables, Southern, Twelve New, J. B. G. Turner, 295
Vegetable Monstrosities, [1839], 952
Vegetation, British, The Study of, Prof. E. J. Salisbury (*Review*), 305
Venereal Diseases, National Society for the Prevention of, Lord Horder elected president of the, 110
Venus, Horrocks's observation of the transit of, 860
Vermiculite, Exfoliation of, by Chemical Means, Miss R. C. Groves, 554
Versailles, Treaty of, The Fourteen Points and the, G. M. Gathorne-Hardy (*Review*), 1031
Vertebrate Anatomy, An Introduction to, Prof. H. M. Messer (*Review*), 192
Victoria: Bush Fires in, 97; Falls, Hydro-Electric Scheme, H. L. Bazalgette, 1098
Vigne's, G. T., Travels in Central Asia, [1839], 762
Violets, Wild, Formation of Cleistogamic and Chasmogamic Flowers in, as a Photoperiodic Response, G. Borgström, 514
Virus: -infected Plants, Micro-manipulative Studies of, Miss F. M. L. Sheffield, 39; Research, Squibb Laboratory for, Dr. R. C. Parker appointed head of the, 504
Viruses Investigation of, The Electron-microscope and the, von Borries and E. Ruska, and others, 40
Vision and Hearing, Theories of, Prof. H. Hartridge (*Review*), 94
Vitamin: B requirements of the Rat, M. M. El-Sadr, H. G. Hind, T. F. Macrae, C. E. Work, B. Lythgoe and Prof. A. R. Todd, 73; B_6 Structure of, 122; C Solutions, Platinum Potential of, in Contact with Molecular Oxygen, Dr. N. Bezssonoff and Mme. M. Woloszyn, 289; B_6 and Skin Lesions in Rats, Dr. P. György and Dr. R. E. Eckhardt, 512; B_1 and Acetate Oxidation by Bacteria, Dr. J. H. Quastel and D. M. Webley, 633; A, in Ling Cod Liver Oil, Dr. L. B. Pett, Marian Lipkind and G. A. Le Page, 634; A, Influence of Age upon the Requirement of, J. T. Irving and M. B. Richards, 908; A, Content of the Livers of a Hundred Healthy Dogs, R. G. Linton and A. Brownlee, 978; und Hormonforschung, Ergebnisse der, Herausgegeben von Sir Edward Mellanby und L. Ruzicka. Band 2 (*Review*), 1080
Vitamine und Hormone: und ihre technische Darstellung. Teil I, Zweite Auflage, Dr. H. Bredereck und Dr. R. Mittag; Teil 2, Dr. F. Seitz (*Review*), 739
Vitamins K_1 and K_2, L. F. Fieser, W. P. Campbell and E. M. Fry, 519
Volcanic Activity in Japan, Recent, H. Tanakadate, 913
'Volpar' Contraceptive Products, Chemical Composition of, 199
Voltage, Spontaneous Fluctuations of, due to Brownian Motions of Electricity, Shot Effect and Kindred Phenomena, E. B. Moullin (*Review*), 900
Voltages, Fluctuation, F. C. Williams, 485
Volumetric Analysis, The Essentials of, J. Lambert, in conjunction with A. Holderness and Dr. F. Sherwood Taylor (*Review*), 1080

War: Emergency, Organisation for, 186; Comes, If (An Essay on India's Military Problems), Prof. B. P. Adarkar (*Review*), 871; Agricultural Executive Committee, appointment of a, 473; and Peace: Essays in Psychological Analysis, Dr. W. Brown (*Review*), 845; Science and the, 953; Gases: The, Chemistry and Analysis, Dr. M. Sartori. Translated by L. W. Marrison (*Review*), 996
Warsaw University, Destruction of the Institute of Experimental Physics, 1010
Washo of Nevada, U.S.A., Ethnography of the, R. H. Lowie, 638
Wasp, Parasitic, Mutant Body Colours in a, Anna R. Whiting, 80
Water: in the Soil, Movement of, Haines and Schofield, 210; Supplies, Safeguarding, 282; Speed Record, New, Sir Malcolm Campbell, 362; and Steam, Thermal Properties of, N. S. Osborne, H. F. Stimson and D. C. Ginnings, 716; Pollution Research Board, Work of the, 718; Movements in the Irish Sea, Sagitta as an Indicator of, E. Lowe Pierce and Prof. J. H. Orton, 784; in Ionic Solutions, Structure of, G. W. Stewart, 985

Wax Emulsions for Deciduous Fruit, R. M. Smock, 838
Weather Reports in the United States, 973
Wedge-Photometer, A Simple, H. W. Newton, 211
Welding, Future of, 703
Western Isles, The, through the Mists of Ages, Sir Albert C. Seward, 413
Whales, Marking of, Preliminary Results of the, by the *Discovery* Committee, G. W. Rayner, 999
Wheat, Fungal Lodging of, Mary D. Glynne, 39
White Settlement in the Tropics, 171
Wireless Telegraphists, Technical Instruction for, Handbook of, H. M. Dowsett. Sixth edition (*Review*), 741
Wistar Institute of Anatomy and Biology, Prof. E. R. Long elected president and Dr. E. J. Farris executive director of the, 199
Wood: Pulp, Dr. J. Grant (*Review*), 740; as a Raw Material, S. H. Clarke (*Review*), 924
Worcester Clay, Vandiferous Nodules in, Dr. J. Newton Friend and R. H. Vallance, 286
World: Power Conference, 1938, Report of the, 20; Civilization, A History of, Prof. J. E. Swain (*Review*). 569; Power Conference, appointment of G. J. T. Bakker as acting chairman of the International Executive Council of the, 781; Affairs Series, The, (*Review*), 1031; Power Conference, Statistical Year-Book of the, No. 3: Data on Resources and Annual Statistics for 1935 and 1936, Edited, with an Introduction and Explanatory Text, by F. Brown (*Review*), 1081
Wound Hormones in Plants, J. English, J. Bonner and A. J. Haagen-Smit, 984
Wyperfeld (Mallee) National Park, Victoria, Sir James Barrett, 272; Botanical Characteristics, Prof. J. S. Turner, 273; Geological Characteristics, Dr. E. S. Hills, 274

X-Ray: Reflections: from Copper, Effect of Temperature on the Intensity of, Dr. G. W. Brindley and Dr. G. H. Atkinson, 477; from Gold, Effect of Temperature on the Intensity of, Prof. E. A. Owen and R. Wilson Williams, 477; Analysis and the Structure of Matter, Sir William Bragg, 961; Measurements on Wet Insulin Crystals, Dr. Dorothy Crowfoot and D. Riley, 1011
O-Xylene, Ozonization of, and the Structure of the Benzene Ring, Prof. J. P. Wibaut and P. W. Haayman, 290

Yale University, Establishment of a Library of the History of Medicine, 1010
Yeast, Hybridization in, O. Winge and O. Laustsen, 253
Yellow: Fever, Spontaneous, in Rhesus Monkeys in the absence of Mosquitos, Dr. G. M. Findlay and F. O. MacCallum, 332; Indicator, Visual Purple and, Cataphoretic Measurements on Solutions of, Dr. E. E. Broda, Dr. C. F. Goodeve, Dr. R. J. Lythgoe and E. Victor, 709
Youth: The Needs of, a Report made to King George's Jubilee Trust Fund, Dr. A. E. Morgan (*Review*), 723; Needs of, Man-Power and the, 843

Zoological Nomenclature, Rules of, Dr. C. Crossland, 942
Zoophytes, British, A History of, [1839], 87
Zululand, Northern, Forests of, Col. D. Reitz, 280

Supplements should be collated and bound with the numbers with which they were issued

Printed in Great Britain by
Fisher, Knight & Co. Ltd. The Gainsborough Press, St Albans.

"To the solid ground
Of nature trusts the Mind that builds for aye"—Wordsworth

Vol. 144 SATURDAY, JULY 1, 1939 No. 3635

SCIENCE, INDUSTRY AND SOCIETY

THE meeting of the Division for the Social and International Relations of Science of the British Association which was held last week in Manchester provided a particularly apt illustration of the twofold functions of the new Division. The formation of the Division is the outcome of the new recognition on the part of scientific men themselves of their responsibility for the social consequences of their discoveries, to which Dr. J. S. B. Stopford, the vice-chancellor of the University of Manchester, referred in his address of welcome. While, however, the formation of the new Division has been widely welcomed outside the ranks of scientific workers themselves, as indicated, for example, in the remarks of Mr. C. Woodcock, head of the economic and research department of the Trades Union Congress in the discussion, the meeting made it clear that educational work in this field must for some time to come be an important activity of the Division.

For this situation there are several reasons. In the first place, as Sir Richard Gregory pointed out in his introductory address as chairman of the Division, the prelude to effective action is clear thinking about the social implications of scientific work, of the uses that are being and could be made of science, of the abuse of scientific knowledge, and of the fuller use which could be made of it for promoting general social welfare.

Such educational activity is also of importance in securing the widespread support which is equally essential if scientific investigation is to be carried out in this field on any adequate scale. At the present time, as Sir Richard Gregory pointed out, the resources available for research on the effects on the community of scientific knowledge acquired or used are very meagre. Large funds already exist for industrial research, though the net annual expenditure of £600,000 of the Department of Scientific and Industrial Research—the most potent agent in Great Britain in promoting the application of science and scientific knowledge to industry—compares unfavourably with the national effort in other contries and might be trebled with advantage. No fellowships exist for inquiry into the effect of scientific and industrial change in the community, and a strong case could be made out for the organization and supply on a similar scale of facilities for research into the changes in the character and conditions of labour, the distribution of industries and population and the many other social problems involved in practical applications of scientific discovery.

It would indeed be difficult to choose two examples better calculated to illustrate the importance of the application of scientific method and research than the two industries—the cotton industry and the plastics industry—selected as the subject of the Manchester meeting. As

Dr. F. C. Toy pointed out, in the old-established cotton industry a period of great mechanical and chemical advance, up to the middle of the nineteenth century, in which the demands of the industry stimulated both scientific and mechanical discovery, was succeeded by one of comparative neglect and stagnation in spite of rapidly expanding trade. The scientific drive passed to the dyers or chemical industries, and scientific revival in the cotton industry only came about twenty-five years ago. Until 1910, there was scarcely a physicist in the industry, and this neglect of science by the industry well explains both the difficulties which from time to time the British Cotton Industry Research Association has experienced in securing support and the failure of the industry to utilize the results of scientific knowledge available for it.

Unquestionably this neglect of science has been a factor in the difficulties which the industry has experienced in meeting the competition of the new synthetic fibres. The development of fabrics which resist creasing or shrinking as well as stains, or which repel water, is largely due to fuller knowledge of molecular structure, and the development of crease-resistant cotton fabrics as a result of sixteen years research described by Sir Kenneth Lee is an example of the way in which scientific research can enable an industry to adapt itself to meet the demands of new conditions.

The value of a central research organization, however, as Dr. Toy pointed out, does not lie in the supply of new knowledge alone. It lies equally in the stimulus which it supplies to scientific and technical thought in the industry as a whole, while it should not be forgotten that industrial research often makes as important contributions to the advance of science itself as science does to that of industry. Indeed, this has been notably true in the development of the plastics industry, where scientific and technical advance have frequently been hand in hand. A remarkable example of this may be seen in the development of the new fibre 'Nylon' to replace natural silk

If the feature of the plastics industry is its direct dependence on scientific research, few industries illustrate more conspicuously the reaction of applied science on the community. Frequently the development of plastics has been linked up with the advance of other industries, but apart from this, plastics are not merely meeting new needs by making possible the cinema, the roll-film, the gramophone record and the electrical industry as we know it, but they are also displacing other materials for constructional purposes, and as Dr. V. E. Varsley and Mr. E. C. Couzens pointed out, offer a new media for the expression of handicraft, possessing possibilities not found in wood and metal. Moreover, we are only on the threshold of the real plastics age, in which materials will be built up by chemical synthesis to meet the great majority of specific requirements.

The technical significance of such developments and the possibilities and advantages inherent in them should not be allowed to blind us to the profound influence which they may have on social life as well as on individual industries. More and more, however, it is realized that industrial efficiency can no longer be computed in mechanical terms; it must take full account of the human factor, and it must also be considered in relation to the welfare or efficiency of society as a whole. We need, as Prof. H. Levy urged in his Pedler Memorial Lecture (which also formed a part of the Manchester meeting), a system of social accountancy, which would provide the information necessary for informed judgment on social proposals.

In directing attention to this need for a survey of the efficiency of our social machinery and the changes it creates in the community, Prof. Levy touched on the second function of the new Division. It is not concerned solely with the education of scientific and public opinion in the social consequences of scientific discovery, at least to the point of lucid thought about definite and specific problems and the provision of means for the investigation. It is equally concerned with the elaboration of the technique for the investigation of social change.

In his lecture, Prof. Levy made a number of suggestions in regard to the measurement of social change which deserve the attention of the Division. A study of the social relations of science implies an examination of the way in which scientific and technical applications are reflected in physiological and cultural development in the community. We require accordingly a complete survey of the appropriate indexes in all these fields. We require measures of the technical level in commodity production contrasted with what might conceivably be attained at any moment; the relative degree of research activity in various branches of science; indexes for physical fitness for various social classes and their resistance to certain diseases; housing standards and educational facilities compared with what might be attained with planning. Such indexes need not be more difficult to provide than the cost of living index.

The Manchester meeting of the new Division succeeded at least in providing impressive illustrations of the opportunities for the application of scientific method in the solution of problems of social change due to industrial development, no less than in industry itself. It may indeed be hoped that the meeting will encourage many more scientific workers to seek to bring to the solution of such problems the same attitude of mind and principles which they use in their research, and stimulate both the formulation of specific projects for investigation and the elaboration of the requisite technique and principles of investigation.

SCIENCE IN A CHANGING WORLD

Modern Science

A Study of Physical Science in the World To-day. By Prof. Hyman Levy. Pp. x+736. (London: Hamish Hamilton, Ltd., 1939.) 21s. net.

THE twentieth century has been an era of violence and change. In our acute awareness of this, we may fail to notice that in the midst of danger, insecurity and the destruction of human values and lives, a new order is insensibly being formed. Scientific men and practical men, starting from widely different viewpoints, are coming to think of things in the same way—one very different from that which satisfied us not so many years ago. Because of this very diversity of origin, it is difficult to grasp consciously what is happening, and yet that conscious grasp is what we feel we need most. Intellectual insecurity is only the counterpart of the present political insecurity of the world. That security can only be won by wide views and hard thinking. Prof. Levy's book is a notable contribution to the series of attempts to reformulate our knowledge in relation to the great internal and external changes it has undergone in the last few years. He has already written much upon this subject, but there is no doubt that "Modern Science" represents much more matured thought than any of his previous writings. Both those who are acquainted with Marxist views in science and those who are not will find it well worth their while to read carefully through its seven hundred pages.

The purpose of "Modern Science" is to bring into the scope of our thinking certain general considerations that have so far been relatively foreign to the tradition of scientific thought, and to show how these considerations are necessitated both by the internal developments of science and the discovery of new relations and contradictions in it, and by the increasingly acute impact of social events on the carrying out of scientific work. The book is addressed not only, and indeed not principally, to men of science, but also to intelligent persons in general. Because the language of science is not the common language, much explanation both of elementary and advanced scientific ideas is necessary, but the book is not so much an exposition of science as a criticism of the limitations of scientific thought and an indication of the lines along which it can be generalized and extended.

The four principal ideas which the author introduces with a wealth of examples are: the general interrelation of the processes of the universe and the consequent artificiality of scientific study in isolation; the prevalence of opposites both in the world of Nature and in our mathematical and physical ways of understanding it; the existence of critical changes of quality brought about by continuous quantitative processes; and the close and permanent interaction between the practical basis of social life and its intellectual interpretation in science. These are all ideas which until recently would have appeared strange and ridiculous to many scientific workers, and still seem so to many. The value of Prof. Levy's analysis is that he shows us that recent developments have made most of them an integral part of scientific thought. The quantum theory in particular brings out very clearly the significance of characteristic values of a physical variable and the presence of instability and discontinuous change. The theory of relativity, on the other hand, while appearing in one aspect as a culmination of the abstract and mechanical world view of Newton, is also one of the first recognitions of the need for comprehensiveness in the formulation of scientific law. From the new viewpoint, much of the science of the past is seen to be an answering of detail-problems, artificially isolated both in their antecedents and from the world around them. The new view does not alter science, but it does help to extend it, and in doing so to make it intrinsically more intelligible.

"Modern Science" is divided into seven parts. The first introduces science as a developing means of using and controlling energy. It shows how from the technical point of view we can have energy in abundance, but that we are still unable for political and economic reasons to make full social use of it. The final chapter, on the inversion of science, is particularly interesting. The second part contains an outline of the main arguments of the book in a most general and practical way. The third part, on the universe of symbols, takes us into mathematics and exhibits the history of mathematics as a continuous struggle to achieve comprehensiveness and freedom. The fourth contains a most penetrating study of Newton's laws and of their generalization in the eighteenth and nineteenth centuries, illustrated by a chapter on aerodynamics, which brings out the relations between theory and experiment. The inadequacy of the Newtonian view is led up to by a fifth part dealing with projective and non-Euclidean geometry. This leads to the sixth and most interesting section of the book, which discusses the actual content of the universe from cosmology to atomic structure, and incidentally the relativity and quantum theories. The seventh part gives a concrete example of applied physical science—its use in the development of illumination.

Finally, we have an epilogue which sums up in nineteen theses the difference between the older views of science and those associated with dialectical materialism. It is impossible to quote more than a few of them, but the following may stand as typical.

DIALECTICAL METHOD	MECHANISTIC METHOD
1. The history of science and the growth of its ideas are intimately bound up with the history of social needs. Whether science will advance rapidly, or be retarded, will depend on how far society is consciously organized to this end.	1. Science is a thing in itself and its use by society is purely extraneous. Science has its own history, that of the erection of a system of logically connected ideas.
2. Scientific truth emerges through the interplay of theory and practice. Truths are not only discovered but made and transformed into greater truths. They are changed in the process of discovery and of verification.	2. Truth is discovered. It lies in the background as an absolute.
4. In science man learns to think logically by the force of experimental practice. His logical perceptions have therefore a history of growth and they reflect the natural processes to which he has been mentally compelled to adapt himself.	4. Man thinks logically in an absolute way. Such processes are unchanging and they analyse events in the universe, forcing them into a previously determined logical pattern.
8. The laws of Nature describe statistical regularities and are changing.	8. The laws of Nature are absolute and unchanging.
11. Process change implies continual qualitative change by the resolution of internal 'contradictions' into a more embracing synthesis. This implies a changing cause-effect relationship in which in each pair elements and groups play a dual role with respect to each other.	11. Cause and effect follow each other in isolation and the laws of Nature are always of the simple cause-effect type.
18. Since science is a form of action in social life and since decisions regarding social action have to be made, there must be a specific type of scientific approach at each level of human activity, from controlled laboratory science to the making of social history.	18. Without complete knowledge no scientific decision can be arrived at. Complete knowledge is defined as that demanded by physical science. Social activity cannot be carried through, therefore, in a scientific manner.

The theses bring out very clearly how much better the ideas of relativity and the quantum theory fit in with the dialectical mode than they do with the mechanical. But as Prof. Levy points out later, the importance of the dialectical method lies even more in the relations of science to society than in science itself:

> "The scientific repercussions of a lack of the fullest appreciation of dialectical change in scientific work itself are slight. On the other hand, the social repercussions of a lack of appreciation of the dialectical changes produced by and on science in its interaction with society may be almost catastrophic. That this lack of appreciation exists is evident from the contradiction that persists in the minds of scientific men, and indeed all others who give thought to the matter, when they contrast the potentialities of science for abundance in social life with its adaptation as a means of ensuring scarcity." (pp. 708–709.)

This is a book for all scientific workers to read. It will provoke thought and discussion. Its length, which the need for elementary presentation makes necessary, is compensated for by the forcefulness and clarity of Prof. Levy's style, and by the excellence of the many illustrations.

J. D. BERNAL.

INSTINCTS OF THE HERD

The Social Life of Animals
By Prof. W. C. Allee. Pp. xiv+265+5 plates. (London and Toronto: William Heinemann, Ltd., n.d.) 12*s.* 6*d.* net.

WHEN Huxley wrote that among animals and among primitive men "Life was a continual free fight, and beyond the limited and temporary relations of the family, the Hobbesian war of each against all was the normal state of existence," he was, not for the first time, overstating the case. The idea that co-operation is as 'natural' and as fundamental as competition is at least as old as Empedocles. Darwin used the term 'struggle for existence' "in a large and metaphorical sense, including dependence of one being on another", and Herbert Spencer insisted that "from the dawn of life altruism has been no less essential than egoism". Patrick Geddes and Arthur Thomson used to impress upon their students the importance of sociality as a factor in animal evolution, and Kropotkin, uncritical though he was, did good service by pointing out the inadequacy of the gladiatorial theory of life. In recent years, the very active school of animal ecology directed by Prof. Allee in Chicago has given much attention to the problems of animal aggregations, seeking to discover the links that hold them together and the advantages, individual or racial, derived from them. In this volume, based on a course of lectures delivered at the Northwestern University, he gives a summary of the more important results of these researches and discusses their significance.

After a brief historical introduction, which might have been expanded with advantage, the author mentions those aggregations of individuals in which the connexion is structural, as in the groupings of fissiparous Protozoa that, presumably, gave rise to the Metazoa, and in the colonial Cœlenterates and the like. He then goes on to describe instances of swarms that are merely swept together by environmental action as plankton animals are by ocean currents, or that are attracted together to some favourable niche of the environment as Protozoa cluster round an air-bubble on the microscope slide or bats assemble in a suitable cave. We cannot tell when or where such accidental assemblages merge into those in which the individuals actively seek the company of their kind, or how mutual toleration leads towards co-operation and mutual aid.

The advantages—or, more precisely, the 'survival-value'—of these aggregations are sometimes obvious; mass defence against predators is visibly effective; but often they are more recondite. There seems to be a 'confusion effect', as when small birds flock together in presence of a hawk; the enemy's attention is distracted, and he is less likely to be successful than when he can concentrate his attention on a solitary victim. It may perhaps not be true that "the wolf cares not how many the sheep may be" and it is certain that a goldfish will eat more water-fleas if it is given a few at a time than if it is presented with the whole bewildering mass at once. Sometimes the advantage is plainly physical, as when hibernating small mammals huddle together for warmth; sometimes it is more subtly chemical, as when it is demonstrated that goldfish thrive better in pond water that has been conditioned by the previous presence of other goldfish. The ill-effects of overcrowding are often lamentably plain, with animals as with men, but there is a growing body of evidence bearing on the less obvious evils of undercrowding in the most diverse organisms ranging from Protozoa up to elephants.

As we proceed up the scale of animal life these various assemblages tend to become organized into more or less definite societies. Even the hen-run has its 'peck-order', although the cock of the walk enjoys only a precarious sovereignty and a very little may turn him into the persecuted butt of his companions. Innumerable gradations lead up to the highly integrated communities of bees, ants and termites in which the various castes are structurally as well as functionally differentiated.

On all these, and many related subjects, Prof. Allee has much to say that is interesting and important, and much that will, we believe, be novel to zoologists who have not given special attention to this department of their science. He writes in a readable style and his explanations are generally, though not invariably, easy to follow. There are, however, one or two points that seem open to criticism.

Prof. Allee is an experimentalist rather than a field naturalist, and he appears somewhat to neglect or to undervalue the great mass of field observations that bear on his subject. It is perfectly true that, as he says, many of these observations "can only be recorded as more or less interesting anecdotes", but there are others, of which the details have been fully collected and scientifically analysed, that are at least as deserving of attention as the results obtained in the laboratory. It is noteworthy that, of the field observations thought worthy of discussion, some, like those relating to the elephant herds of the Knysna Forest and the Addo Bush (p. 89), are presented without the particulars necessary for forming a judgment on their significance.

The great advantage of the experimental method lies in the possibility of obtaining precise quantitative results. It demands a correspondingly careful handling of the numerical data in the exposition of these results. It is disappointing to find, therefore, that the very first table in the book (p. 38) flatly contradicts the interpretation of it given in the text. A reference to the original paper from which it is quoted shows that a transposition of figures has occurred. The diagrams on pp. 44 and 46 are taken from a paper still unpublished and they cannot, therefore, be checked, but the figures they contain give percentages widely different from those that are said in the text to be extracted from them. On p. 74 a certain coefficient is said to be "obtained by multiplying the number of fish by their average length in millimetres. . . ." A non-mathematical zoologist would get the same result by taking the sum of their lengths. In a book written in the United States and printed in England one may suspect difficulties in the matter of proof revision; but meantime Prof. Allee cannot complain if readers must suspend judgment on some of his conclusions.

One of the most telling chapters in the book is that entitled "Some Human Implications". There has been no more deplorable example of the crude application of biological principles to the complexity of human affairs than the attempt to justify international war in terms of the struggle for existence. Prof. Allee exposes very effectively the futility of this argument. If, on the other hand, co-operation, at first physiological, then instinctive, and latest of all, conscious, has been a factor in animal evolution no less important than competition, then biology does offer some hope to those who look forward to a better world order. In the meantime, alas, we, on this side of the Atlantic, must get on with our A.R.P.

W. T. CALMAN.

CRYSTAL CHEMISTRY

(1) An Introduction to Crystal Chemistry
By Dr. R. C. Evans. Pp. xi+388. (Cambridge: At the University Press, 1939.) 18s. net.

(2) Crystal Chemistry
By Dr. Charles W. Stillwell. (International Chemical Series). Pp. x+431+1 plate. (New York and London: McGraw-Hill Book Co. Inc., 1938.) 25s.

THE appearance of these two books is symptomatic of a new development in natural science, the birth of a comprehensive theory of the solid state. Both are the work of writers at least partly concerned with teaching, but whereas the first bears the firm impress of the university, the second is slightly technological, and reviews several interesting applications.

(1) Dr. Evans has assuredly written a volume which should never be far away from the mind and elbow of the serious student of the subject. A beginning is made by discussing in detail the forces which bind together the 'bricks' of which the crystal edifice is composed, after which the structures resulting from their interplay are examined systematically. Naturally, this latter portion of the book is much the larger of the two, since no important configuration is omitted. In addition, a place is found for a brief survey of liquid crystals, and for liquids themselves, and glasses. The author remarks that his intention has been to avoid overloading his pages with mere detail of crystal types: the effect is to maintain the reader's interest unabated.

The essence of Dr. Evans's thesis appears to the reviewer to be contained in the concluding discussion of Part 1; and indeed it could not have been better said. It is that the molecule, while all very well in the gaseous state, is not necessarily by any means such a helpful concept in crystals; in fact, it has been responsible for much over-emphasis upon the part played by the classical laws of chemistry. A somewhat similar restriction applies to valency, especially in intermetallic systems.

(2) To the student occupied in an orthodox course of chemical training, Dr. Stillwell's book will come as a welcome shaft of light. It has always been exceedingly difficult to introduce the properties (and indeed the very existence) of solids into such a curriculum without much artificiality. Crystal chemistry, treated as this volume treats it, will do much to help.

Perhaps of necessity the balance appears a little uneven: certain aspects like the silicates and ternary compounds are dealt with at length, whereas the question of colour, for example, receives somewhat old-fashioned and perfunctory notice, omitting entirely the ingenious and subtle suggestions of Saha (1930–31) and the work that followed them. The format, too, is not very attractive, with its cramped setting, which makes the otherwise valuable tables difficult to follow.

It is tempting to compare the outlooks displayed by these two books. The Cambridge view of crystal chemistry is something like this. Here are the 'things', and here is a copy of the rules according to which the game is to be played. It now rests with the players, and the degree of skill which they have achieved is of no mean order. The American approach is otherwise: chemistry as usually taught is not altogether satisfactory; let it therefore be impregnated with a new and active principle, but the way will be long and the wind cold.

A profound study of the solid state is a first-rate intellectual pursuit in either case. For Dr. Evans, however, it is—probably subconsciously—great fun: one doubts whether it is quite that for Dr. Stillwell. F. IAN G. RAWLINS.

SOME EASTERN AUSTRALIAN WILD FLOWERS

Wild Flowers of Australia
By Thistle Y. Harris. Pp. xviii+198+65 plates. (Sydney and London: Angus and Robertson, Ltd., 1938.) 8*s.* 6*d.*

AT a moderate computation, the flora of Australia contains some eleven thousand species of vascular plants. These are found over an area about twenty-five times the size of Great Britain and Ireland, in an island continent which extends through more than 28° of latitude. It is no easy task to select for illustration a fair example of such a flora. In spite of its title, the present book can scarcely be said to have done so. About ninety per cent of the plants figured and described in it come from the coastal district of New South Wales or the adjacent highlands. It is true that many of these same species do extend into Queensland, and a smaller number south into Victoria; but the representation of the floras of Tasmania or South Australia is slight. The small number of Western Australian plants included gives no useful impression of the peculiar flora of that State.

The author says that her book is an attempt to meet the demand for a popular guide to Australian wild flowers. No claim to completeness is made, but it is unfortunate that no space was found for any eucalypt and that not a grass nor a sedge is mentioned. Some of the figured species are uncommon plants, whilst others, quite as beautiful and far more widespread, are omitted.

The book is divided into two parts. The first contains illustrations of 248 species, reproduced by three-colour process and grouped in sixty-five plates. Although the individual blocks are small (2¼ in. × 1½ in.), in many cases the pictures are successful in giving a true impression of the form and colour of the plant illustrated. In other cases the artist has made the limit of the block a sort of Procrustean bed and taken unwarrantable liberties with the length of flower stalks to make the plant fit the picture. The result is a travesty of the plant, as in the figures of Brunonia, Dipodium, or *Drosera binata*. Much of the colour work is good and the figures of many of the Proteaceæ, Myrtaceæ and Epacridaceæ do give a real impression of the plants depicted. The blue tones have reproduced least satisfactorily; the figures of Cheiranthera and Stenochilus are quite misleading. For technical reasons in printing, the blocks on a plate have been grouped according to predominant colour, not affinity of the plants. This has led to a haphazard association of plants which, in some cases, might have been avoided. Each plate is accompanied by a popular description of the plants, their distribution in the different States and their flowering season. By some irritating mischance, only once does this account face the plate to which it refers. There are some inaccuracies: one in this section should be corrected. *Dipodium punctatum* is not a parasite, but a holosaprophytic orchid.

The second part gives a systematic account of the families with keys and a brief technical description of the species figured. As there have been inevitably so many omissions of the genera and species, these keys would be very misleading to a stranger trying to run down a plant. A visitor to the 'bush' near Sydney is as likely to find a Leucopogon, Woollsia or Monotoca as an Epacris; but there is no warning in the key to the Epacridaceæ that such genera exist. In any future edition, the derivation of the generic and specific names given in this part requires careful revision. One error cannot be passed. The Smith commemorated in the species *Zieria Smithii* was not "an Australian biochemist". Sir E. J. Smith deserves better of Australian botany than to be so forgotten. T. G. B. OSBORN.

NEW PROSPECTS IN ISOTOPE SEPARATION

By Prof. Hugh S. Taylor, F.R.S., Princeton University

THE identification of the heavy hydrogen isotope and its separation gave considerable impetus to the search for methods of bulk separation of the isotopes of other elements. Previous to this time, the experimental man of science had been content to demonstrate that displacements of normal isotope ratios could be secured by one or other method. Aston and Harkins had shown that these ratios could be changed by diffusion processes in the cases of neon and chlorine. Brönsted and Hevesy changed slightly the atomic weight of mercury by distillation methods. It was the separation of the hydrogen isotopes and the demonstration of their extraordinary utility in many problems of chemical, physical and biological interest that re-awakened the interest in more complete separations of other isotopic elements. The simultaneous advances in the study of the nucleus, by bombardment with swift-moving primary particles, enhanced the desire for individual isotopic species of the elements, at the same time that it provided an alternative tool for research in the form of artificially produced radioactive elements.

The successful separation of the hydrogen isotopes by electrolysis has not been extended to other elements. The separation factor is too low in the case of oxygen to make the method practicable, and the same is true for lithium. The use of a series of diffusion pump units, developed by Hertz, has permitted large changes in isotope concentrations to be secured, notably with hydrogen, neon and carbon. The separation was complete in the first two cases, and 50 per cent ^{13}C has been secured with methane as the diffusing gas. Minor concentrations of heavy nitrogen and oxygen have also been obtained. The principal objection to the method is the small amount of concentrated products which may thus be secured, since the pumps operate at not more than a few millimetres pressure. Capron and de Hemptinne were enabled to increase the speed of attainment and the yield of 50 per cent ^{13}C from methane by incorporating in the pump circuit, at the light end, a reservoir of methane in the form of gas adsorbed on silica gel at liquid air temperatures. For the concentration of oxygen, the most promising method developed hitherto has seemed to be the distillation column method as constructed by Pegram, Huffmann and Urey.

The most encouraging successor to the electrolytic separation of hydrogen proved to be the isotopic exchange reaction method developed by Urey and his colleagues. With this method, isotopic ^{15}N has been made available in large amounts of moderate concentrations and smaller amounts of highly concentrated heavy isotope. In this method, ammonia gas is exchanged countercurrent with ammonium ion in a column, the heavy nitrogen accumulating at the bottom. The success of this process makes 100 per cent ^{15}N available, at not too great cost, whenever required. The extension to heavy carbon is in progress, involving exchange between hydrogen cyanide gas and sodium cyanide liquors, by which exchange simultaneous separation of both carbon and nitrogen may be secured. The laboratory scale data seem as promising as those of nitrogen. Sulphur can be similarly treated with a greater separation factor than with carbon. Exchanges with zeolitic materials may be employed in the case of the ions of the alkali elements.

The mass spectrographic method can obviously be employed for the separation of charged ions, and this has been put to use in the preparation of the small amounts of the lithium isotopes necessary for nuclear and transmutation reactions. The development of high speed air-driven centrifuges, notably by Beams of the University of Virginia, has led to their use in isotope separation. Units are now in operation on liquids, with continuous feed and bleed. Marked displacements of the isotope ratio of chlorine in carbon tetrachloride have thus been secured. This method is most promising for not too large separations but in marked quantities. The separation depends only on the atomic weight difference and not on the mass ratio, and can thus be applied to liquids containing isotopes of high atomic weight as well as to the lighter isotopes. The method requires, however, expensive equipment and a slowly acquired technique.

From the point of view of general availability in the average laboratory, the newest method of isotope separation developed by Clusius and Dickel[1] is the most interesting, and of great promise for the general solution of the problem of separation of gaseous and liquid isotopic materials in quantity. Clusius combines the well-known thermal diffusion process, suggested by Chapman, with a thermal syphoning process by carrying out the separation in vertical tubes in the axis of which is a hot surface, the outside surface being kept cooled. The original form consisted of a heated wire placed concentrically in a cylindrical tube. In tubes of one metre length with a temperature gradient from centre to outside of 300–600°, it was shown that bromine in helium and carbon dioxide in hydrogen could be practically completely separated, the heavier gas concentrating at the bottom of the vertical column. With a three-metre tube, a four-fold concentration of oxygen in air was secured and a three-fold concentration of the heavy neon isotope. In the same tube a displacement of the chlorine isotopes in hydrogen chloride from 76 : 24 to 60 : 40 was secured in one operation. More recently[2] Clusius and Dickel announced the production in a tube of total length 36 metres, of 8 c.c. daily of hydrochloric acid of which more than 99 per cent of the chlorine was of mass 37. Simultaneously, at the top of the column two litres of hydrochloric acid ($Cl = 35{\cdot}147$) was produced, from one litre of which 25 c.c. of hydrochloric acid ($Cl = 35{\cdot}06$) could be produced. Further purification of this should, owing to the packing fraction of the element, give a chlorine of atomic weight just less than 35.

The method has been tested by W. Groth[3] on the separation of xenon isotopes in comparison with a 12-stage Hertz diffusion pump system which gives a displacement of 0·5 units in the atomic weight in 12 hours at 2 mm. pressure. The same displacement can be secured at atmospheric pressure in a 2·5-metre tube, 12 mm. wall diameter, heated down the centre by a tungsten wire at 1,000°. With a 5-mm. tube and a wire temperature of 1,650°, a displacement of 1·6 atomic weight units was secured. In a metre tube with a glass core heated internally, Brewer and Bramley[4] showed that a 27 per cent enrichment of ammonia at the bottom of the column with 50 : 50 methane (16) – ammonia (17) mixtures could be secured in fifteen minutes under favourable pressure and temperature gradient conditions.

The separation of the chlorine isotopes, successfully achieved by Clusius and Dickel, represents one of the most favourable cases for the operation of the thermal diffusion process. For, as Chapman showed, the separation is dependent on the product, C_1C_2, of the two fractions C_1 and C_2 of the mixture, respectively 0·76 and 0·24 in the cases of ^{35}Cl and ^{37}Cl. The separation of the carbon isotopes is much less favourable since the ratio ^{12}C to ^{13}C is 0·99 : 0·01.

Experiments conducted by G. G. Joris in the Princeton laboratories show, however, that even this mixture is capable of efficient resolution. In a column 1·5 metre long, with wall distance between hot and cold glass surfaces of 7·5 mm., a mean temperature of 400° K. and a temperature gradient of 450°, a separation factor $^{13}C : {}^{12}C$ (bottom) $\div$ $^{13}C : {}^{12}C$ (top) of 1·21 is secured in one hour. In three separate three-metre columns with varying dimensions of hot and cold surfaces and wall distances from 7·5 mm. to 10 mm., with the same temperature conditions, the separation factor rose to 2, but in longer time intervals up to 5 hours. The most recent data secured on a 12-metre iron tube, 2 cm. internal diameter, heated axially by a chromel wire, No. 16 gauge, gave a separation factor of 3 in 48 hours with a heating current of 6 amperes, and a separation factor of 20 in 48 hours with a heating current of 9 amperes. This latter represents a concentration of the normal isotopic fraction of 1·1 per cent ^{13}C to 2·1 per cent at the bottom of the column and a depletion to $\sim 0{\cdot}1$ per cent ^{13}C at the top of the column.

It is obvious that the maintenance of this separation factor will result in concentrations of upwards of 20 per cent ^{13}C at the bottom of the column when the normal ratio of 1·1 per cent ^{13}C is kept at the top of the column. Such experiments are in progress. In the 12-metre tube, 3·76 litres of gas at 20 cm. pressure at ordinary temperatures are employed, methane being the gas used for the separation. Experiments by Prof. T. Ri, in the smaller columns, with carbon dioxide – oxygen and nitrogen – ammonia have shown that the separation factor depends on composition variables, on the pressure (the factor shows, in agreement with a previous finding of Brewer and Bramley, a broad maximum in the region of 20–30 cm.) and most pronouncedly on the temperature gradient. This is obvious from the preceding data in the 12-metre column and also from data obtained with nitrogen – ammonia mixtures in the 1·5-metre column.

The theory of the thermal diffusion – thermal syphon process is complex. Two contributions are now available, one by Waldmann[5] and a paper by Furry, Jones and Onsager[6]. From Waldmann's paper the superiority of the process over straight thermal diffusion is measured by the ratio $0{\cdot}67\ h/d^*$ where h is the height of the column and d^* is of the order of magnitude of the distance between hot and cold surfaces. The convection therefore multiplies the thermal diffusion effect enormously in tall columns. The temperature gradient also plays a determining role in the same theory. That the process is also applicable to liquid separations is evident from data of Clusius and Dickel[2] with sodium chloride solutions, acetone – water mixtures, and light and heavy water. The same conclusion is reached from the data of H. Korsching and K. Wirtz[7] with *n*-hexane – carbon tetrachloride and benzene – chlorobenzene mixtures.

---

[1] *Naturwiss.*, **26**, 546 (1938).
[2] *Naturwiss.*, **27**, 148 (1939).
[3] *Naturwiss.*, **27**, 260 (1939).
[4] *Phys. Rev.*, **55**A, 590 (1939); *Amer. Chem. Soc. Abstracts*, Baltimore Meeting, April 1939.
[5] *Naturwiss.*, **27**, 230 (1939).
[6] *Phys. Rev.*, in the press.
[7] *Naturwiss.*, **27**, 110 (1939).

THE GAS INDUSTRY IN GREAT BRITAIN

WILLIAM MURDOCH died one hundred years ago and, at the annual meeting of the Institution of Gas Engineers on June 6 last, his position as founder of the gas industry received grateful commemoration in a Murdoch Centenary Lecture delivered by Dr. E. F. Armstrong. The lecture was only to a small extent biographical, although points of interest are recorded bringing out clearly the all-round quality of the man as a born engineer "of admirable inventive power and common sense genius", to quote the tribute of Nasmyth. It was made the occasion for the preparation of a reasoned history of the gas industry in Great Britain in the small compass of sixty-seven pages, brief but packed with information concerning the highways and some of the byways on which the industry has travelled in time.

Although Murdoch is accorded his rightful place, proper acknowledgment is made of other founders of the industry, such as Samuel Clegg, whose "mark on its history is second only to that of Murdoch" and who became engineer of the Chartered Gas Company in 1813 and had "practically single-handed to give a public service supply. Thus, when a few gas lamps were first installed on Westminster Bridge, the lamplighters refused to handle them so that he had to go round with his ladder and light them himself". Scepticism on the practicability and safety of public lighting with gas was very general and was shared even by men of the scientific calibre of Humphry Davy. Winsor also is not forgotten, a man of little technical knowledge but a fervent enthusiast, described as the "exploiter, propagandist and undaunted impresario of our Industry, to whom must be given the credit for the idea of widespread illumination from a single source".

The year 1839 was unusually eventful and, under the heading "A Century Ago", Dr. Armstrong sketches a background of contemporary happenings. In 1839 the first railway train left Euston on the first stage of the new London to Birmingham railway, the *British Queen* made the Atlantic crossing under steam alone, "Nicholas Nickleby" was published and people were reading Carlyle's "French Revolution", issued two years earlier, and the *Sunday Times* for January 13 reported that "On Thursday evening Hounslow was lighted up for the first time with gas supplied from the gasworks at Brentford. There are 18 lights." Both steam and gas, two great industrial users of coal, one for power and the other for lighting, had become more or less established by this time, and in an appendix Dr. Armstrong gives a list of ninety gas companies established by Act of Parliament up to 1839.

A patent was granted in 1819 to David Gordon for compressing gas and supplying it in copper cylinders under a pressure of 30 atmospheres, and such 'portable gas' was used at the Royal Institution until 1834, when it was replaced by coal-gas. "Historically", Dr. Armstrong points out, "the Portable Gas Company must always be associated with the discovery of benzene which Faraday separated in 1825 by distillation of the condensed oil gas liquor that collected in the vessels used by the Company."

The primary use of gas for more than a century was for lighting, and the story of the development of the apparatus in which it was burned has been well told by Dean Chandler. The invention of the incandescent mantle by Welsbach, first shown to the public in 1887, came at the right moment because "the electric bulb was introduced only a year or two earlier and started a new era of competition with gas-lighting". Dr. Armstrong quotes interesting figures for public lighting by gas in the area supplied by the South Metropolitan Gas Company. In 1899, with flat-flame burners, the candle-power per cubic foot of gas consumed per hour was 2·5; in 1902, with upright incandescent burners, 14·0; and in 1938, when 70·6 miles of lighting by high-pressure lamps was included, the figure had risen to 43·0.

As the gas industry in Great Britain developed and monopoly of supply was granted to each company in its own area, the absence of competition and the technical possibility of producing a larger volume of leaner gas through the use of fireclay retorts (instead of iron) at a higher temperature brought into prominence the necessity for a rigid control of gas quality. For this purpose the City of London Gas Act of 1868 appointed a body of three competent and impartial persons known as the 'gas referees' to prescribe apparatus and methods to be used in the testing of gas. This arrangement continued until a few months ago when, as Dr. Armstrong regretfully remarks, "The disappearance of the Gas Referees, as the result of the Gas Undertakings Act of 1934, which has transferred their duties to the Board of Trade, has meant the loss of a contact with leaders in the scientific world to which the Gas Industry has attached great value." This is none the less true although, since the passing of the Gas Regulation Act of 1920, calorific value has quite rightly taken the place of illuminating power as the criterion of quality throughout Great Britain.

It was recognized early in the history of the gas industry that the presence of sulphur compounds in gas was very objectionable and Clegg tried as early as 1805 the device of putting lime into the tank of the gas-holder for purification. Dr. Armstrong points out that eleven different processes were in operation in the gas works of the Metropolis in 1856–57. The complete removal of sulphuretted hydrogen by iron oxide, revivified by air, has become standard practice, but the residual sulphur compounds, amounting usually to some 20–30 grains per 100 c. ft. still provide an incentive to research, although oil-washing for benzole and the Carpenter-Evans catalytic process have both been applied successfully to lower this figure.

The usefulness of gas as a fuel for heating purposes and its virtues were "extolled by the indefatigable Winsor". Alfred King invented a gas-cooking-stove so early as 1830, and in 1872 the Salisbury Gas Company commenced hiring cookers to consumers. The earliest attempts were simply solid fuel ovens with gas burners inserted, and Dr. Armstrong traces the development to the cooker of to-day with enamelled finish, thermostatic control, safety-taps, quick-boiling burners and other useful adjuncts. By 1850 there were a number of gas fires in use, these consisting merely of lumps of pumice or other incombustible matter in a coal-grate with a gas-burner below. It was not until between 1904 and 1908 that the gas-fire radiant was introduced, and a new impetus was given to efficiency of design by the experimental study of the gas-fire by the newly formed Joint Research Committee of the Institution of Gas Engineers and the University of Leeds. Modern design is directed to high radiant efficiency combined with a distribution of heat making for the maximum of comfort. Ventilation too has been studied in detail. The rise in radiant efficiency is given by Dr. Armstrong as from 29 per cent on the gross calorific value in 1909 to 45 per cent in 1939 on the same basis.

It is not possible to make more than a mention of many other matters which are included in the lecture, some gratifying curiosity and others a deeper interest; for example, the possibilities of a greatly increased load for industrial heating offer an excellent example, and the whole range of secondary products, such as coke, tar and ammoniacal liquor. The modification of the retort from iron to fire-clay, horizontal to vertical, intermittent to continuous, and the whole subject of water-gas must be left, as well as an interesting page on co-partnership and a synopsis of gas legislation. There is, too, a suggestive final chapter entitled "The Present and Future of Gas", indicating possible lines of advance and insisting on the gas industry's taking a pride in attracting the best men into its ranks both as whole-time workers and as advisers.

JOHN W. COBB.

CERCOSPORA LEAF SPOT DISEASE OF BANANAS

By DR. C. W. WARDLAW, IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD

THOUGH widely distributed in the Indo-Malayan and Australian regions and known to mycologists since 1902, the leaf spot disease of bananas caused by *Cercospora musæ* Zimm. (also known as Sigatoka disease) was not recorded in the western tropics until 1934[1]. It is not known precisely how or when this malady was introduced into the Caribbean region, or whether its spread took place from one or several foci of infection; but during the brief period of two to three years from its first recognition in Trinidad it had appeared with epidemic intensity in many of the islands and on the mainland of Central and South America, and by its destructive effects on plantations showed itself to be a disease of first-class economic importance.

Briefly, the disease manifests itself as a profuse spotting of leaves; later, the tissue around the spots begins to die rapidly and large, coalescing dead patches appear, so that in severe infections the leaf may be more or less completely destroyed (Figs. 1 and 2). Bunches on affected plants show slow or arrested growth and behave abnormally during development and subsequent ripening. Where the economic situation permits, the disease is being fought by dusting and spraying with various copper-containing fungicides.

SPREAD AND INTENSIFICATION

Information on the spread and intensification of a disease from an initial infection to the stage where it has assumed epidemic proportions is not always available to the investigator. In Trinidad, however, it has been possible to follow the progress of Cercospora leaf disease through its several phases. The disease was first observed in the Maqueripe district in north-west Trinidad in a small, new plantation of Giant Governor bananas, the planting material for which

Fig. 1.

SEVERE SPOTTING OF BANANA LEAVES BY *Cercospora musae* Zimm.

(underground rhizomes, bulbs, etc.) had been obtained from scattered plants in the southern part of the island in January 1932. Leaf spotting became conspicuous towards the end of 1933, and plants of the Dwarf Cavendish variety in immediate proximity also became infected, though in a less severe form, some time later.

During frequent inspections at the beginning of 1934, Cercospora leaf spot was not observed anywhere in the Maqueripe district except in this one area, the Giant Governor plot being the centre of infection. A thorough stripping and burning of all diseased leaves was undertaken; but this did not halt the progress of the disease, and by the end of 1934 it became evident that adjacent Gros Michel blocks planted in 1932–33 had become infected. An island survey undertaken about this time showed that the disease was also becoming generally distributed, but whether only from Maqueripe or from several foci of infection is not known.

At this stage, the Gros Michel blocks at Maqueripe, though generally infected, showed little diminution in productiveness. The general mycological observation made during 1934–35 was that the older the stand of plants, the more intensive was the infection; but premature ripening of bunches on the plant, as previously recorded by Australian workers, was nowhere observed. During 1936 production was seriously affected: plants at all stages of development were severely spotted, many bunches showed slow or arrested development and an increasing number of commercial bunches was spoilt by premature ripening. During an inspection in January 1937, practically every bunch of export size showed this symptom. The intensification of infection to the point where premature ripening of bunches becomes general is the most serious economic aspect of this disease.

PHYSIOLOGICAL ASPECTS

On physiological grounds, several aspects of the disease require comment. It is known from detailed studies undertaken by Stahel in Suriname that leaves can only be infected when quite young, that is, at the time of unrolling or soon after, the pathogen entering by way of the stomata. Penetration of the tissues takes place slowly, typical lesions requiring from three to four weeks for development. Although *C. musae* may cause serious losses on a wide range of soil types, the severity of spotting and rapidity of leaf destruction appear to be associated with certain adverse growth conditions, unfavourable water relations (as in water-logged clay soils, light soils subject to rapid drying out, etc.) being important. The debility and premature ageing of leaf tissues, known in some instances to be determined by unfavourable water relations, may be envisaged as standing in somewhat the same relation to Cercospora leaf disease as does the premature senescence of fruits to the early development of latent infections. It is relevant to note that in resistant varieties only the oldest leaves normally become spotted. But where such varieties are being grown under conditions which make for extreme physiological drought, some of the younger leaves may also show the development of typical Cercospora lesions.

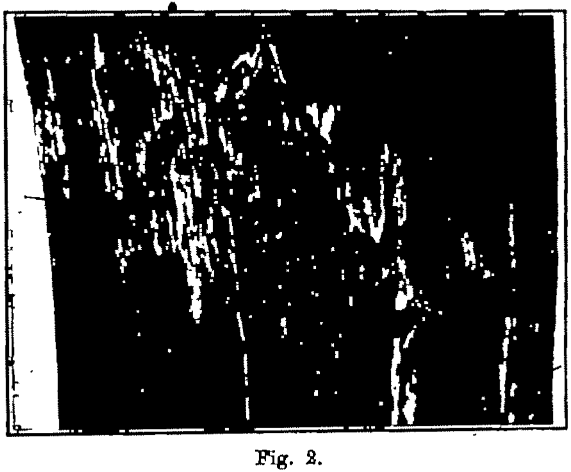


Fig. 2.

SEVERE SPOTTING OF LEAVES BY *C. musae* Zimm. FOLLOWED BY THE DESTRUCTION OF CONSIDERABLE AREAS OF LEAF TISSUE.

Severe leaf spotting is accompanied by the development of a buff to pale ochraceous salmon colour in the pulp. A less conspicuous but easily observable symptom is the presence of a characteristic pale bluish discoloration of some of the vascular strands of the true stem. These contain vessels in which various pathological symptoms, including the production of tyloses and the collapse of vessels, have been or are being induced as a result of the diseased condition of the leaves. In severely diseased plants, where the bunch is still quite small and immature, this symptom can also be observed. As the development of the bunch proceeds directly from the storage rhizome and indirectly from the leaves, it may be suggested that, as a result of severe leaf disease, the rhizome is itself to some extent in a physiologically unbalanced condition or affected by toxic fungal secretions. If support for this view can be obtained, it will have an important bearing on the elucidation of the progressive intensification of infections described above, and of other aspects of the disease.

EFFECT ON COMMERCIAL FRUIT

Severe attacks of Cercospora leaf disease are accompanied by a premature ripening of bunches while still attached to the plant. When the disease is less severe, apparently normal green bunches may be harvested, but during the 30–36 hours that elapse before the bunches are charged into the holds, individual fruits or a majority of the fruits of affected bunches may become soft and yellowish. In still less severe infections, affected bunches may escape detection at the wharfside, but may become soft and coloured during the period of refrigerated transport. Bunches which are only slightly affected may behave as approximately normal fruit.

In bulk storage trials, details of which are given elsewhere[4], it has been conclusively demonstrated that when bunches harvested at "¾-full" (English) grade from a plantation showing what might be described as an intermediate intensity of Cercospora leaf disease, are held at 53° F. for fifteen days with subsequent ripening at 68° F., evidence of abnormal storage behaviour can be observed. Affected fruit is characterized by pulp or a more or less well-marked buff colour, it tends to ripen prematurely, to develop 'chilling' symptoms during the period of refrigerated transport, and to ripen with undesirable rapidity on removal to a higher temperature. Flavour and aroma are also affected. So far nothing is known of the biochemical nature of the abnormalities present in affected fruit at harvesting, but after cold storage it may be expected to share some of the undesirable features of fruit which has been chilled. 'Cercospora bunches' ripened at tropical temperatures frequently show a profuse development of anthracnose spots (*Glœosporium musarum*) on attaining to the 'eating ripe' condition.

The effect of Cercospora leaf disease on fruit physiology is twofold: (i) ripening abnormalities are introduced; and (ii) bunches tend to remain of small size; hence, as fruit may actually be considerably more mature than is indicated by its appearance, further departures from the normal storage behaviour for that grade may be anticipated.

SPECIFIC AND VARIETAL SUSCEPTIBILITY OF BANANAS

Since the first recognition of this disease, various commercial varieties, including the Gros Michel, Dwarf Cavendish, Congo and Giant Governor have proved highly susceptible under plantation conditions. When plants of the Imperial College Hybrid, I.C.2 (derived from *M. acuminata*, a wild seeded species as male parent, and the Gros Michel as female parent) were established in close proximity to severely affected Gros Michel plants, it was observed that spotting only occurred in a mild form on the oldest, senile leaves. This variety, in brief, apparently possesses considerable inherent resistance to infection or exploitation by *Cercospora musæ*—an observation which again directs attention to the importance of attempting to secure new commercial types of bananas by appropriate hybridization studies.

By way of amplifying knowledge of the relation between hereditary constitution and susceptibility to Cercospora leaf disease, a survey was made by Prof. E. E. Cheesman and the writer of the very considerable collection of types, species and hybrids available for study at the Imperial College of Tropical Agriculture[5]. Three definite conditions have been recognized: of the twenty-two types and two sub-types, thirteen are definitely susceptible, eight are highly resistant or immune, and three are *mildly* susceptible, spotting as a rule occurring only on the oldest leaf of fully grown plants, or plants bearing bunches. Among the species collection, a high degree of resistance is the rule: *M. acuminata* Colla (clone *A*), *M. balbisiana* Colla (clone Ceylon), *M. textilis* Nee, *M. ornata* Roxb., Pisang Lilan, undetermined species from Annam and Burma have consistently remained quite free from Cercospora spotting although growing in close proximity to severely infected stools of susceptible varieties. Among a third collection comprising sixteen different clones, referred to *M. balbisiana* (*M. sapientum* L. *senus* Roxb.) no spotting has occurred. In the collection of Imperial College hybrids, most of the plants, with some interesting exceptions, are quite free from leaf spotting. Among a large number of other hybrids in which hereditary characters from parental wild species are prominent, a noticeable absence of leaf spotting is again the rule.

In both the species and hybrid collections it is to be noted that infections described as *mild* are all characteristically of one kind, spotting occurring only on the oldest leaf. Recent field observation on plots of I.C.2, located in different parts of the island, indicate that where Cercospora infections occur, they are invariably of the mild type.

The hybrids mentioned above have been raised in the course of a breeding programme directed primarily towards the control of Panama disease (*Fusarium oxysporum cubense*) and their resistance to an entirely different malady is as interesting as it is potentially important. It may also be pointed out that the eight varieties highly resistant to Cercospora are all likewise highly resistant to Panama disease. The numerous qualities required of a commercial banana remain the same whether it is to be bred resistant to a wilt or to a leaf spot. Evidence has accumulated to show that combining those qualities in a single plant is the real problem of banana breeding, rather than disease resistance alone. The conclusion has already been drawn that the greatest hope of obtaining a good export banana resistant to Panama disease lies in breeding from Gros Michel with appropriate wild species. It follows that the best hope of obtaining a good export banana resistant to Cercospora leaf spot lies in the same direction[5].

---

[1] Wardlaw, *Trop. Agric.*, 11, 7, 173–175 (1934).

[2] Stahel, *Trop. Agric.*, 14, 9, 257–264 (1937).

[3] Wardlaw, *Trop. Agric.*, 14, 4, 117–118 (1937).

[4] Wardlaw, Leonard and Barnell, *Trop. Agric.*, 14, 6 (1939).

[5] Cheesman and Wardlaw, *Trop. Agric.*, 14, 12, 335–36 (1937).

OBITUARY

Dr. E. T. S. Appleyard

THE tragic death of Dr. E. T. S. Appleyard through injuries caused by a fall came as a great shock to his many friends. He was born in 1904, the son of Edgar Snowden and Elizabeth Appleyard of Huddersfield. He received his school education at Almondbury Grammar School and entered Cambridge as a scholar of King's College. Taking a first class in physics in the Natural Science Tripos, he spent several years on research in the Cavendish Laboratory. In 1929 he was appointed to a George Wills research associateship in the Wills Laboratory at Bristol, a post which he held until his death. During the tenure of this post he was awarded a Rockefeller fellowship for the session 1931–32 in the University of Chicago.

Appleyard's first research in the Cavendish Laboratory was on the polarization of the light emitted from atoms bombarded by a directed beam of electrons, and this was afterwards extended to the case of excitation by positive ions.

Following upon a few minor papers in spectroscopy in his earlier years at Bristol, Appleyard embarked upon a new field to which he made important contributions. With Lovell (*Proc. Roy. Soc.*, 1936, 1937) he investigated the nature of thin metallic films of the alkali metals evaporated on to a cooled surface *in vacuo*, by measuring their electrical conductivity under varying conditions. This work threw an entirely new light on the subject and cleared up many previous discrepancies in the literature. He followed this with similar work on mercury films, and with the co-operation of the Royal Society Mond Laboratory and the collaboration of Bristow, Misener and London, he extended the investigation to the superconducting state. A summary of his results on the variation of magnetic field penetration with temperature has already appeared in these columns (143, 433 ; 1939), and his last active work was to complete the paper describing the investigation in detail. Its consequences are of much significance and the results have already created considerable interest.

Appleyard was a very able physicist with an acute and critical mind. His wide knowledge, not confined to his own fields of work, made him an invaluable member of a research laboratory. In addition to research he took his share in the teaching and supervision of Part II honours students at Bristol, a number of whom have stated how much they appreciated the thought and time he gave to their interests. Indeed his willingness to be of assistance to everyone in the laboratory, academic and laboratory staff alike, and his desire to ensure that the fullest credit was given to all who helped him in his work, was one of his most lovable characteristics.

Appleyard experienced great pleasure, which his colleagues shared, on the success of his recent experiments on superconductivity, and a fruitful field of research for some years on similar lines seemed to be open to him. It must now be left to others to carry it on. He will be sadly missed. A. M. TYNDALL.

WE regret to announce the following deaths :

Dame Maria Ogilvie Gordon, known for her work on the geology of South Tyrol, on June 24.

Sir Frederick Hobday, C.M.G., honorary veterinary surgeon to the King, formerly principal of the Royal Veterinary College, on June 24, aged sixty-nine years.

Dr. Witmer Stone, emeritus director of the Academy of Natural Sciences of Philadelphia, on May 23, aged seventy-two years.

Dr. Yojiro Wakiya, formerly director of the Fisheries Institute, Fusan, Chosen, on April 21, aged sixty-seven years.

NEWS AND VIEWS

The Royal Visit to America

THEIR MAJESTIES were greeted on their return to England on June 22 and again on their drive to, and from, the Guildhall in the City of London on the following day with enthusiasm which needed no pageantry, no ceremonial, to quicken its sense of the significance of the events of the brief period which have elapsed since the King and Queen sailed for Canada on May 6. King George and his Consort were being hailed as conquerors—conquerors of a continent—no less certainly than were those of their predecessors, who in days gone by had passed through Temple Bar to celebrate a victory in the capital city. In this enthusiastic, but intimate, greeting of King and Queen there was a deep and strong undercurrent of loyal gratitude to them that in their journey from one end to the other of the vast Dominion of Canada, and no less in their visit to its great neighbour, the United States of America, their Majesties had so borne themselves that personal devotion to those wearing the Crown and a spirit of kindly hospitality to honoured guests had been transmuted to a deeper consciousness of the common devotion of all, President and citizen, Sovereign and subject alike, to the ideals of liberty and justice which transcend birth, creed and the barriers of national division in a supreme loyalty to the cause of humanity. In all the ceremonies and incidents of the Royal tour which, as His Majesty said at the Guildhall with a homely but happy touch of common interests, have been made "familiar . . . through the daily press, the news reels, and the Broadcasting Corporations", none was so deeply charged with emotion, none so moving to those gifted with historical imagination, as the simple scene in which King George laid a wreath upon the tomb of George Washington. This act of homage epitomizes as a symbol a memorable episode in the history of the British Commonwealth of Nations no less surely than His Majesty's impression of his experience, summed up in the memorable words "the strength of human feeling is still the most potent of all the forces affecting world affairs".

Pilgrim Trust Lecture

THE Pilgrim Trust Lectures, administered jointly by the Royal Society and the U.S. National Academy of Sciences, were inaugurated last December by a notable lecture delivered by Dr. Irving Langmuir in the theatre of the Royal Institution, London. The selection of the lecturer for the second of the series was in the hands of the Royal Society, which decided, most appropriately, to send its president, Sir William Bragg, as the ambassador of science in Great Britain to the United States. Sir William visited the United States during the spring, and on April 24, in the course of the annual meeting at Washington of the National Academy of Sciences, delivered the second Pilgrim Trust Lecture, which appears on p. 21 of this issue of NATURE. The effect of science upon social conditions formed the theme of Sir William's address, which he illustrated by dipping into the history of the Royal Society. Starting as a body of 'virtuosi' who met for discussion and experiment about the middle of the seventeenth century, the Royal Society early became concerned in problems of interest to a wider circle and to the State. Inquiries submitted to correspondents, their reports, and papers read before the Society, illustrate the effects of science upon society and conversely, of the circumstances of the times upon scientific investigations. Sir William leads up to an eloquent plea for the earnest consideration of current affairs in the spirit of science, which links up with the efforts of the Division for Social and International Relations of Science of the British Association; the Manchester meeting of the latter referred to on p. 1 of this issue deals specifically with some social aspects of scientific research, while Sir William points the moral on the wider issue.

Mr. M. G. Evans

THE chair of physical chemistry in the University of Leeds which fell vacant by the death of Prof. H. M. Dawson in February last, has been filled as from October 1 by the appointment of Mr. M. G. Evans, lecturer in chemistry in the University of Manchester. Born on December 2, 1904, he was educated at Leigh Grammar School and passed through the University of Manchester, where he was a pupil of Prof. A. Lapworth. While Prof. Hugh S. Taylor of Princeton was staying as a visitor for one term at the University of Manchester in 1931, Mr. Evans joined him in research on adsorption, and he renewed this connexion later by working for one year in the Frick Chemical Laboratory in Princeton, where he was closely associated with Prof. Henry Eyring. Since his return to Manchester in 1934, Mr. Evans has steadily developed his theoretical investigations on the mechanism of chemical reactions. During this time he has richly contributed to the fund of ideas which, it is the hope of the younger school of physical chemistry, promises to form a pattern for the understanding of at least the simpler types of reactions. Though Mr. Evans's principal contributions to science are in the theoretical field, he also took active interest in the experimental work carried on in Manchester. His appointment to one of the three chairs in the Department of Chemistry in Leeds is a significant recognition of the part which the new theories originating from quantum mechanics have to play in the life of chemistry to-day.

Dr. J. B. Speakman

THE appointment of Dr. J. B. Speakman to the chair of textile industries of the University of Leeds will afford pleasure to the many admirers of his work on the structure and properties of the wool fibre. Dr. Speakman is a graduate and D.Sc. of the University of Manchester, where, except for a period of war service, he spent the years 1915–1920. His next three years were passed at Eton with Prof. R. Whytlaw-Gray, carrying out research on aerosols for the Chemical Warfare Committee. Since 1925 he has been in charge of the Textile Chemistry Laboratory of the University of Leeds, where he was appointed lecturer in 1925 and reader in 1937. Dr. Speakman has been awarded the Warner Memorial Medal of the Textile Institute, and three times he has been the recipient of the Research Medal of the Worshipful Company of Dyers. He has also served for a dozen years on the council of the Textile Institute, and on the Publications Committees of the Textile Institute and the Society of Dyers and Colourists. Under his direction, the Leeds Textile Chemistry Laboratory has attained a high and well-deserved reputation, and his new appointment will undoubtedly lead to still wider successes in his chosen field.

Dr. R. G. S. Hudson

DR. R. G. S. HUDSON has been appointed to succeed Prof. A. Gilligan as professor of geology in the University of Leeds. Dr. Hudson studied geology at University College, London, under Prof. E. J. Garwood. He later joined the staff of the Geological Department at University College and commenced research on the fauna of the Yoredale Series. He continued his interest in Carboniferous stratigraphy after his appointment in 1922 to the geological staff of the University of Leeds. The greater part of his work has dealt with the Dinantian and Namurian of Yorkshire especially with the relation between the various facies and faunal assemblages. He early demonstrated the unconformable junction between the Lower and Upper Carboniferous of Yorkshire; later, with Dr. G. H. Mitchell he described the geology of the Skipton anticline, and with the aid of various grants put down a boring in that area to the base of the Carboniferous. He has devoted attention to the Variscan orogeny and its control of sedimentation. His interest in the fauna of the Carboniferous has resulted in the description of new genera and species of corals such as Rylstonia, Rhopalolasma, and various species of Orionastraea. In 1931, Dr. Hudson was awarded the Wollaston Fund of the Geological Society and has served on the Council of that society. He has also been secretary of various committees of Section C, British Association, and is now joint secretary of that section. Dr. Hudson has taken considerable part in the organization of the geological societies in Yorkshire, and for some years has been editor of the *Proceedings of the Yorkshire Geological Society* and the *Transactions of the Leeds Geological Society*.

Imperial Cancer Research Fund: New Laboratories

THE new laboratories of the Imperial Cancer Research Fund were opened on June 27 (see also p. 41). Sir Humphry Rolleston, chairman of the Executive Committee, read a message of regret from Lord Halifax, president of the Fund, who at the last moment had found himself unable to attend. Lord Halifax said that all would appreciate that at the present time he is even more than usually subject to sudden and unavoidable calls on his time and that although he ought not, perhaps, to have agreed to open the new laboratories he had been particularly anxious to do so. Lord Halifax sent the notes which he had prepared for his speech, in which he reviewed the history of the foundation of the Fund and its progress. He referred to the many famous men, including Lord Lister, A. J. Balfour and Joseph Chamberlain, who helped the Fund and mentioned the policy of collaboration with all organizations at home and abroad which has been followed throughout the thirty-seven years of the Fund's existence. An address on "Scientific Aspects of Cancer Research" was delivered by Sir Frederick Gowland Hopkins, whose theme was the importance of laboratory effort in cancer research. He expressed his own faith that each increase in accommodation provided for skilled laboratory effort has never failed to be justified by its results. Sir Frederick described the distinguished past of the Fund and stated his confidence in a future of continued and eminent success. A vote of thanks to Sir Frederick was proposed by Sir Robert Hutchison, president of the Royal College of Physicians and seconded by Mr. Hugh Lett, president of the Royal College of Surgeons.

THE laboratories, designed by Messrs. Lanchester and Lodge, occupy an open position on the Ridgeway at Mill Hill. The three-storied main building is built in T-form with a central staircase; the corridors, as a result, are short and well-lighted. A goods lift serves one wing which is devoted mainly to animal rooms, stores and service rooms. The library, offices, one large laboratory, a room for X-ray equipment, centrifuge room, workshops and stores are on the ground floor. The first floor comprises a large chemical laboratory with a smaller laboratory adjoining, five other private laboratories, photographic room, sterilizing room and animal rooms. The Director's office and laboratory are on the second floor, where there are three other laboratories, operating room, histological room and animal rooms. There is a cold room in the basement. The laboratories vary in size; some are suitable for one worker using simple equipment; others can accommodate two or three workers or bulky apparatus. Most of the rooms have one high and one low bench each with a sink supplied with mains pressure water and hot water; gas and 5 and 10 amp. electric points are provided. The natural lighting, by large windows, is notably good. Artificial light is supplied by central pendants and supplemented, wherever required, by Anglepoise table lamps. Elaboration of structure and equipment has been avoided in favour of adaptability to varied needs. A detached animal house is designed for work with the larger animals; provision is made for the maintenance of fowls and the normal stock of rabbits and guinea pigs. Other animals, as required, are accommodated in out-houses. There are six acres of land available for pens, grazing and the cultivation of food crops for animals.

The Decline of Population

A DEBATE on the prospective decline of population took place in the House of Lords on June 21. Lord Samuel pointed out that whereas the number of live births per 1,000 women of child-bearing age was 129·8 in 1891, at the census of 1931 it had fallen to 64·3, that is, almost exactly half in the forty-year period. In the earlier period one out of every four married women between the ages of fifteen and forty-five years gave birth to a child in any particular year, while in 1931 this was only true of one in eight. Counterbalancing effects, the fall in the death-rate and the change from emigration to an inward movement of people, was far from equalling this decline in the birth-rate. He advocated family allowances as a means of diminishing the cause and desire for small families. Other measures suggested were housing estates for larger families and removal of the marriage bar in certain occupations such as bank clerks and women teachers. He advised the appointment of a Royal Commission to inquire into the whole question. Lord Snell said that the real problem is qualitative rather than quantitative and that the question of age proportion is most important. Lord Dawson of Penn said the prospective fall in population is too great even if we have regard to quality, as the country has failed to reproduce itself since 1925 and to-day 100 mothers only produce 76 girl babies or future mothers. Contraception is a specialized example of man's gradual control of natural sources and is spreading to all classes and creeds. It should be seen that parents willing to bear their quota of children should not be penalized. In tenement blocks there should be crèches, nursery schools and other necessities, and the health services should be linked up into a connected whole.

LORD STAMP said there is little popular apprehension on this subject because we are still living under the delusion of continual expansion. He pressed for a quinquennial census to provide the necessary information for a Commission. Boys between the ages of thirteen and eighteen years in England and Wales in 1938 numbered 2,100,000. In seven years this will fall to 1,787,000. The effect of this tendency is already being felt in schools. The Bishop of Norwich remarked that his predecessor a century ago had thirty-seven children while that Bishop's two brothers each had thirty-two children. Households of the better stock now have small families, for one reason, because of the necessity for domestic help in rearing a family. Lord Derwent said family allowances would be inadequate without propaganda, and that the birth-rates of France and Italy continue to decline. This is principally from incertitude regarding the future. The Archbishop of York said that while the older men who have been out of work prefer to get back to work even if their wages amount to less than their relief, this is by no means true of the younger men. They should ensure in some way that a man in work always obtained more than a man without work. Lord Templemore put forward the view that some forecasts anticipate an earlier decline of population than appears justified. For the first time since 1873, the birth-rate began to rise in 1934 and this has continued for the last five years. But too great value should not be placed on that. As regards family allowances, public opinion has not yet crystallized. The Population Statistics Act, 1938, would supply information which should throw light on the incidence of fertility in different sections of the population.

Students and Military Training

THE adoption in Great Britain of the principle of conscription and the calling up for registration of youths between the ages of twenty and twenty-one years for a period of military service has raised the question of the position of university students. As regards those proceeding to universities after October next, Mr. E. Brown, Minister of Labour, stated in the House of Commons on June 22, that at a meeting held under the auspices of the Ministry between representatives of the Committee of Vice-Chancellors and Headmasters, together with representatives of the departments concerned, it was agreed unanimously to recommend that such boys should be given the option of postponing or anticipating their liability to undergo military training. Mr. Brown said he intended "to put this agreed conclusion into operation, subject to reviewing the position in twelve months' time in the light of experience, when I propose again to seek the advice and assistance of the representatives of the universities and the schools". He also agreed to bear in mind the further recommendation that those under the age of eighteen years on January 1 of the year in which they wish to take their training should not be allowed to anticipate their military service.

Biological Expedition to Jamaica

A LARGE expedition is leaving the University of Cambridge for Jamaica this summer. It is financed by the Royal Society, the Royal Geographical Society, Mr. J. A. Steers, Gonville and Caius and St. Catharine's Colleges, Cambridge, and the Universities of Cambridge, Manchester and Sheffield. The members of the expedition are Dr. V. J. Chapman, the leader, university demonstrator in botany, Cambridge; Dr. H. Hamshaw Thomas, reader in plant morphology, Cambridge; Mr. J. A. Steers, lecturer in geography, Cambridge; Mr. J. S. Colman, lecturer in zoology in the University of Sheffield; Mr. W. R. Philipson, of the British Museum (botany); Mr. K. R. Sporne, of Downing College; Mr. J. Lofthouse and Mr. D. J. Crisp, both of St. Catharine's College. The main party is proposing to examine shore-line development in relation to the formation of coral reefs and cays and also to the salt ponds, and it is intended to make a comparison of the cays and the mode of their formation with similar structures in the Great Barrier Reef. This will be facilitated by the presence of two members of the Great Barrier Reef Expedition—Mr. Steers and Mr. Colman. Dr. Chapman will examine the botanical side of this problem, and is intending to devote particular attention to the mangroves. A party consisting of Dr. Thomas, Mr. Philipson and Mr. Sporne is going to spend a month in the rain forest where each will carry out research on his own problems: Dr. Thomas working on the Pteridophyta, Mr. Philipson collecting, because he is one of those appointed to complete the late Dr. Rendle's "Flora of Jamaica", and Mr. Sporne investigating flower morphology. The whole expedition will return at the beginning of October with the exception of Mr. Philipson, who will stay on for a few more months.

Earthquake on the Gold Coast

EARTH tremors shook the whole district of the Gold Coast, Ashanti, Dahomey and Western Nigeria in West Africa from about 7.10 p.m. on June 22 to 4 a.m. on June 23. It is not yet clear whether there were several shocks of approximately equal dimensions from one or several closely situated epicentres, or whether there was one large earthquake with precursors and aftershocks. With the evidence available at the moment, the latter appears to be the most probable as the greatest impact of the earthquake was felt at Accra (5° 30′ N., 0° 10′ W.), Cape Coast (5° 5′ N., 1° 0′ W.), and Sekondi (4° 53′ N., 1° 48′ W.) at 7.15 p.m. on June 22. If the intensity of the shock was the same at each of these three places, as the immediately available evidence seems to indicate, then the epicentre was near 5° N., 1° W. and the focus rather below normal, or it was, say, 3·5° N., 1° W. in the Gulf of Guinea and depth of focus normal. Further evidence from the area, but more particularly the evidence of seismograms, will decide this. Many public buildings, banks, offices and native houses in the area have been damaged or destroyed, killing seventeen people at Accra, twenty-nine at Cape Coast and twenty at Sekondi, besides injuring several others. At Accra the electric lighting system was interrupted, but this was quickly remedied. An earthquake of these dimensions is an exceptionally rare occurrence, if not unknown, near Accra, and according to recent catalogues of epicentres there is no active epicentre anywhere near the present one. It is unfortunate that there are no seismographs situated nearer the probable epicentre than Algiers, Johannesberg, Cape Town and Nairobi, though the shock appears to have been sufficiently intense to have been registered at these, and by seismographs at even greater epicentral distances.

Entomological Control of Lantana

THE rapid spread of Lantana, a garden escape, in Northern Queensland has brought it amongst the serious weed pests for which the Council for Scientific and Industrial Research, Australia, is seeking methods of control. In 1935 studies of *Teleonemia lantanae* were commenced in Fiji, where this bug had been introduced from Mexico, its native home, by way of Hawaii. As it proved harmless to any Australian plants of economic importance, it was established under quarantine conditions in Canberra in 1936. The first liberations were made late in that year in the Northern Rivers area of New South Wales, and afterwards near Atherton in Queensland, and at Rockhampton. Disappointment followed; the bugs seemed to have disappeared, until in April of this year they were reported in the Atherton district in enormous numbers over an area of some twenty-four acres. Leaves were falling from the Lantana bushes, flowers had been destroyed and in some instances up to two feet of the ends of branches had been killed as the result of the bug feeding on them. At Rockhampton also there are signs of establishment. Undue optimism is to be deprecated, and it is unlikely that similar success will be attained to that of Cactoblastis on prickly pear. It still remains to be seen whether Teleonemia can maintain itself in large numbers and whether continuous defoliation will destroy Lantana; nevertheless, the outlook is promising.

Exhibition of New Textile Fibres

AN exhibition of new textile fibres has been arranged at the Science Museum, South Kensington, and will be opened on July 3 for two months. To-day fibres possessing many of the properties of natural wool are manufactured from skimmed milk. The exhibit illustrating the stages in the manufacture of casein yarn includes several examples of fabrics, woven on worsted machinery. Another group of exhibits includes yarns and materials as produced by the viscose and cellulose acetate methods. These are generally termed rayon or 'artificial silk'. By modification of the spinning processes it is now possible to manufacture exceptionally strong yarns of this material, and some of the applications are illustrated by such articles as a section of a motor tyre showing the cord reinforcement, 'doped' aeroplane fabric, fine gauge hose, sail cloth, etc. An interesting American exhibit shows a new type of cellulose acetate rayon in which the fibre is characterized by an inherent stabilized crimp, producing a yarn the behaviour of which is comparable in some respects to that of wool. One of the most important textile discoveries of recent times has been that of nylon. This is a truly synthetic yarn and is the first textile fibre prepared wholly of raw materials from the mineral kingdom. Although derived from coal, air and water, nylon can be produced in filaments of exceptional strength or as fine as a spider's web, yet having elasticity and lustre. Another striking development is to be found in the use of glass fibres. Objects showing this class of fibre include woven and knitted fabrics made entirely of pure glass with a collection of articles indicating the commercial applications. An exhibit of interest from Tokyo shows fibre and yarn produced from seaweed. Jute, sisal, and hemp are each represented, with examples of the latest types of yarns and materials produced from these fibres.

British Museum (Natural History): Acquisitions

RECENT acquisitions in the Department of Zoology include a collection of Northern Rhodesian mounted heads and skulls of ungulates made chiefly at Mpika by the late Mr. F. H. Melland and presented by Mrs. Melland. The collection contains some very fine sable and roan antelope heads and is of special interest in that the species represent a transition stage from the southerly types of South Africa to the more northerly forms found in Tanganyika Territory and Kenya Colony. Another interesting gift is the skull of a hippopotamus from Nigeria presented by Mrs. Piper. Purchases include a large collection of South American mammals from Dutch Guiana, and another from Ecuador. The latter is worthy of special mention since it contains a series representing that most interesting genus of Diprotodont marsupials, Caenolestes. The Department of Mineralogy has received a series of specimens of Darwin glass from Mt. Darwin, Tasmania, collected and arranged by the late Mr. Hartwell Conder and presented by his widow. Darwin glass is a silica glass. Thousands of tons of it in the form of rounded and rod-like pieces are found over an area of sixty square miles in Tasmania. It is believed that the silica-glass was formed by the heat engendered by the impact of a large meteorite. Some crystals of the rare mineral withamite, a pink variety of epidote, have been presented by Mr. W. G. Myers, who found them at the type locality in Glencoe where the new road has cut through the lavas in which withamite occurs. Good crystals of this mineral are rare. A very large rough crystal of microcline feldspar from Norway has been purchased. This crystal measures about 14 × 12 × 10 inches and weighs about 100 pounds.

Report on Abortion

THE report of the Inter-Departmental Committee on Abortion, which was appointed by the Minister of Health and the Home Secretary under the chairmanship of Mr. Norman Birkett, K.C., has been issued (H.M. Stationery Office. 2*s*. 6*d*. net). In the Majority Report, signed by fourteen members, the question of the prevalence of abortion is first examined. They stress the difficulties entailed in arriving at any estimate; but suggest that the number of abortions occurring annually in England and Wales is between 110,000 and 150,000, of which perhaps forty per cent are criminal. The Committee discusses the existing law, analyses the motives for criminal abortion and the methods employed, and examines proposals for amending the law. It recommends that the law should be clarified so as to make it plain that the induction of abortion is legal when the operation is carried out to save the life, or to prevent impairment of health, of the pregnant woman, but expresses strong opposition on ethical, social and medical grounds to any broad relaxation of the law. It is recommended that therapeutic abortions should be notifiable by the operator to the medical officer of health, and that there should be some restriction on the sale of abortifacient drugs. The majority of members of the Committee are not prepared on general grounds to recommend the unrestricted dissemination of birth control advice by the public health services.

The New Radcliffe Observatory

IN *Occasional Notes Roy. Astro. Soc.* (No. 4, March 1939), Dr. H. Knox-Shaw gives a very full description of the work on the erection of the 74-inch reflector at Pretoria, and three plates illustrate various parts of the equipment, the turret, the telescope itself as viewed from the north-east, and also the Newtonian observing carriage and the Coudé room. It is satisfactory to know that the pyrex disk for the large mirror has been successfully cast and the figuring will be completed in a few months, after which the mirror will be sent to Pasadena for aluminizing. It will be possible to use the telescope at three foci, Newtonian, Cassegrain and Coudé, the focal length in the first case being 30 feet, and the equivalent focal lengths in the last two being 111 ft. and 173 ft. respectively. The Newtonian focus will be used for direct photography and the other two for spectroscopic observation. A two-prism spectrograph for use at the Cassegrain focus is under construction and will soon be ready, and a projection measuring machine and also a microphotometer have been made for the Observatory. It is anticipated that the full programme of the work will be undertaken early in 1940, and the initial programme will include the determination of the radial velocities of the *O* and *B* type stars in the portion of the galaxy beyond the reach of the northern observatories. The object of this research is to corroborate present views on galactic rotation. When opportunities occur, photography of the nebulæ south of −40° declination will be undertaken

Museums and Children

THE revival of museum efforts which in Great Britain has followed upon the Miers report, has fortunately included in its sweep attempts to increase facilities for the interest and education of the young. But in this aspect of museum work America undoubtedly leads the way, and everyone interested in juvenile education must be grateful to Miss Ruth Weston for her impressions of American methods which appear as a supplement in the ***Museums Journal*** (39, 93, May 1939). Her first impression is one of the bold conception, enterprise, and general 'aliveness' which have produced such museums. Some are special children's museums housed in their own special buildings, in several instances right away from any other museum. Others form sections of larger museums, with special exhibition and other rooms for juveniles, either as an isolated wing or included within the main building. Sometimes the show galleries are supplemented by club rooms, library rooms, reading rooms, and a lecture theatre, which in Boston Children's Museum can seat more than 500. Loan collections of natural history objects for schools and even for individual child borrowers (as at Brooklyn), loan art collections, recording in colour and in black and white the development of art in different periods and countries (like the 2,000 reproductions at Toronto Art Gallery), have become the order of the day in these progressive museums. Much has been done in some British museums, but much more must be accomplished if museums are to play their part in the educational system; and there should be the less hesitation in transforming some of the now existing severe and aridly didactic galleries into simplified children's galleries, since our observation is that adults enjoy and benefit from the children's exhibits as much as the children themselves.

The World Power Conference

THE annual report of the World Power Conference for 1938, prepared by the Central Office of the World Power Conference, 36 Kingsway, London, W.C.2, has just been issued. There was a meeting of the International Executive Council in Vienna during August 29–September 1, attended by more than a thousand persons from thirty-seven different countries. The British Council was officially represented by Sir Harold Hartley and J. M. Kennedy. The British delegation numbered ninety-three and was nearly double the size of any other visiting delegation. Approximately two hundred papers were presented at the meeting. It is hoped to publish these papers and the discussions on them this year in the *Transactions of the World Power Conference*. A new national committee has been formed for Algeria, and there are now forty national committees. In response to an invitation issued and accepted in 1936, the second Chemical Engineering Congress of the World Power Conference will be held in Berlin in 1940. At the same time and place the third Congress on Large Dams will be held. The questions to be discussed have already been fixed. By invitation of the Swiss National Committee a meeting of the International Executive Committee will be held in Zurich shortly.

"Micro-entomology" at Stanford University

WE have received several parts of the journal entitled "Microentomology: Contributions to Entomology from the Natural History Museum of Stanford University". This periodical is now in its fourth volume, and it only publishes papers emanating from the Museum just named. The text is from manuscript expressly typed by the Stanford University Press and reproduced by the photolith method. This type of publication has been adopted as a partial solution of the prevailing high costs of printing by monotype and hand-set type. The reproduction has been admirably carried out, but the main factor in the process is the perfect typing of the copy, since the method affords little or no opportunity for errors and corrections. Among the papers published in this journal is a series of articles on the Coccidæ by G. F. Ferris and collaborators. These are well and clearly illustrated and, in fact, illustrations form the notable feature of this publication, the saving on printing costs allowing for an unusually large number.

New Seismological Observatory

IT is learned from *Earthquake Notes* (10, No. 4, April 1939), published by the Eastern Section of the Seismological Society of America, that a new seismological station is soon to be established at Bogotá, Colombia, South America. It will be at a height of some 2,800 m. above sea-level in the Northern Andes, and will thus be one of the highest in the world. This is made possible by a grant from the Carnegie Corporation of New York to the Jesuit Seismological Association, and the director of the station is J. Emilio Ramírez, S.J., of St. Louis University. The new station will fill a very noticeable gap in the map of seismological observatories, and will supply a definitely seismic area with important observational facilities.

The Lister Institute of Preventive Medicine

THE annual general meeting of the Lister Institute of Preventive Medicine was held on June 16 when the governing body presented the Institute's forty-fifth report. This contains a survey of the Institute's activities, with financial statement and the staff changes, during 1938, and a summary of the research work pursued. Studies on viruses are prominent, and Dr. Eagles has investigated a possible virus factor in the causation of acute rheumatism. Serological investigations include further work by Dr. Felix on the antigenic structure of the typhoid bacillus and on the standardization of therapeutic anti-typhoid serum, and a study by Dr. Muriel Robertson on the immune reactions *in vitro* of certain ciliate Protozoa. The nutritional value of buckwheat and its sensitizing action to light has been studied by Dr. Chick, and the results suggest that the nutritive value of the proteins of wheat are inferior to those of buckwheat. The National Collection of Type Cultures of Micro-organisms is housed at the Institute, and during the year some 6,300 cultures have been distributed, and many new strains deposited for maintenance.

National Baby Week

THE National Baby Week Council (117 Piccadilly, London, W.1) announces that 'National Baby Week' will be celebrated during July 1–7. Propaganda this year will be concentrated on "Fathercraft in the Child Welfare Movement", and the "William Hardt" challenge shield is offered for competition among senior girls in public elementary schools studying infant care. Full particulars may be obtained from the Secretary.

International Exhibition of the Art of Greater India

THE ROYAL ACADEMY, in collaboration with a number of connoisseurs of Indian art, is arranging to hold in January–March, 1940, an International Exhibition of the Art of the Indian Empire, French Indo-China, Netherlands, India, Burma, Malaya, Siam, Afghanistan, Tibet and Nepal. It is believed that the museums and private collections of those European powers most closely connected with the regions of Indian influence can furnish an exhibition of surprising interest and value, which would serve as a prelude to an exhibition of Indian art, drawn mainly from collections in Asia, to be considered when more settled conditions give a reasonable

(*Continued on page 29*)

NATURE

SUPPLEMENT

Vol. 144 SATURDAY, JULY 1, 1939 No. 3635

HISTORY IN THE ARCHIVES OF THE ROYAL SOCIETY*

By Sir William Bragg, O.M., K.B.E., Pres.R.S.

THE archives of the Royal Society are rich in materials that illustrate various aspects of the history of the last three centuries. They have, of course, a special character, since they refer almost entirely to the matters in which the Society has concerned itself, grouped under the general title of "The Improvement of Natural Knowledge". But these matters have increased in importance with the passing years and are now a subject of the first concern of the whole world. The effect of science upon social relations and social conditions has become very great, and the gains are obvious. Yet science does not appear to be in all cases beneficent. It has become a matter of anxious consideration whether or no the increase in the knowledge of Nature must necessarily bring evil as well as good. Is there a fault to be remedied, and if so, where does the fault lie? These questions have roused a debate which is even now in progress, and some hard thinking is being given to them.

It is of some help, I think, to consider the steps by which the present position has been reached, and the Royal Society archives may be used to provide the necessary illustrations.

A few 'virtuosi', to use the contemporary phrase, who met for discussion and experiment in the middle years of the seventeenth century, were weary of the miseries of the civil war, and were glad to turn their thoughts to the consideration of natural phenomena over which the passions of men had no influence. Experimental science had long tempted thoughtful minds, and now the first founders of the Royal Society threw themselves with thankful relief into a work which seemed to them to be both a pressing duty and an absorbing occupation. They were like boys let out of school rushing out into the surrounding world to explore brooks and hedges and anything that seemed interesting. When I take down the first volumes of the *Transactions* from the shelves or look through the early manuscripts at the Royal Society, I feel as if I was turning out schoolboys' pockets and finding the usual assortment of mixed oddities.

Early Activities

In its first efforts, the Society was mainly concerned with the collection of information. The leading fellows sent questionnaires to various parts of the world which in their demand for comprehensive detail would have done credit to any inquisitive department of a modern Government. An admirable example is to be found in the series of questions drawn up by Lord Brouncker and Mr. Boyle and approved at one of the earliest meetings of the Society; in which most appropriate suggestions were made as to what should be looked for on an ascent of Teneriffe. It shows no little knowledge and penetration to inquire whether a "filtre or siphon" would work as well at the top of the mountain as at sea-level, whether a bell or watch or gun would give the same sound, a flame have the same appearance, whether a pendulum clock went at the same rate, whether birds of heavy flight would fly as well or better or worse, and so forth. It was quite apt to ask what alterations would be found in living creatures carried to the top, both before and after feeding, and "what the experimenters do find in themselves as to difficulty of breathing, faintness of spirits, inclination to vomit, giddiness, etc."

On March 28, 1672, Lord Henry Howard presented the answers to a series of questions on

---

* From the second Pilgrim Trust Lecture, delivered before the U.S. National Academy of Sciences on April 24.

R 274

Barbary, where a retainer of his had recently been travelling: a remarkably pictorial account of the country and its inhabitants. It was expected apparently that some traces of the arts and sciences were to be found there, no doubt because it was known that the Arabian races had handed on the knowledge of the Old World to the New. But there was no learning at all. In particular "there were no chemists except Jews and Christian slaves that distilled brandy in jars". So, too, a good account is given of Hudson's Bay and its people by a Captain Guilliaume and a Mr. Bailes, who had recently voyaged there. Naturally most of the information relates to navigation and trade, but it is interesting to find also an account of the 'Maneto' or supreme power and of his priest the 'Pawaw'. The early records contain many such questionnaires and replies thereto.

Robert Boyle was the centre of a vast correspondence on scientific and other matters, and fortunately a large collection of his papers is possessed by the Society. Many or these have been published in his well-known "Life and Works". Quite a number of them crossed the Atlantic, and you will not blame me if I choose some of them to illustrate what I have to say. They were in the main of the informative type on which such great value was set. Thus a certain 'P.S.' writes from Virginia on August 29, 1688, describing humming birds, wampum, roanoke and pook, the latter being forms of currency. The trade measurement of length was the primitive cubit. The climate of New England was a frequent topic; it was supposed to be changing for the better. Perhaps under improving conditions the settlers were less susceptible to its rigours.

The governor of Boston, Leverett, and the deputy governor, Symonds, with other of their fellow citizens, write to Boyle in protest against charges of disloyalty to the King, anxiously rebutting accusations of neglecting the baptism of infants and so forth. In 1682, Hezekiah Usher begs the remittance for twenty-one years of the King's claim for one fifth of all minerals recovered, so that prospecting may be encouraged.

Boyle's correspondence was, as the last two extracts show, by no means confined to scientific matters. After all, the first founders of the Society were either statesmen themselves or closely connected with statesmen, and might well be supposed to be proper persons to be entrusted with important news. Thus Richard Wharton writes from Boston, warning Boyle that the French are working round the interior of the settlements towards Carolina and the South. In 1684, Randolph writes from New England of the possibility of drawing on the vast forests of Maine for supplies of masts and timbers for the navy, and discusses methods of making pitch and resin which are a secret of the French. John Winthrop writes in the same strain urging the Royal Society to approach the Government on the matter: he explains that there are sawmills handy to rivers, houses and provisions for workmen who may be sent, that small ships up to 400 tons have already been built. The supply of timber for the Navy was one of the greatest anxieties of Great Britain, from the time of this correspondence until steel replaced wood. Dry rot was a terrible curse from which the navy suffered more than the merchantmen, because the latter were more often aired and open to inspection during loading and unloading. A strange story of its ravages has recently been told by Ramsbottom in the *Essex Naturalist* (vol. 25). Among the incidents is the probable failure of the *Speedwell* to accompany the *Mayflower* on account of dry rot.

It is well known that Boyle was deeply interested in the conversion of the Indians and that the Society for the Propagation of the Gospel owes much to his initiative. In 1664 he receives a letter from John Endicott, of Boston, describing the progress of the mission. John Eliot, also of Boston, writes frequently, expressing deep gratitude, and hopes for further help. His address to Boyle was always eloquent, as for example "To the Right Honourable Learned abundantly charitable and constantly noursing Father".

In modern times it is an honour and an honour only to be elected a correspondent of a learned society. But a correspondent of the Royal Society in its early days was expected to correspond. When Cotton Mather was advised that he had been elected a fellow, he wrote in 1715 to his friend Richard Waller, the Society's secretary—the letter is in the Society's archives—saying that

> ". . . the tendency [of the Society] to Refine and Sweeten the minds of men, and reconcile them unto Just Regards for True Merits in one another, with an extirpation of that noxious clamour the party spirit, and finally how generously the more polite Literators of the world go on in it, with a decent contempt on the Banters of the Bruitish among the people, but the result of his consideration will be that it will be a greater honour to be taken into the list of your servants, than to be mixed with the great men of Achaia.
>
> "One who is entirely of that opinion, having been so listed with you has been desirous to discharge his obligations by agreeable assiduities, and therefore besides what every year brings you from him as an addition of Curiosities to the rich and vast assessment you are preparing he has bestowed a few hours upon the Philosophical Religion which he now humbly tenders to your acceptance."

The "Curiosities" here referred to became a famous object of interest in London; the collection was known as the "Repository". It grew to so great a size that the Society found it unmanageable, and handed it in 1782 to the British Museum, which had been founded a few years before in order, in the first place, to contain the collections bequeathed to the nation by Sir Hans Sloane. Sir Hans was president of the Society from 1727 until 1741.

The "Banters of the Bruitish" must clearly refer to the scornful comments of many clever men who did not sympathize with the experimental study of the world, who resented the intrusion of the new knowledge and laughed at the apparent futility and irrelevance of its beginnings. If they did not foresee the magnitude of its consequences, they were little more at fault than the experimenters themselves. How could intelligent men waste time on objects so small that they must be examined under the microscope ? Or on the consideration of such intangible substances as the air ? How could they give serious attention to the abnormalities and monstrosities that idle correspondents thrust upon them ? Of course, the Society did at first give its time to many accounts that even then must have looked ridiculous to men of a serious and settled mind. There were, for example, reports of a calf that had its hair inside out, of a man who squinted only on alternate days, of another who could not see if his hair were suffered to grow more than an inch long. It must have been quaint hearing when Dr. Tyson, at a meeting of the Society, declared that one of his teeth having been drawn at Oxford some years before had been replaced and had apparently taken root again, since it was still of use. In those early days of inquiry it was of course necessary to sift all information that came to hand, but it would certainly be difficult for the unscientific mind to see the point in all cases.

APPLICATION OF RESEARCH

These oddities were, however, an insignificant part of the Society's proceedings. Of far more importance among the Society's early papers are such as deal with the pressing questions of the day. Navigation claimed much attention. I have already referred to the anxieties respecting a sufficient supply of masts for the navy. Perhaps the Dutch and French were aware of those difficulties when, as Ramsbottom remarks, they were accustomed to fire high in a sea fight.

At the end of the seventeenth century, ships were growing considerably in size, since now they must become accustomed to the crossing of the Atlantic. Many English ports were unable to provide water of sufficient depth at all states of the tide, and tide tables were urgently required. Their calculation required the co-operation of mathematicians and astronomers. The archives contain of course many communications relating to the foundation of the Royal Observatory at Greenwich.

Pepys, when he was president of the Society, begged continually for information on any matter whatever that might assist him in his care for the navy. Probably he was really disappointed when Sir William Petty's double-bottomed ship turned out so badly, though he had made his bet that it would. Petty, a very able man, had supposed that a ship resembling in form two ships lashed side by side would stand up to a cross-wind better than a ship of ordinary design. The idea was that, of course, which is embodied in the outrigger of some Polynesian races. Again, there is an interesting note in the account of the *Proceedings* of July 28, 1686.

> ". . . it was remarked that sheathing with lead was the best expedient [for preserving ships from the worms] and found to be so by the experience of Sir Anthony Deane ; but that the carpenters finding it against their profit opposed it by affirming that the iron of the pintles of the rudders of ships so sheathed were much more apt to be corroded by the sea water than those sheathed with wood which yet was a groundless supposition."

The carpenters had more reason than was supposed ; we know now that electrolysis can be exceedingly troublesome.

So also the ventilation of coal mines was an urgent question, and is frequently referred to in the archives. It had become necessary to dig deeper than before. The accumulation of water became a serious hindrance and the many noxious damps were often fatal. Air pumps and water pumps are dealt with in numerous well-known papers by Boyle, Hooke, Papin and others. Sir Robert Moray wrote on the ventilation of mines in Belgium. There was much correspondence on the subject. Its general character may be illustrated by an extract from a letter which a certain Dr. Jessop of Yorkshire wrote to the Society in 1675. Let me give it in its original form, which now sounds so quaint.

> "There are four sorts (of damp) common in these parts. The first is *Ordinary Sort* of which I need not say much being known everywhere : the external signs of its approach are the candles burning orbicular and the flames lessening by degrees until it quite extinguish ; the internal, shortness of breath. I never heard of any great inconvenience which anyone suffered by it, who escaped swooning. Those that swoon away and escape an absolute suffocation are at their first recovery tormented with violent Convulsions, the pain whereof when they begin to

recover their senses, causeth them to roar exceedingly. The ordinary remedy is to dig a hole in the earth and lay them on their bellies with their mouths in it: if that fail they tun them full of good Ale: but if that fail they conclude them desperate."

These few extracts from the records of the Society will serve, I hope, to convey an impression of the character of the Society's activity in its early days, when first an organized attempt to collect knowledge by experiment and observation began to exercise its influence. At whatever point one picks up the story as it is told in these old records, one finds it full of interest, which lies not only in the subjects that are dealt with, but also in their relation to the activities of the time, and to the men themselves whose handwriting lies before one.

It is to be observed that these records are easily read by an educated man. Those who wrote them had in general no thoughts which the educated man could not follow, nor was it necessary to use terms which were not in ordinary use. Newton's "Principia" would, of course, be intelligible to a small number only, but in general the 'virtuosi' spoke a common language. The days of specialization and division into separate societies had not begun. How great is the contrast with the publications of a modern learned society!

It is also to be observed that there is no strict reckoning of services rendered, and no calculated recompense. Men like Hooke and other immediate servants of the Society were paid for their work, as was necessary and right, though the amount was incommensurate with their deserts. But the labours of the enthusiastic fellows and of their correspondents in all parts of the world were given freely. Indeed the Society had no money to pay with. It received no financial assistance from the Government, and the fellows' subscriptions (which, by the way, the treasurer found it remarkably difficult to collect) covered only the necessary expenses of the meetings. When the Society decided to print the "Principia", Dr. Halley himself provided the necessary funds. To this day, the fellows give without reward the services which their connexion with the Society entails. But I do not ask for any special commendation; the point is that such free service is common among learned societies, and is certainly a chief reason why they are held in respect.

The general intelligibility of the communications to the Royal Society persists for a long time. The calculations of the astronomers, the mathematicians, opticians and so forth appealed naturally to a limited number, but still we may suppose that fellows were able to understand the most part of that to which they listened. Perhaps it may be said, broadly, that the change begins when new terms must be invented to describe the increasing complexity of observations, and new units for quantitative description. Electricity and magnetism have been chiefly responsible; so that the experiments on frictional electricity which were so popular in the middle of the eighteenth century are especial objects of interest.

The progress of the subject is illustrated in the Society's archives by the many papers and letters of Watson, Franklin and others. Franklin's communications came by way of his friend Collinson, who gave them to Watson for presentation to the Society. Watson was himself a keen student of frictional electricity; and it would seem that some of the important experiments were made by Franklin and himself independently. But Franklin was, of course, the greater man, and Watson gave him full praise: "Although there are in the work some few opinions in which I cannot perfectly agree with him I think scarce anybody is better acquainted with the subject of electricity than himself."

Franklin was advised by his friend Mitchell that the paper on the subject of the identity of the lightning flash with the sparks of the electrical machine was received with laughter by the Royal Society. But the records in the *Journal Book* and elsewhere seem incongruous with such an occurrence. The warmth of Watson's praise, though he was an independent worker, his recommendation that Franklin's papers should be accepted, the repetition of Watson's commendation by the president when awarding Franklin the Copley Medal all go to show that there was probably no more than a hesitation to accept Franklin's view of the particular paper to which Mitchell referred; and the absence of some papers from the *Transactions* may well have been due to an arrangement with Collinson, who regarded the communications which he had received as private letters. At that time the *Transactions* of the Royal Society were not printed by the Society itself, but privately and independently.

The many papers in the archives that refer to frictional electricity form in themselves an interesting collection, showing the keen interest felt in the phenomena by experimenters in Europe and America, and they give additional strength, if it were needed, to Franklin's great reputation.

ACTIVITIES IN THE EIGHTEENTH CENTURY

Electricity was already, in the middle of the eighteenth century, offering a new field of experimental inquiry, and the importance of it was becoming realized. In the words of Martin Folkes, president from 1741 until 1752:

"Electricity seems to promise an inexhaustible Fund for Inquiry: and sure *Phenomena* so various and so wonderful can arise only from Causes very general and extensive, and such as must have been designed by the Almighty AUTHOR OF NATURE for the Production of very great Effects, and such as are of great Moment to the System of the Universe."

The numerous papers on frictional electricity form one of the most interesting sections of the archives during the eighteenth century.

The Society's membership did not equal in brilliance that of the centuries that preceded or followed. But there were several great subjects of consideration besides that in which Franklin made so prominent a figure. A large collection of Fahrenheit papers shows the interest taken in thermometers in the earlier part of the century. Another large collection deals with inoculation against smallpox. At the end of the century, Rumford describes his beautiful and valuable experiments on heat: he is prolix of words, but he makes excellent reading. He was, of course, a pioneer in the experimental study of the nature of heat. His work is well illustrated in the Society records. At the turn of the century the chemical investigations of Humphry Davy introduced a brilliant period in British science, and these also are well recorded.

The first quarter of the nineteenth century was not, however, a happy time for the Society. Internal dissensions and unchecked growth of membership, and the formation of societies which intended to take over special sections of the Society's work, until then unrestricted, all tended to reduce the value of the records and their interest. There were denunciations of the management and laments over the decline of science. Yet one of the greatest periods of scientific discovery had already begun, with Young, Fresnel, Davy and Faraday. But now the language began to be more difficult to the uninitiated. When the phenomena of electricity, magnetism, chemistry, light came to be studied in their mutual relations, the new world in which they figured was difficult of entry. This was not only because ideas were new and could only be represented with the aid of analogies, such as current, pole, capacity and the like, but also because new terms had to be invented to provide labels for conceptions which had never entered men's minds before. What, for example, could such words as anode and cathode mean to the non-electrician? So the ordinary reader is left behind, and the language of science becomes rapidly specialized.

It is interesting to observe the care with which Faraday chose his terms. He was in the habit of consulting Whewell, the master of Trinity College, Cambridge; the correspondence is preserved in Trinity College Library and in the Royal Institution. A letter in the possession of the Royal Institution reads as follows (Whewell is replying to Faraday):

"... I still think *anode* and *cathode* the best terms beyond comparison for the two electrodes. The terms which you mention in your last shew that you are come to the conviction that the essential thing is to express a *difference* and nothing more. This conviction is nearly correct, but I think one may say that it is very desirable in this case to express an *opposition*, a contrariety, as well as a difference. The terms you suggest are objectionable in not doing this. They are also objectionable it appears to me, in putting forward too ostentatiously the arbitrary nature of the difference. To talk of Alphode and Betode would give some persons the idea that you thought it absurd to pursue the philosophy of the difference of the two results, and at any rate would be thought affected by some. Voltode and Galvanode labour no less under the disadvantage of being not only entirely, but ostentatiously arbitrary, with two additional disadvantages; first that it will be very difficult for anybody to recollect which is which; and next that I think you are not quite secure that further investigations may not point out some historical incongruity in this reference to Volta and Galvani. ...

"I am afraid of urging the claims of *anion* and *cation* though I should certainly take them if it were my business—that which *goes to* the *anode* and that which goes to the *cathode* appearing to me to be exactly what you want to say. To talk of the two as *ions* would sound a little harsh at first: it would soon be got over."

The selection of the terms anode and cathode were based on a suggestion made by Faraday. In order to obtain a description which he could remember, he supposed his electrolytic trough to be placed parallel to the equator, and the current in the trough to run in the direction in which a current would have to run round the earth in order to give to the earth its observed magnetism. This implied that the current ran from east to west. It came, therefore, from the sunrise and went to the sunset, and the terms anode and cathode were taken as describing the way of the sun in the morning and in the evening.

Many groups of papers in the archives relate to work done for the Government, or for national enterprise, eclipse expeditions, biological and geodetic expeditions and so on. There is an interesting bundle of Sabine papers which have not yet been published. Sabine (1788–1883) was largely responsible for magnetic surveys in various parts of the world. Not a little of it is concerned with New England. There are letters from G. P. Bond, of Cambridge, the astronomical observer of the American Academy of Arts and Sciences, discussing the magnetization of the earth; from

I. M. Gillin, of the Observatory at Washington; T. D. Graham, of Baltimore; A. D. Bache, belonging to the Coast Survey, and so on. A letter from the secretary of the American Academy announces the appropriation (April 22, 1840) of 1,000 dollars for the purchase of instruments recommended by the Royal Society.

I shall say nothing of records more recent. We are all familiar with the bold advance of modern science, and extracts from the archives relating thereto would be superfluous. Specialization continuously increases. Papers become ever more complicated, each appealing only to a fraction of the scientific world and not at all to the general reader. The change from early times is very great indeed. It is inevitable and it implies success in experiment and deduction. But its effects are serious and must be examined carefully.

SCIENCE AND SOCIETY

These extracts show, I think, that the archives furnish a rich commentary on the history of the period during which the Royal Society has been in existence. They show, too, that the Society has played no small part in the doings which that history records. The new spirit which gave rise to the Society demanded that action should be based upon experimental research, and however spasmodically the world as a whole has obeyed this new principle, however ignorant men of all kinds, rulers and ruled, have been of the working of the leaven, the change in the ordering of men's activities has proceeded steadily and strongly. It has grown as the roots grow underground, preparing the life of the plant when the time comes for it to flourish. That time is already here, if we may judge by the extent to which natural knowledge is now used in all that men do.

We now observe the flower and the fruit that it bears. As we all know, we have reason both for satisfaction and for anxiety. We do see the happy results of a better acquaintance with Nature in a greater freedom from disease, in a richer life, in new opportunities for the exercise of talent, in a wider outlook. On the other hand, the problem of the well-being of the community is still far from complete. Not long ago the American Association for the Advancement of Science met in Richmond, Virginia, to hear a noble address from its president. The very title of his address, "Intuition, Reason and Faith in Science", was an indication of the position from which many of our most thoughtful scientists regard the problem as it stands to-day. From our side of the water we were glad to send Sir Richard Gregory to show that we also are trying to take our bearings for a new advance. We cannot stand still, of course; we must go forward, even though the way is not clear. We know the strength of science, we see that it has done great things, and are confident that its powers can be employed with greater and greater success as we give our whole minds to the problem that we have to solve. How shall we ensure the right use of natural knowledge, give full play to its beneficence and prevent its abuse? You and we and, let us hope, all associations of scientific men the world over, are of one mind in this matter, and are glad of the strength that unity brings.

The very fact that we share this goodwill points to the road that we must take. The goodwill that is based on our mutual understanding of what we are striving for is somehow to cover the world. I have not of course the presumption to say that science is by itself to leaven the whole. There are other incentives to co-operation; first and foremost stand the binding forces of pure religion. But the co-operation of the scientific workers is a new leaven, though it is not the first in the field. It is our own contribution which, if we can make, we must make or we fail in our duty to the world. I assume that we accept the duty.

We can surely conclude, from what we learn in the accumulated accounts of their doings, that the learned societies have not been unmindful of this primary purpose. No doubt in the early days when men collected facts as matters of interest, the recitals to which they listened were to many of them a private benefit only. Yet there were always men of wider vision who saw also the future benefit to their country or the world in the ordering of natural knowledge. The archives of the Royal Society, into which I have dipped here and there in order to provide illustrations of my argument, show the continuous endeavour of a body of men of science to be of help to their fellowmen. They may not have been always conscious of such an effort; in any community you may find some who are purely selfish. But as a body of men, vivified by those who had in them most of the right spirit, they have played a great part and I believe firmly a beneficent one

We cannot but ask ourselves whether it is possible to say that such and such actions and dispositions of societies like yours and ours have been the dispensers of good, while others are to be set on the opposite side. Some results derived from science are good: some already are bad. Are these antitheses related to similar opposites in our work as scientists?

Most thinkers now agree that we are not responsible for the uses that are made of the knowledge we find. We cannot control the strong passions that seize upon discoveries for selfish purposes. The work of discovery goes on and no one can stop it, not even ourselves. The constant demand for knowledge that is required for the solution of problems in health, in industry, in every human activity is so insistent that knowledge increases continuously and rapidly; and even if there were not this practical urge, there would be the never-failing curiosity to know more. We must therefore accept the position; we all seek for an understanding of how to make the best of it.

Exposition of Scientific Research

I have referred already to the addresses given recently by Dr. Birkhoff and Sir Richard Gregory. They illustrate a movement which gathers strength. It is based on an anxious determination to find out how the new situation is to be gauged and treated, and in particular, what the scientist may do. There is so much inquiry to be made before an answer can be given to this general question that it would be wrong to anticipate a conclusion. We can only remind ourselves of a few obvious lines of action, which we take in the expectation that the less obvious will become clear.

There is the great question of right exposition. It may be that there are some who would even now disclaim any duty of scientific men in this respect; and certainly there were many who would have done so in the past. If, however, we suppose that natural knowledge and the power which it gives are a common possession of mankind, we ought to make sure that what is found is understood. We cannot compel men to make use of science in the right way, but the chance that good use will be made is in a curious way dependent on the ease with which it is stated. If its expression is in forbidding terms, the man who sees no direct benefit from the effort of facing a difficult understanding leaves it alone. On the other hand, the man who is engaged in a fight against his fellows, whether in business or in war, grasps at any advantage that knowledge gives him, if he becomes aware of it; and of late years such men have seen the advantage, whence comes much of our present perplexity. The world is horrified by the development of frightful engines of war. It observes, too, that a technical invention, based it may be on some new scientific discovery, may throw great industries out of gear and bring misery upon employers and employed. These are obvious evils, and it is not surprising that the proper desire to increase knowledge is supposed to be associated with a tendency, even a desire, to make ill use of that knowledge. Also those men of goodwill who are acquainted with scientific aims and achievements have their own peculiar distress, because they know how little is done for the general good, compared to what could be done.

Exposition, therefore, becomes one of our chief concerns. It must be mated necessarily with the understanding that appropriate education can provide. We desire that all men, and especially men of goodwill, and especially also men of good education who are the natural leaders, should be aware of what science is doing and can do. A certain surviving distrust based on past misapprehensions has to be cleared away and replaced by co-operation.

I was standing once on the platform of a little up-country railway station in Australia, with others who had come to share the mild excitement of the arrival of the infrequent train. There was bustle when the train was ready to start, flag-waving, bell-ringing and cries to stand back. The engine whistled loudly—and went off by itself: the coupling with the train had been forgotten. There was a moment's pause, and then a shout of laughter while the shame-faced officials set out to repair their mistake.

There is something like that in what is taking place to-day. Scientific workers are so preoccupied with their business of research—naturally so—and in their researches have gone so far, that the world has no clear knowledge of the positions that have been reached. We have to see to the coupling and take the world with us. It may seem ungracious to make a statement of this kind when so much is already being done to popularize scientific knowledge. Yet it is to be observed that much of the science which is absorbed by the people lies on planes of lower value. Some that is intended for popular enlightenment is of that kind which seeks to dazzle by the recital of huge numbers. We must, of course, learn how narrow is our knowledge if we limit it to the consideration of spaces of about the same magnitude as our own bodies, or of times comparable with our own length of days. But that is a lesson in humility; the mere staring at big figures is childish if there is nothing more.

There are scientific writings which tend to be mystical and need very careful reading, lest they seem to contain a meaning when in fact they do not. Some of the terms used to describe scientific observations are drawn from the general vocabulary, such as wave, vibration, ray, ether and so forth, and are defined or re-defined for the specific purpose. If they are allowed to carry at the same time any unrestricted meaning that can be given to them in ordinary usage, an argument which includes them gets out of control and leads to danger.

The Spirit of Research

The observations of natural science, though they have now passed far beyond the range of the unaided senses, have not left the plane in which eyes and ears are accustomed guides. Neither they themselves not any combination of them rise to a higher plane; that is reserved for conduct, which, however, must take account of them.

The understanding of science that should be general to all men is of a simpler kind. It rests on a knowledge of the elementary laws of Nature, so far as we can ascertain them, and an appreciation of their continuous influence upon our lives. It leads to an awareness of the general position, though not necessarily a detailed acquaintance with it. It couples us all together in the desire to learn from Nature. We enrich our own lives, and we learn how to enrich the lives of our neighbours; but the great happiness lies in the discovery that there is a world in which we can all work together for the common good, in which there is endless work to be done, and an unselfish purpose can lead us from strength to strength.

Herein lies the finest work of science. Even the relief from pain and disability, the increase both in quality and in quantity of the fruits of the earth, the betterment of all the conditions of life, are not the end; there is something higher. It is the mutual service that is rendered when these things are fought for, and the happiness of mutual trust and reliance, and the last great act of virtue, that is to say, the sacrifice of self. To quote from Dr. Birkhoff's address: "I would state a fundamental truth about the social level which in some sense is the highest level of all [ranking, that is to say, above four other levels which he described, mathematical, physical, biological, psychological]: the transcendent importance of love and goodwill in all human relationships is shown by their mighty beneficent effect upon the individual and upon society."

Collectively and individually, men of science have done great things. Yet their achievements have value of one kind, and the spirit in which they worked has value of another kind; and the latter value is far more to be desired than the former. We may truly say of some of our greatest men of science that the world has gained more from their lives than from their discoveries, and this is so even if their influence on the world is limited to that which the world has been able to perceive. Their discoveries made them famous, but they themselves are better known than their discoveries. Faraday's reverence for truth and unselfish devotion to its acquisition have a higher value than the laws which he established. We gladly admit our debt to Pasteur and to the Curies, and yet the inspiration which we draw from their lives is even better than the results of their work. The world admires Franklin for his discoveries in electricity, yet it respects him more for his wisdom. I might prolong the list, but everyone can do that for himself. In brief, the spirit in which knowledge is sought and the manner in which it is used are more important, more real, than knowledge itself.

The records of scientific discovery, of the development of the fields of experiment which began three hundred years ago, have shown the growing power of science. The extent of their power is to-day a chief concern; we must, as so many are now trying to do, give anxious thought to its exercise. The power is not actually in the hands of the scientist, though he is deeply interested in its future because he has been, and is, the occasion of its existence. It may fairly be inferred from experience that the scientist himself will never be a tyrant. His work does not rouse in him the desire to dominate, but rather to assist. Love of accuracy, patience, perseverance, self-denial have been common qualities and necessarily so. These have a place in the general esteem, and therefore have their effect. Most of all the world respects the devotion to service that has so often been found; the warm love of their fellows which has inspired so many to give themselves and their labour without counting the return. We must hope that such a spirit will continue in ourselves, whether as individuals or as societies.

The problems of society, and in particular those into which natural knowledge enters so powerfully, will long demand a patient examination. But whatever may be the tactics that are developed in the end, it is certain that the satisfactory solution will be based upon moral influence. It is for us, as scientific workers, to supply the natural knowledge and help in its application; but that is not the complete account of what we have to do. Our effectiveness will depend, as is shown by all human history, including our own limited experience, upon the devotion, wisdom and goodwill which we bring to our task.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST ALBANS

prospect of successful organization. The co-operation of the French Government has been secured, and that of the Dutch Government is expected. The executive committee of the Exhibition is under the chairmanship of Sir Edwin L. Lutyens, and Sir John Marshall and Sir Richard Winstedt are vice-chairmen. The assistance of experts in the great museums containing Indian collections has been promised.

The Night Sky in July

Astronomical twilight (the sun not greater than 18° below the horizon) lasts all night in the latitude of London until July 21. The moon is full on July 1 at 16·3h. and again on July 31 at 6·6h.; it is new on July 16 at 21h. Mars is in conjunction with the moon on July 3, Jupiter on July 9, Saturn on July 11, Mercury on July 18, and Mars again on July 30. Mercury is at greatest elongation (27° E.) on July 13, and may be visible in the evening twilight up to about July 10. Mars and Jupiter both rise in the late evening. Venus continues as a morning star, rising at 2h. 50m. in mid-July. On July 23 Mars is in opposition and near its greatest apparent brightness, −2·6m., which is brighter than Jupiter is at any time. At this opposition, the diameter of the disk of Mars subtends 24″. The least distance separating Mars from the earth on July 27 is just over 36 millions of miles. On July 17 between 4h. 12m. and 5h. 0m., Jupiter will appear without its four bright satellites. Satellites II, III and IV will disappear by being eclipsed by the parent body between 2h. and 3h., and Satellite I begins to transit the disk of the planet at 4h. 12m. At 5·0h., Satellite IV will re-appear from eclipse. The next occasion when a similar phenomenon will occur is on July 10, 1942. The ring system of Saturn is now well opened, the diameter of the minor axis of the outer ellipse of the outer ring being about 11″. Neptune, in the constellation Leo, makes a close approach on July 30 to the star B.D. + 4° 2492, magnitude 8·7; the minimum distance between planet and star will be about 20″. Amongst the meteor showers due with their maximum late in this month are the Sagittids and the δ Aquarids.

Announcements

The Council of the Institution of Civil Engineers has awarded a Charles Hawksley Prize of £150 for 1939 to Donald Henry May, of Clapton, London, for his design of a grain-silo. Arthur James Francis has been "honourably mentioned", and a grant of £50 has been awarded to him for his design of a steel highway bridge.

On the recent occasion of the 150th anniversary of Schiller's inaugural lecture at the University of Jena, the Society of Medicine and Natural History of Jena presented the anatomist, Prof. R. Spanner, with the bronze memorial medal in recognition of his outstanding work on anatomy, and especially his researches on arterio-venous anastomoses.

A committee has been formed to celebrate the quatercentenary of the death of Paracelsus; it is under the presidency of Prof. Laignel Lavastine of Paris, with the collaboration of Cornil, dean of the Marseilles medical faculty, Abel Rey of the Sorbonne, Garraux, president of the Swiss Medical Federation, Cawadias of London, Verzar, dean of the medical faculty of Basel, and Anderes, dean of the medical faculty of Zurich.

Applications for grants from the Permanent Science Fund of the American Academy of Arts and Sciences are invited for consideration by October 1, 1939. Applications should be made on special forms furnished by the Committee. Further information can be obtained from the chairman of the Committee on the Permanent Science Fund, Prof. John W. M. Bunker, Massachusetts Institute of Technology, Cambridge, Mass.

A studentship, established in memory of Edward Teshmaker Busk, who in 1914 lost his life while flying an experimental aeroplane, will be awarded in July. The studentship is of the value of about £150, tenable for one year from October 1; but a student may be re-appointed on the same terms for a second year. It is open to any man or woman being a British subject and of British descent who has not attained the age of twenty-five years on October 1. The object of the studentship is to enable the holder to engage in research, or preparation for research in aeronautics. Further information can be obtained from Prof. B. Melvill Jones, Engineering Laboratory, Cambridge.

The Twelfth International Congress of Psychology will be held in Edinburgh during July 22–27, 1940. Further information can be obtained from Prof. Godfrey Thomson, Moray House, Edinburgh 8.

In September of this year—most probably during the second fortnight of the month—Messrs. Carl Zeiss, Jena, will hold the fourth technical-scientific course of lectures on spectrum analysis, photometry, microscopy and fine measuring. During the principal lectures, new results of practical value concerning modern material-testing and fine measuring will be dealt with. Sufficient time will be reserved in the form of informal discussion for purely scientific research, and short lectures will also be delivered. This year ample opportunity will be provided for practical work with the instruments under the guidance of experts. Further information can be obtained from Messrs. Carl Zeiss, Dept. ZWA, Jena, Germany.

A first supplement, covering the years 1935–36, has been issued to the catalogue of foreign books in the Tokyo Imperial University library. The catalogue is arranged in ten sections covering general and miscellaneous; philosophy, religion, education; languages, literature, fine arts; history, biography, geography; law and politics; economics, commerce, public finance, statistics, social sciences; science; engineering, industries, army and navy; medicine and agriculture. Each section consists of an author index and an alphabetical list of periodicals.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 37.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Instability of the Mesotron and the Gravitational Constant

THE recent discovery that the mesotron is unstable in free space introduces into physics a new dimensional constant, the mean life τ_0 of a mesotron at rest, of magnitude about $2\cdot5 \times 10^{-6}$ sec. It is convenient to consider not τ_0 but the related fundamental length $L_0 \equiv c\tau_0 \doteqdot 7\cdot5 \times 10^4$ cm. This length is very much longer than any of the lengths, ranging from 10^{-14} cm. to 10^{-8} cm., which can be formed out of the constants e, $\hbar$, c and the various fundamental atomic masses. Thus, without using large powers of the non-dimensional atomic ratios (for example, $\hbar c/e^2 \doteqdot 137$), it is not possible to express L_0 in terms of these constants alone.

If L_0 is to be related to the other natural constants, it is clearly necessary to include the gravitational constant G. When this is done, the following expression gives at once the right order of magnitude:

$$L_0 \sim R_0 \frac{e}{w}, \tag{1}$$

where $R_0 \equiv e^2/\mu c^2$ and is the 'classical' radius of a mesotron of mass μ, and $w \equiv \mu G^{1/2}$ is its 'gravitational charge'. The use of w instead of G is advantageous, since it brings the gravitational forces $G\mu^2/r^2$ into the same form as the electrostatic forces e^2/r^2.

Since $\mu \doteqdot 170\, m$, where m is the mass of an electron, $R_0 \doteqdot 1\cdot6 \times 10^{-15}$ cm., and, since for a mesotron $e/w \doteqdot 1\cdot2 \times 10^{19}$, the right-hand side of (1) gives 2×10^4 cm., in rough agreement with the observed value of L_0. Another possible form of (1) is, of course, $(r_0/137)\,(e/w)$, where r_0 is the 'classical' radius of an electron.

It would be attractive to conclude from this result that perhaps the decay of the mesotron may provide a link between atomic and gravitational phenomena. This implies, on Yukawa's theory, that there must also be a connexion between gravitation and β-decay.

Nothing so far has been said of the neutrino, into which, together with an electron, a mesotron is supposed to decay. If a neutrino has a finite rest mass μ_0, this might have been brought into the calculation, and if the mass were of the right magnitude, there would be no necessity to introduce G. For example, if $\mu_0/m \sim 10^{-15}$, L_0 can be expressed simply as $L_0 \sim \hbar/\mu_0 c$. In view of (1), we have $\hbar/\mu_0 c \sim R_0 e/w$, and this would be interpreted as showing that the mass of the neutrino, as well as the life-time of the mesotron, is connected with gravitation.

There is one possibility that would make all this argument false. It is the unlikely one that perhaps the life-time τ_0 of the mesotron, as measured in the earth's atmosphere, may not be the same as that in free space, but may depend on the local conditions, for example, on the local gravitational, electric or magnetic potentials.

P. M. S. BLACKETT.

Physical Laboratories,
The University,
Manchester.
June 20.

Reaction between Hydrogen and Oxygen Sensitized by Nitrogen Peroxide

NITROGEN peroxide exerts a powerful catalytic effect on the combustion of hydrogen[1]; small quantities may depress the ignition temperature by so much as 200° C. (for example, addition of 0·09 mm. NO_2 lowered the ignition temperature of 100 mm. H_2 + 50 mm. O_2 in a porcelain vessel from 580° to 370° C.). At any particular temperature the sensitized ignition is confined between readily reproducible, narrow limits of concentration of nitrogen peroxide outside which a slow catalysed reaction occurs. It was further shown[2], in this laboratory, that a simple correlation exists between the induction period found to precede the onset of both the slow reaction and the ignition, and the catalytic effect of the nitrogen peroxide on the slow reaction and the ignition. The results were interpreted by assigning to nitrogen peroxide the dual role of stimulation of chain branching, and inhibition by the direct termination of chains. This stimulation of branching may be visualized if we suppose that the nitrogen peroxide, by participation in a collision with some highly energized link of the chain, is dissociated and gives rise to an oxygen atom.

The fact that induction periods precede the slow reaction as well as the ignition, and that the plot of induction period against concentration of nitrogen peroxide shows no discontinuity as the ignition points are passed, shows that even in the region of slow reaction the system possesses a positive 'net branching factor φ'. This positive value of φ leads to an exponential increase of the number of centres with time, and at the end of the induction period, when their number increases very rapidly, these become increasingly subject to removal by recombination in three-body collisions, a process which depends on the square of the concentration of centres. Through the interplay of branching and self-neutralization, the number of centres and hence the reaction rate, thus tend to potential equilibrium values. It was concluded[2] that ignition only occurs when some critical volume element becomes self-heating; a condition which intervenes when the potential equilibrium concentration of centres reaches a critical value.

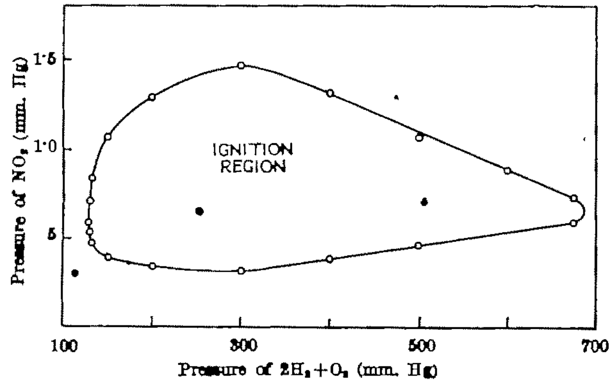
Additional evidence for this point of view is now provided by the study of the effect of pressure of reactants and foreign gases on the induction period and ignition limits.

(*a*) *Foreign gases.* Addition of foreign gas to an explodable mixture of hydrogen, oxygen and nitrogen peroxide of constant composition, progressively lengthens the induction period and eventually converts the ignition into a slow reaction. For four foreign gases the relative amounts necessary to quench ignition are:

$$A : N_2 : He : CO_2 : : 6 : 3{\cdot}6 : 3 : 1.$$

The order of effectiveness in lengthening the induction periods is the reverse of this. These results are explained if the foreign gas can alter the net branching factor φ by deactivation of energized chain centres, which would otherwise lead to branching by collision with nitrogen peroxide molecules. Further analysis of the results indicates that, in the case of helium, the high thermal conductivity may also enter as a major factor determining the ignition condition.

(*b*) *Pressure of reactants.* At a given temperature, increase in the pressure of reactants causes the upper limit to rise to a maximum and then to fall; whilst the lower limit, though less dependent on pressure, falls to a minimum and then rises. The accompanying diagram shows the effect of pressure on the limits in a pyrex vessel of internal diameter 7·0 mm. at 364° C. This result is readily interpreted on the thermal theory. The fact that increase of pressure progressively shortens the induction periods to an almost constant low value, indicates that the explodability of the mixture as measured by the net branching factor progressively increases to an almost constant value. To this cause must be attributed the initial widening of the explosion region. At higher pressures, however, the increased probability of recombination of centres in three-body collisions decreases the equilibrium reaction rate and causes the explosion region to shrink.



A more complete account of these and related experiments, together with a quantitative development of the theory, will be published elsewhere.

R. G. W. NORRISH.
F. S. DAINTON.

Chemical Laboratory,
The University,
Cambridge.
May 30.

Reflection of Medium and Short Radio Waves in the Troposphere

THE discovery that radio waves could be reflected in the troposphere was announced by us[1] and immediately corroborated by Watson Watt and his coworkers[2]. Since that time, many observations have been made upon both long and short waves and the diffraction theory of G. N. Watson[3] has been simplified for numerical calculation. The calculations show that diffraction alone will not account for the intensity of the received signal. It was then thought by some experimenters that refraction due to changing air densities might be responsible for most of the bending in the troposphere. However, Englund and his associates[4] have clearly shown that the waves (in their case less than 5 metres in length) are reflected from the boundaries of different air masses.

We have been examining the tropospheric reflections of medium and short waves (1,614–17,310 kc.) at vertical incidence for almost four years, and our observations are in complete agreement with Englund's theory for short waves. For example, whenever a cold high-pressure area comes in from the northwest, the measured height of the *C* region falls, rising again as the high is succeeded by a low-pressure area from the same direction.

In order more fully to confirm our theory that the medium and short waves could be reflected vertically from the interface between two different air masses, we have sent up an aeroplane which took readings on the air temperatures at different heights directly over the radio station, while we were measuring the heights of the reflecting layers by means of the radio pulse. Several flights have been made with the following results:

Flight	Date	Height of *C* region by radio pulse above sea-level (km.)	Height of temperature inversion by aeroplane above sea-level (km.)
1	Dec. 22, 1938	1·4	1·2
2	Dec. 28, 1938	1·09	1·04
3	Jan. 2, 1939	1·2 1·8 } two reflections	1·15 1·7 } two reflections
4	Jan. 5, 1939	1·52–1·9	1·5 turbulent air
5	Jan. 6, 1939	1·14–1·29 1·50–1·63 } two reflections	1·16 discontinuity 1·56 sharp inversion
6	April 22, 1939	1·45–1·75 2·3–2·6 } two reflections	1·4–1·65 2·1 } turbulent air

This is the first direct comparison between the two methods. The agreement is nearly perfect. The aeroplane was furnished by Dr. L. S. Adams, president of the Tri-State Aviation Corporation.

Using two transmitting sites simultaneously, we have measured the same reflection heights over various base-lines in different directions. Frequencies between 1,614 kc./sec. and 17,310 kc./sec. failed to show any marked differences in the heights of the reflecting regions. The strength of the reflected waves decreased at the higher frequencies. During the past three years, all the stronger reflections have come from regions between 0·5 km. and 2·5 km. above our altitude of 0·29 km.

R. C. COLWELL.
A. W. FRIEND.

Department of Physics,
West Virginia University.
May 15.

---

[1] Thompson, H. W., and Hinshelwood, C. N., *Proc. Roy. Soc.*, A, 124, 219 (1929). Norrish, R. G. W., and Griffiths, J. G. A., *Proc. Roy. Soc.*, A, 120, 147 (1928).

[2] Foord, S. G., and Norrish, R. G. W., *Proc. Roy. Soc.*, A, 152, 196 (1935).

[1] NATURE, 137, 782 (May 9, 1936).

[2] Watson Watt, R. A., *et al.*, NATURE, 137, 866 (May 23, 1936).

[3] Watson, G. N., *Proc. Roy. Soc.*, A, 95, 546 (1919).

[4] Englund, C. R., Crawford, A. B., and Mumford, W. W., *Bell Syst. Tech. J.*, 17, 489 (October 1938).

Potentials at Oil-Water Interfaces

WHEN a water-immiscible phase, called an oil, separates two aqueous phases, there is in general a potential difference between the aqueous phases. Since this potential difference is much greater than those found when electrolytes diffuse freely in water, it has been assumed that diffusion in the oil cannot account for the observed potentials[1]. Bauer[2] at one time, and more recently Ehrensvard and Sillén[3], suggested that these potential differences are caused by adsorption at the interfaces. Craxford, Gatty and Rothschild[4] pointed out that adsorption as such can only influence potential under two conditions, namely, if the interface is a perfect insulator or if adsorption influences the rate of diffusion of ions across the interface. Unless the interfacial monolayers have a resistance to anions or cations comparable with the bulk phases, it can be shown that they cannot affect the potential when a steady state has been attained.

I have measured the potential difference between a hanging drop and a sessile drop of water in oils lighter than water in such a way that the thickness of the oil between the interfaces could be varied. Albumin attached to a moist glass fibre can be passed through the oil and spread at either interface. When both interfaces are protected by albumin films, they can be pressed together so that only a thin 'soap bubble' of oil remains between.

There is a quick change of potential when albumin is spread at an oil-water interface, so that the water becomes negative with respect to the oil. This potential difference decays to zero at a rate that increases with increasing conductivity of the oil. With oils of specific resistance of 10^9 ohms, the half-life is about 10 minutes, at 10^5 ohms only a few seconds. Sweeping with a brass barrier in the usual way produces similar time potential curves even if the interface is originally quite clean.

At the oil-water interface, the oil molecules can be regarded as forming an oriented monolayer with their polar groups in the water. As a consequence of this sheet of oriented dipoles, charge separation across the interface will build up diffuse double layers in both phases, so that at equilibrium there will be no potential difference across the system. If the diffuse double layer is disturbed, either by changing the dipole fields or by sweeping with a barrier, time will be required to re-establish equilibrium in the two phases. Since a spreading film drags with it quite thick layers of water[5], and presumably oil, the potentials observed after spreading a protein film may be due largely to mechanical disturbance of the double layer.

The addition of electrolytes to one of the aqueous phases will produce diffusion potentials if one of the ions is more soluble in the oil. Methylene blue chloride and sodium eosinate both produce high potentials of opposite sign as if the dye ions were diffusing into the oil ahead of the Cl^- or Na^+ ions. Using butyl acetate as the oil, eosin can be seen diffusing into the oil and the potential falls in a few hours. With high resistant oils these potentials fall more slowly, and methylene blue chloride in 0·01 molar potassium sulphate against octyl alcohol maintained a negative potential of more than 70 mv. for 24 hours. Protein films at the interface have no effect on these diffusion potentials. However, if two drops protected by protein films be pressed together, reducing the oil to a thin film, the potential drops to zero, since there is insufficient resistance in the thin oil phase to maintain a concentration gradient of appreciable magnitude in the oil. With octyl alcohol it is sometimes possible to separate the drops and regain the diffusion potential. With butyl acetate the films stick together to form a stable triple layer that prevents convection but has little or no effect on diffusion or potentials and has a resistance of less than 0·5 ohm cm^2.

The above considerations throw doubt on any explanations of steady bio-electric potentials based on interfacial potentials or diffusion potentials across thin oil films. However, since some monolayers can retard the evaporation of water, it is possible that monolayers may exist that can influence oil-water potentials by virtue of their low ionic permeability.

A full account of these experiments with further theoretical treatment will be published elsewhere.

R. B. DEAN.

Department of Colloid Science,
Cambridge.

---

[1] Michaelis, L., "Hydrogen Ion Concentration", 192 (1926).

[2] Bauer, *Z. phys. Chem.*, 92, 81 (1916). See Adam, N. K., "The Physics and Chemistry of Surfaces", 361 (1938).

[3] Ehrensvärd, G., and Sillén, L. G., NATURE, 141, 788 (1938).

[4] Craxford, S. R., Gatty, O., and Rothschild, NATURE, 14, 1098 (1938).

[5] Schulman, J. H., and Teorell, T., *Trans. Faraday Soc.*, 34, 1337 (1938).

Adjustment of Electrical Units

THE international body responsible for the allocation of values to electrical units, the General Conference of Weights and Measures, decided at its last meeting, in 1933, to change at some future date the long-accepted value of the ohm; no more regrettable decision could have been taken.

Recent measurements show that the ohm is 5 parts in 10,000 greater, and the ampere 1·5 parts in 10,000 less, than the values originally aimed at for them. As a result, the watt measured electrically is about 2 parts in 10,000 greater than the watt derived from the metre, kilogram and second. Physicists and electrical engineers agree almost unanimously that, for practical reasons, the electric standards ought to be adjusted so as to secure equality of the 'electrical' watt and the 'mechanical' watt.

But adjustment can be effected in several ways. The method contemplated by the General Conference of Weights and Measures is to reduce the volt by 3·5 parts in 10,000 and the ohm by 5 parts in 10,000. The change in the volt would cause no serious difficulty, but the change in the ohm entails re-engraving practically all resistance boxes, for all precision resistance boxes claim an accuracy superior to 5 parts in 100,000.

There is no doubt whatever that if an adjustment so large as 5 parts in 10,000 were made, the great standardizing laboratories, universities, scientific institutions, etc., would desire to possess standards in agreement with the new value of the ohm. The replacement of existing apparatus, much of which is all the more valuable for having been under observation for many years, would be extremely wasteful. It is also entirely unnecessary, for adjustment of the watt can be effected by keeping the ohm as it is at present, and reducing the ampere and the volt by 1 part in 10,000, as pointed out by G. Giorgi[1], G. A. Campbell[2] and others.

As the alteration of the ohm has not yet been enforced, it is to be hoped that the General Conference will not lack courage to examine, in the light of fresh facts and new arguments, a question in which there is a considerable body of opinion opposed to its earlier decision.

P. VIGOUREUX.

H.M.S. *Osprey*,
Portland.

---

[1] Giorgi, G., "Memorandum on the M.K.S. System of Practical Units" (Central Office, International Electrotechnical Commission, London, 1934).

[2] Campbell, G. A., "A Definitive System of Units". *Bull. Nat. Research Council*, No. 93, p. 48 (1933).

Acoustic Properties of Mud Bricks

FOLLOWING up our tests of the thermal properties of mud bricks[1], we have investigated their acoustic properties by reverberation methods for sound absorption, and by direct methods for sound insulation.

The sound insulation of a 9-inch mud brick wall (uncracked) is determined by the weight per sq. foot, as is known for many other materials. Cracking commenced as drying proceeded, accompanied by a marked fall in the sound insulation.

The sound absorption of an irregular mud brick surface is very considerably greater than the same wall finished with a smooth mud surface. The measurements explain the short times of reverberation in mud brick rooms.

The results are as follows :

Sound absorption (O.W.U.)			Sound insulation in decibels				
			Age of wall				
Frequency of sound	Irregular surface	Smooth surface	1 hr.	1 day	3 days	9 days	30 days
250	0·32	0·10	45·6	46·5	39·0	31	31
500	0·48	0·16	53·9	49·9	42·2	35	33
1000	0·56	0·19	64·4	55·8	50·5	40	40
2000	0·55	0·18	—	—	—	—	

The bricks were composed of 97·5 per cent mud and 2·5 per cent straw by weight.

F. H. CONSTABLE.
M. K. MAHAS.

Acoustics Laboratory,
Egyptian University,
Giza.
May 29.

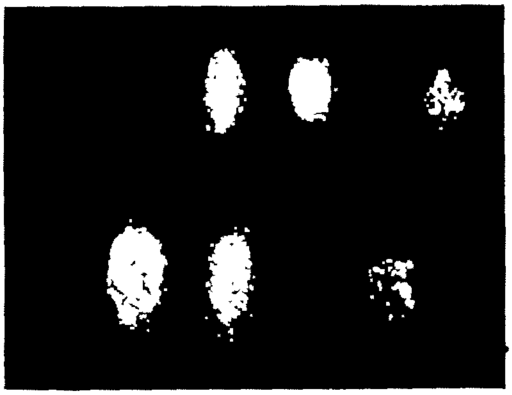
NATURE, 142, 837 (1938).

Spring Development of the Gonads of the Starling (*Sturnus v. vulgaris* L.)

IN 1937[1] and 1938[2] Rowan reported some interesting differences in the state of the gonads of the starling in winter. The gonads of birds obtained in London were considerably larger than those of birds obtained from flocks frequenting a roost in the country, and this was interpreted as indicating that the noise of traffic, by causing the birds to be restless throughout the night, had induced a precocious development of the reproductive systems. Bissonnette[3], however, failed to obtain this result experimentally.

It is known that the winter starling population of the British Isles is derived from two main sources. The results of bird marking have shown that the majority of British breeding birds remain in the country throughout the winter, whilst their numbers are greatly augmented in autumn by flocks of starlings coming from the Continental countries bordering the Baltic and the North Sea. These immigrants, which leave Britain again in March, congregate at night in roosts which contain tens of thousands of birds. It is possible, therefore, that the starlings taken by Rowan in London were British, whereas those taken in the country were Continental.

With this alternative explanation in mind, starlings were obtained between March 11 and March 21 from a quiet residential district two miles from the centre of Leeds. In this area the birds roost, for example, under the eaves of houses, where they are not subject to any disturbances from traffic during the night. No increase in their numbers can be noted during winter, and the extremely dirty condition of their feathers is additional evidence that they are town birds. These birds proved difficult to obtain, but, of the six examined, the three males were in full breeding condition. They had large white testes (see accompanying reproduction, No. 4) and their seminal vesicles contained spermatozoa. The ovaries of the females were small (No. 5), and afterwards it was found that this sex does not come into full breeding condition until the middle of April.



GONADS OF STARLINGS. NATURAL SIZE.

For comparison with these birds, which were almost certainly British, starlings were also obtained from a roost which had been established during the previous autumn in a small plantation near Beamsley Beacon in Wharfedale. Estimations, supported by photographic evidence, showed that about ten thousand birds occupied the roost each night, and it is probable that the great majority of these were of Continental origin. Between March 7 and March 14, thirty-one birds were obtained in the plantation, and, with one exception, these were sexually undeveloped. In the fifteen males, the testes (No. 1) were small and dark grey in colour, and microscopic examination showed that they were completely quiescent. The vasa deferentia and seminal vesicles were small and embedded in fat. In the females, the ovaries (No. 3) were slightly smaller than those of the town birds, and only minute eggs were present. The oviducts were very slender. These birds were therefore in a similar state to those obtained from the country by Rowan in February 1937.

One male bird, however, obtained in the roost on March 9, was entirely different. The testes (No. 2) were almost fully mature, each being large and white in appearance, and the seminal vesicles were correspondingly well developed. Although obtained in the open country, this bird was in the same condition as those in the Leeds suburb, and it therefore appeared possible that a number of local starlings were present among the thousands of immigrants occupying the roost. This was finally proved when all the Continental birds suddenly left on March 15. A small residual population of about a thousand starlings remained to roost in the plantation each night, and, at the time of writing (May 13), they are still continuing to do so. These birds were clearly local, and they were discovered to come from a small area of some five square miles immediately adjacent to the roost. Fifteen specimens were obtained between March 22 and 25, and the seven males proved to be uniformly similar to that one male bird obtained in the roost on March 9.

Although the separation of British and Continental starlings depends on circumstantial evidence, it nevertheless appears probable that a difference exists between the times of onset of sexual activity in these two types of birds. The onset of maturation in the starling is almost certainly conditioned by the increase of daily light in the early months of the year, and it would appear that these two types of birds possess different reactions to the same environmental changes. The British birds react early and do not migrate. The Continental birds react more slowly and migrate before reaching their full sexual development.

Morphologically, the two types of starling have not been separated, but, if these results are substantiated, it is apparent that they should be treated as distinct physiological races.

W. S. BULLOUGH.
R. CARRICK.

University of Leeds.
May 13.

Rowan, W., "Effects of Traffic Disturbance and Night Illumination on London Starlings", NATURE, 139, 668 (1937).

[2] Rowan, W., "London Starlings and Seasonal Reproduction in Birds", *Proc. Zool. Soc.*, A, 108, 51 (1938).

[3] Bissonnette, T. H., "Studies on the Sexual Cycle in Birds, IV" *J. Exp. Zool.*, 58, 281 (1931).

Formation and Breakdown of Glycogen in the Live

Parnas and Baranowski[1] have shown that glycogen undergoes a special kind of breakdown in muscle to hexosemonophosphate. The authors term this phosphorolysis of glycogen:

$$(C_6H_{10}O_5)_n + n.H_3PO_4 = n.C_6H_{11}O_5.PO_3H_2.$$

Ostern, Guthke and Terszakowec[2] identified the product formed under these conditions as a mixture of Robison and Neuberg esters.

Cori, Colorick and Cori[3] found that the intermediate step in the breakdown of glycogen to the Robison ester was the glucose-1-phosphoric ester described by them. They further showed that the glycogen phosphorylating enzyme is widely distributed and that in dialysed liver extracts it forms from glycogen glucose-1-phosphoric ester, which is partly dephosphorylated to glucose. It seems therefore possible to them ". . . that the blood sugar of mammals is produced by this enzyme system rather than by a diastase"[4].

We have used concentrated liver brei made by grinding 1 part of the liver of starved rabbits with 1 part of phosphate buffer solution at *p*H 7·2. Glycogen added to the brei is rapidly broken down as well in the presence as in the absence of fluoride. With fluoride, Cori ester is quantitatively formed, and then converted to Robison ester; provided that excess of glycogen is present, only so much is broken down as can be phosphorylated by the amount of phosphate available. Without fluoride, glucose is formed, no uptake of inorganic phosphate being detectable; this is because dephosphorylation is so rapid that the primary phosphorylation of glycogen is masked. It can, however, easily be demonstrated by the addition of $M/200$ fluoride, which completely inhibits the dephosphorylation. Under these conditions, the phosphorolysis proceeds in the liver at the same speed as in muscle; at a glycogen concentration of 2 per cent and at 37°, nearly 4 gm. of glycogen is phosphorylated by 100 gm. of liver in one hour. A velocity of breakdown of glycogen of this magnitude would be sufficient to maintain the blood sugar of an animal in face of its physiological requirements, even during exercise.

In the presence of oxygen, the phosphorylation and breakdown of glycogen are quicker than in its absence, probably because the reaction is accelerated by the oxidative removal of part of one of its products —the Robison ester.

Phlorrhizin inhibits the breakdown of glycogen in liver by more than 70 per cent. Since it specifically poisons the phosphorylation of glycogen[3], this is further proof that phosphorolysis is the chief, if not the only path of the anaerobic and aerobic glycogen metabolism in the liver.

Cori ester, added to normal liver brei, is rapidly dephosphorylated; in the presence of fluoride, most of it is converted to Robison ester, but a part of it forms a substance which gives an opalescent solution, is dextro-rotatory (α_D about +190°), gives a red-brown colour with iodine*, does not reduce, but is precipitable by alcohol, and reduces after hydrolysis. We think, therefore, that this substance is glycogen. In an experiment in which 80 mgm. of Cori ester was added to 10 gm. of liver brei poisoned by fluoride, 7·6 mgm. of glycogen was formed, corresponding to about 20 per cent of the Cori ester. The reaction is thus clearly similar to that described by Schaffner[5] and by Kiessling[6] as taking place in yeast. Since phosphorylations are involved in the formation and breakdown of glycogen in liver, it is understandable that glycogen from liver (however carefully prepared) contains some organic phosphorus[7].

P. OSTERN.
ERIC HOLMES.

Biochemical Laboratory,
Cambridge.
May 24.

* Cori, Schmidt and Cori reported recently (*Science*, 89, 464; 1939) that glycogen is formed from Cori ester by purified muscle enzymes. The fact that their product gives a blue colour with iodine is very interesting, and shows perhaps that there are differences between the synthesis of glycogen in liver and in muscle.

[1] Parnas and Baranowski, *C.R., Soc. Biol.*, Paris, 121, 282 (1936).

[2] Ostern, Guthke and Terszakowec, *Hoppe-Seyl. Z.*, 243, 9 (1936).

[3] Cori, Colowick and Cori, *J. Biol. Chem.*, 117, 135 (1938); 118, 619 (1937).

[4] Cori and Cori, *Proc. Soc. Exp. Biol.*, N.Y., 39, 337 (1938).

[5] Schaffner, *Naturwiss.*, 27, 195 (1939).

[6] Kiessling, *Naturwiss.*, 27, 129 (1939).

[7] Ostern and Hubl, *Acta Biol. Exp.*, 13 (in the press).

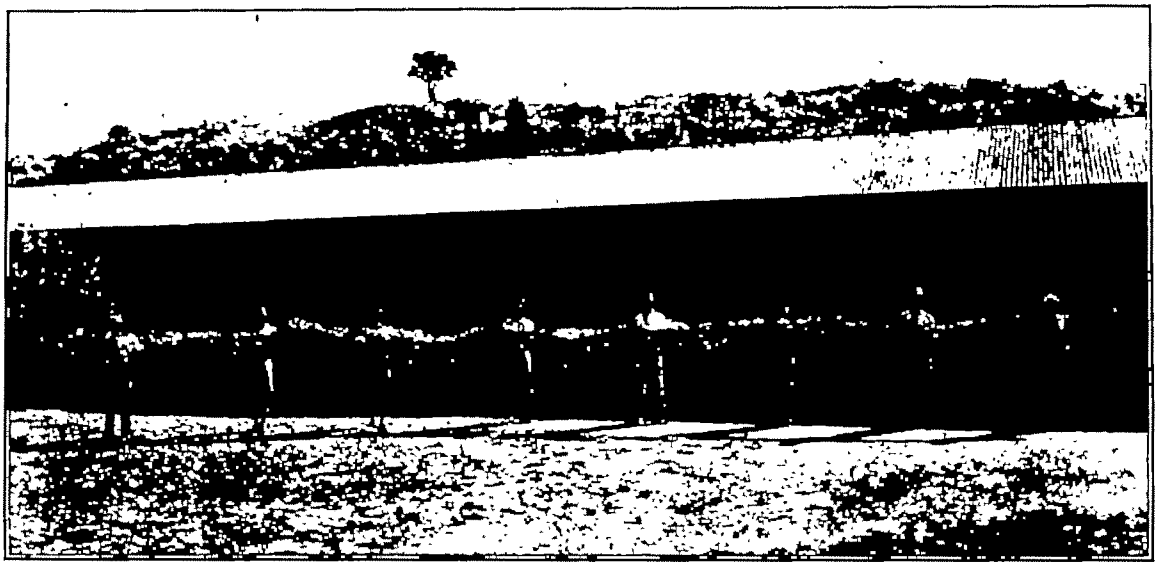
A Grass Leviathan from East Africa

DURING an expedition which the Government of the Union of South Africa sent recently to East and Central Africa for the purpose of collecting grasses which might prove of value to the Union for pasture, ay, silage and erosion control, a remarkable grass vas encountered and collected in East Africa and has ince been grown at the Department of Agriculture's rass Introduction Research Station at Pretoria with stonishing results. The grass combines all the ttributes of a pasture, hay and soil preserver in uch a remarkable manner that it is felt that it leserves more than ordinary notice. The grass elongs to what is known locally in East Africa as he Star grasses. These occur commonly in the Rift Valley and are regarded amongst the farming community, both black and white, as the best and most nutritious grasses in ranching country. For example, n the country around Lake Solai, the dry bed of which is covered with these grasses, it has long been the custom of stockowners who have grazed their animals in the country around Nakuru, where they invariably suffer from 'nakuritis', to send them o the rich Star grass pastures of Lake Solai, where they immediately pick up in condition and recover.

These Star grasses belong to the genus Cynodon Rich., to which the common dog's tooth, Bermuda grass, couch grass of Australia, Bahama grass of the West Indies, the doub grass of India and the kweekgras of South Africa also belong. There is great variation both in the habit and structure of these grasses, but they are usually placed by botanists under the name *Cynodon plectostachyum*.

A number of these Star grasses were encountered by the expedition in Tanganyika and Kenya, but on examining the grass plots laid down at Kabebe, near Nairobi, by Mr. D. C. Edwards, grassland officer to the Government of Kenya, I was shown a remarkable Star grass in one of his plots, which he stated had appeared there by accident and had evidently been introduced by seed contained in a sod of a fine-leaved lawn grass (also a Cynodon) from Uganda. Apart from this, the origin of the grass was unknown. This Star grass was standing nearly three feet high in the plot, and was regarded as a promising hay type. The edges of the plot, however, were kept closely trimmed and thus little indication of the true character of the grass was manifest. The grass was so outstanding that it was decided to keep a sharp look-out for it. The expedition first encountered this giant Star grass in its natural habitat in the evergreen and deciduous parkland country between Eldoret and Kitale in the Trans Nzoia province of Kenya, and along the eastern foothills of Mount Elgon. Afterwards it was collected frequently in Uganda in the neighbourhood of Ruwenzori, in the Semliki Valley, around Lake Edward and Lake George and in several localities in the eastern Belgian Congo.

Apart from its luscious and dense stand, often 3–4 feet in height, the most remarkable character of the plant in the veld was its amazing network of robust runners or stolons, and it was at once realized that in this plant Nature had provided us with valuable material for erosion control. Living material was brought to Pretoria and was planted out under conditions where the growth of the plants could be studied in detail. The plants have been under observation for some five and a half months and during this period, under a rainfall of 27·49 inches, they have made remarkable growth.



A GIANT STAR-GRASS RUNNER (WITH OFFSHOOTS) MEASURING 48½ FEET IN 5½ MONTHS FROM THE TIME THAT IT LEFT THE PARENT PLANT.

GROWN AT RIETONDALE PASTURE RESEARCH STATION, PRETORIA.

Individual plants during this time have covered more than eight thousand square feet of soil, and in many instances have put out runners (with offshoots) from the parent plant, measuring in length more than fifty feet. These runners and offshoots, of course, anchor themselves down firmly at almost every node. The material offers great possibilities for erosion control in areas where this grass can be successfully established.

I. B. POLE EVANS.

Division of Plant Industry,
Department of Agriculture and Forestry,
Pretoria.
May 17.

Oxaloacetic Acid in the Leguminous Plants

INVESTIGATIONS in our laboratory have revealed that oxaloacetic acid has a central position in biological fixation of nitrogen. Recently P. W. Wilson[1] reported that, contrary to the findings in this laboratory, he has not been able to find oxaloacetic acid in the growing legumes. In the determination of oxaloacetic acid, Wilson employed the aniline manometric method of Ostern, making the determinations in the expressed sap of the plant material from which the proteins are precipitated with tungstate in a sulphuric acid solution.

Oxaloacetic acid disappears easily from the plant material during the preparation of the sap if the respiratory system is active. Therefore we have employed a different procedure in preparing the plant sap. Since oxaloacetic acid is most stable in alkaline solution—according to Straub the stability increases at least up to *p*H 14—we add caustic soda solution (1 c.c. of 10 per cent solution per 3 gm. fresh plant) and fine quartz sand to the plant material. The mass is rubbed fine in a mortar and the sap pressed through a cloth. Thus the sap is kept alkaline—*p*H about 12–13—right from the start and the respiratory system is destroyed. The sap is cooled at 0°, sulphuric acid is added to lower the *p*H to about 5, the solution is added to Ostern's buffer solution and the carbon dioxide formed through aniline is determined manometrically in the Warburg apparatus. By this method we have found, for example, in the leaves of young red clover grown in the greenhouse in April–May, 48–264 γ oxaloacetic acid per 1 gm. The accompanying table illustrates one of our determinations carried out with red clover at the start of flowering. Oxaloacetic acid was destroyed in one experiment by heating the acidified plant sap.

t° C	Minutes	Thermo-barometer	4 c.c. dil. plant sap + 2 c.c. buffer + 0·05 c.c. aniline + 0·2 c.c. water		4 c.c. dil. plant sap + 2 c.c buffer + 0·25 c.c. water. No aniline
			Exp. acc. to the method described	Sap acidified and heated	
8·9	0	151	153	149·5	151
9·3	30	167	179	165·5	167
		16·0	26·0	16·0	16·0
Change in the pressure			10	0	0
Oxaloacetic acid (γ) per 1 c.c. sap			104	0	0

Daily and diurnal variations are considerable, as would be expected. After flowering of peas, oxaloacetic acid is no longer found.

We have modified for plant material also the method of Szent-Gyorgyi and Straub for the colorimetric determination of oxaloacetic acid. Two samples of equal size are taken from the plant material. Hydrazine hydrochloride is added immediately to one sample and the mass is rubbed fine in a mortar. To the other sample is added sulphuric acid to make the *p*H of the mass about 3, and the mass is kept at room temperature for 4 hours to destroy the oxaloacetic acid completely. Both samples are then extracted with ether in a percolator for 36 hours. The ether solutions are shaken frequently with soda solution. The soda solutions obtained are acidified with sulphuric acid to *p*H 2–3, cooled at 0°, whereupon sodium nitrite solution is added. After 5 minutes, the solution is made strongly alkaline with caustic potash and the yellow colour formed thereby is determined colorimetrically. The difference in the colours of the two samples should be due to th amount of oxaloacetic acid. The reliability of thi method is being further investigated by us. On th basis of the determinations hitherto, the latte method seems to give higher values than the manometric method described above. If the plant material is made strongly alkaline right from the start, as described in connexion with the manometric method, the values obtained by the manometric and colorimetric methods have been in good agreement in the determinations hitherto carried out.

In the article referred to, Wilson states also that he has not been able to bring about nitrogen fixation with excised root nodules in the solution of oxaloacetic acid. This result is at great variance with the numerous experiments carried out in our laboratory. In most experiments we have determined the nitrogen fixation by Kjeldahl's method, and also in some experiments by determining the amount of nitrogen in the gas mixture[2]. In addition, we have noted the increase of amino nitrogen in the solution in the presence of oxaloacetic acid and the formation of oxime nitrogen. So far as we can see, there cannot be any doubt about nitrogen fixation with excised root nodules.

A more detailed account of our experiments will be given in the *Biochemical Journal*.

ARTTURI I. VIRTANEN.
A. A. ARHIMO.

Biochemical Institute,
Helsinki.
May 22.

---

[1] Wilson, *Ergeb. Enzymforsch.*, 8, 13 (1939).

[2] Apparatus described in Virtanen's paper in *Svensk Kemisk Tidskrift*, 51, 19 (1939).

Discovery of Sugar-cane Seedlings

AN interesting review of the book "The World was my Garden", by David Fairchild, appeared in NATURE of December 31, 1938, p. 1138. In this review I note the following sentences: "There are occasional slips, as for example on p. 123, when the late Dr. J. B. Harrison is described as being the discoverer of sugar-cane seedlings. In Barbados and the West Indies generally, this honour has always been ascribed to the late John R. Bovell."

Neither the reviewer nor the author of the book is strictly correct. Seedling canes were found by the overseer of a Barbados plantation so early as 1858, and the discovery recorded in the Barbados *Liberal* of February 12, 1859, while the fertility of the cane was established at about the same time in Java, Reunion and Mauritius. Systematic research work on the production of new seedling varieties of sugar-cane dates from the re-discovery of the fertility of the cane by Soltwedel in Java in 1887. The discovery of seedling canes in Barbados by Harrison and Bovell, referred to by the reviewer, was a joint one made in 1888, and quite independently from that of Soltwedel. The six months period separating the dates of the Java and Barbados discoveries is explained by the fact that the cane produces its flowers in May–July south of the equator, and in November–January in the northern hemisphere. Bovell afterwards became renowned as the breeder of the world-famous *BH*.10(12) and several other valuable seedling cane varieties, while Harrison went to British Guiana and worked with cane seedling in that country.

E. C. STEVENSON.

Sugarcane Research Station,
Department of Agriculture,
Mauritius. May 6.

Cotton Mycorrhiza

THE mycorrhizal habit among tropical crops is becoming more generally recognized. A few years ago when I was isolating Fusarium from cotton roots, I noticed in the cortex the presence of fungal hyphæ which were clearly differentiated from Fusarium mycelium. I also observed that certain sparsely septate hyphæ with very characteristic projections were always found in close proximity to cotton roots.

I did not pay much attention to these structures at the time because I was concentrating on Fusarium. However, during my recent work on cotton mycorrhiza, I found the typical vesicular-arbuscular endophyte within the cortical tissues. Penetration takes place through the piliferous layer. The hyphæ penetrate two or three layers of cells and then pass into the intercellular spaces of the cortex and sometimes penetrate into the cells themselves. Vesicles of an inter- or intra-cellular type are developed in certain strains of cotton. They are terminal, round, oval or irregular. The arbuscule sporangiole apparatus is found within the inner cortical cells next to the endodermis.

Butler[1], in his recent paper on the occurrences and systematic position of the vesicular-arbuscular type of mycorrhizal fungi, named the endophytes *Rhizophagus* sp. According to his statement, he found the endophyte scarce in Gujerat, whereas in the Sudan cotton the roots were transformed into mycorrhiza and the extra matrical development of the fungus was very luxuriant.

In conclusion, it may be said that *Rhizophagus* sp. appears to grow in the soil around the cotton roots and also within the cortical tissues, producing vesicles in the first case and vesicles and arbuscular sporangioles in the second. The factors which influence the presence of the endophyte within the roots are now under investigation; but from the results so far obtained it seems that soil type, manuring and the age of the plant are chiefly instrumental.

YOUNIS SABET.

Botany Department,
Faculty of Science,
Abbasieh, Cairo.

---

[1] Butler, E. J., *Trans. Brit. Mycol. Soc.*, **22**, Pts. III and IV, 274–301 (1939)

Points from Foregoing Letters

It is shown by P. M. S. Blackett that if the observed lifetime of a mesotron is to be related to the other fundamental constants, that the gravitational constant must be included. This can be done in a very simple way and may indicate a relation between atomic and gravitational phenomena.

R. G. W. Norrish and F. S. Dainton have studied the effect of pressure of reactants and foreign gases on the critical concentrations of nitrogen peroxide, and the induction periods of the hydrogen-oxygen reaction sensitized by nitrogen peroxide. The authors consider that the inhibiting effect of foreign gases is due in part to the deactivation of highly energized chain centres, and that at high pressures the inhibiting effect of reactants is due to the increased probability of self neutralization of centres.

Direct observations of temperature changes at various levels of the atmosphere by means of aeroplane flights, made simultaneously with radio measurements carried out directly underneath, to determine the height of the reflecting layers, are reported by R. C. Colwell and A. W. Friend. They confirm the view that medium and short waves can be reflected vertically from the interface between two air masses.

R. B. Dean states that oil-water potentials disappear when the oil is reduced to a very thin film, because the thin oil film is no longer able to maintain a diffusion gradient in itself. Potential differences set up when a protein is spread at one interface disappear in a short time owing to the formation across the interface of a neutralizing double layer in both phases.

P. Vigoureux suggests that the necessary adjustment in the value of the watt should be made by keeping the ohm as it is at present and reducing the ampere and the volt by 1 part in 10,000; this would obviate the scrapping of much valuable apparatus in many laboratories.

The sound absorption of an irregular mud brick surface is found by F. H. Constable and M. K. Mahas to be considerably greater than the same wall finished with a smooth surface, which accounts for the short time of reverberation in mud brick rooms.

A comparison of the gonads of British and Continental starlings points to a difference in the time of onset of sexual activity in these two forms. It is suggested by W. S. Bullough and R. Carrick that they may constitute separate physiological races.

P. Ostern and Eric Holmes state that the chief path of glycogen breakdown in the liver is by way of phosphorolysis to Cori ester, which is either dephosphorylated to glucose or converted to Robison ester. In fluoride poisoning, added glycogen is converted to Robison ester so long as phosphate is available for esterification. The excess of glycogen can be recovered, whereas without fluoride the whole of the glycogen disappears, owing to the circulation of phosphate, which is rapidly freed from hexose monophosphate. In the presence of fluoride, part of the added Cori ester is converted into glycogen and part into Robison ester.

A photograph of a giant Star-grass runner (*Cynodon plectostachyum*) from South Africa is submitted by I. B. Pole Evans. It grew 48¼ ft. in 5¼ months from the time it left the parent plant, and may prove to be a very valuable plant for erosion control.

A. I. Virtanen and A. A. Arhimo describe a method for the determination of oxaloacetic acid in plants. Considerable quantities of oxaloacetic acid are found in growing legumes at definite times of day. Daily and diurnal variations are great.

E. C. Stevenson writes that seedling canes were found by the overseer of a Barbados plantation so early as 1858 and the discovery recorded in the *Barbados Liberal* of February 12, 1859, but systematic research work on the production of new seedling varieties of sugar-cane dates from the re-discovery of the fertility of cane by Soltwedel in Java in 1887.

RESEARCH ITEMS

Rock Paintings and Engravings of the Western Sahara

THE first of a projected series of studies of the scientific results of Théodore Monod's expeditions to the Western Sahara in 1934–36 is devoted to rock-paintings, engravings and inscriptions (*Pub. du Com. d'Études Hist. et Scientifiques de l'Afrique Occidentale Française*, Sér. A, No. 7, 1938. Paris: Lib. Larose. Pp. 156 + 9 pls.). It includes an iconography, accompanied by a complete enumeration of known sites, followed by general remarks on classification and chronology, with a study of the inscriptions by Georges Marcy. The material of this western area is poor both in quantity and quality in comparison with the remarkable assemblages in southern Oran, Ajjers and Fezzan. Only Libyco-Berber graffiti are at all abundant, and that only in certain areas. The western material falls into two, or strictly speaking three, classes, as compared with the seven or eight distinguished by H. Winkler in the desert of Upper Egypt. The chronological problem accordingly is simplified. In the west is (I) a single undifferentiated neolithic. Next comes (II) a Libyco-Berber group, also homogeneous, but with local facies of unknown chronological relation. Thus the camel abundant at Tichitt-Oualata is rare at El Beyyed, while at Chinguetti it is the horse that predominates. Groups I and II can be distinguished readily. They belong to different cultures, of which I alone is prehistoric. Differences of patination are evidently a result of local conditions, and the only sure guides to classification are technique, style and content. Hence a 'bovine' period, corresponding, it may be assumed, to a sedentary agricultural neolithic stage, which at times was ichthyophagous, is followed by an equine-camel period, in which the lakes of the last humid phase gradually disappear and climatic conditions would appear to deteriorate. Even an approximate dating cannot be suggested, as there is no fixed point for the close of the neolithic and the arrival of the Libyan horsemen, while the only *terminus ad quem* is the Islamization of the country.

Respiratory Metabolism of Infant Brain

H. E. Himwich, Z. Baker and J. E. Fazekas (*Amer. J. Physiol.*, 125, 601; 1939) studied the respiratory metabolism of the brain of infant rats (1–24 days old) with the following results. (1) Like the adult brain, the infant brain is dependent on added carbohydrate (glucose) for maximum respiration and possesses a small aerobic glycolysis. The respiration of the infant brain is also stimulated by lactate, succinate, pyruvate and fructose. (2) On the basis of *dry* weight, during the first eleven neonatal days the rate of glucose oxidation is lower than that of lactate. In the absence of substrate and the presence of lactic acid the respiration is the same as that in the adult. (3) The oxygen consumption of the brain of the new-born rat is smaller than that of the adult brain per unit of *wet* weight of tissue. (4) The diminished capacity for oxidation may be correlated with the protein concentration, which is lower in the infant brain. The authors therefore suggest that the diminished oxidation is a quantitative rather than a qualitative phenomenon.

Human-Birth Weights

H. P. DONALD (*Proc. Roy. Soc. Edin.*, 59, 91–108; 1939) has analysed the factors influencing the birth-weight of 3,000 infants at the Else Inglis Memorial Hospital, Edinburgh. The average weight tends to be higher in the summer than in winter. Sex, order of birth, age of mother, and family characteristics are shown to influence the birth-weight. The view is favoured that birth-weight is more a quality of the mother than of the children.

Inheritance of Cataract

A RECESSIVE gene in the rat causes the degeneration of the retina of the eye about seventeen days after birth. M. C. Bourne and H. Grüneberg (*J. Hered.*, 30, 131–136; 1939) have examined histologically animals homozygous for this recessive gene. They find that in all cases the rod nuclei die and lesions appear. Secondary effects may or may not be present, such as persistence of the hyaloid artery and degrees of opacity of the lens (cataract). The characteristics resemble retinitis pigmentosa, an inherited anomaly in man. This case is interesting in showing one constant effect of a gene combined with several inconstant characteristics.

Heterochromatic Regions of Chromosomes

IN many recent cytological publications there has been an increasing tendency to recognize deeper affinity for stains in certain regions of the chromosomes. These regions more retentive of stains are described as heterochromatic. Dontcho Kostoff (*Proc. Ind. Acad. Sci.*, 8, Sect. B; 1938) has collated various aspects of this question; he points out that the regions near the centromeres tend to be heterochromatic and may persist in interphase as prochromosomes, whilst the end regions may also be heterochromatic, and sex chromosomes are often markedly so. After platinum chloride fixation and gentian violet staining, Kostoff concludes from his preparations that the chromomeres are more closely spaced in the heterochromatic regions, and this leads to his support of Koltzoff's suggestion that genes are possibly located between the chromomeres. The paper also puts together an interesting series of phenomena, such as the effects of infection by micro-organisms, glandular secretions and X-ray effects, and discusses their possible influence on chromosome conjugation and 'somatic' crossing-over. The paper has evidently lost much in its expression in the English language, but the ideas suggested, with the bibliography, are well worth consideration.

Lepidoptera of the Mascarene Islands

A CATALOGUE of these insects from the above-mentioned islands, by J. Vinson, has lately (December 1938) been published by the Mauritius Institute and Public Museum (*Mauritius Inst. Bull.*, 1, Part 4). By the expression 'Mascarene Islands' the author includes the islands of Réunion (Bourbon), Mauritius and Rodriguez. This definition is now very generally used in entomological writings. The catalogue enumerates 387 species and, of these, 43 per cent r 168 species are endemic but only 14, or 6 per cent, f the genera are actually endemic. On the whole, he fauna of Lepidoptera is considerably richer in he Mascarenes than in the Seychelles. While there re certain cosmopolitan elements in the fauna such s the butterfly *Vanessa cardui* and such moths as *Heliothis armigera, Ephestia cautella, Pyralis farinalis* nd *Plutella maculipennis*, there are others of more pecial interest. Thus *Papilio phorbantia* is confined o Réunion and *P. manlius* is only found in Mauritius. here are also Danaid butterflies of the genus Euploea, amely, *E. goudotii, euphon* and *desjardinsi*. They are onfined to Réunion, Mauritius and Rodriguez espectively. Among the moths, the sub-family Hypeninæ provides many peculiar and restricted pecies. For example, of the twelve species of Hypena, even are endemic in Mauritius or in Réunion. The mall moth *Crambus seychellus*, which is unknown utside the Seychelles, is represented in Mauritius nd Réunion by a distinct race, namely, *emmerezellus*. ts larva is a serious pest of lawns in Mauritius where t has become known locally as the lawn cut-worm. Mention needs also to be made of the family Metaphandidæ the species of which are almost all confined o the Mascarenes and Seychelles, with a few species n India.

Life in Arctic Ice and Snow

A report recently issued by the Smithsonian Institution gives an account of E. Kol's studies of plants growing in ice and snow in the Mount McKinley National Park, Alaska. Reference is made particuarly to three organisms, and the remarkable feature which emerges is the prolific growth that occurs during the short season when the surface of the ice or snow melts temporarily in the August sun. The surface of the Columbia Glacier is described as covered for miles by light brownish-purple algal vegetation known as ice-bloom; the organism responsible is the green alga Ancyclonema, which Dr. Kol has also found in various localities in Europe, but never in sufficient quantity to form ice-bloom. Above Valdez, around the Thompson Pass, the snowfields at the beginning of August showed the phenomenon of red snow, the coloration extending from the surface to a depth of several inches, and in one case to two feet, into the snow. The effect is produced by *Chlamydomonas nivalis*. The red snow in this particular pass looked as if sprinkled with red pepper, instead of the raspberry red of some other snowfields. In snowfields of the mountain above Juneau, masses of tiny snow fleas were present, piled to a depth of about half an inch and giving the surface a deep violet-grey colour.

Vegetation of the Aka Hills, Assam

N. L. Bor has recently published a synecological study of this area (*Ind. For. Rec.*, New Ser., Botany, 1, No. 4, Govt. of India Press, New Delhi, Nov. 1938). Hitherto, the area from a botanical point of view was practically unexplored, for nothing but a meagre collection, by Griffith, in the foothills was known of its flora. The area was of importance phytogeographically because it lies midway in the four hundred miles wide gap between Sikkim and the Arbor Hills, areas, especially the former, well known botanically. A preliminary survey of the area is given, the biotic factors are outlined, and the various vegetational units are grouped into climax and seral communities. The special relations existing between vegetation and water in quantity are discussed in a chapter headed "Hydroseral Communities". Some important chapters are devoted to economic factors. Dr. Bor was able to collect some 3,500 species in all, though he does not pretend to have been able to visit the whole area. As an indication of the interest of the paper, the discovery of *Quercus incana*, Roxb. within this tract bridges the enormous gap which has hitherto existed between its known habitats in the north-west Himalaya and Upper Burma; whilst *Juglans regia*, L., and *Populus ciliata*, Wall, so common in the north-west Himalaya, are now found to extend well into the eastern Himalaya. A last example of a 'find' is *Salvia japonica*, Thbg. var. *parviflora*, not previously recorded outside its Chinese home.

Fungal Lodging of Wheat

The 'lodging' of wheat and other cereals has been ascribed to various causes such as excess nitrogen or wet weather, but Mary D. Glynne of Rothamsted Experimental Station has shown (*Agric. Progress*, 16, Pt. 1, 1939) that the fungus *Cercosporella herpotrichoides* is frequently responsible for the weakening of straw at harvest time. The organism attacks young wheat plants in late autumn or early spring, and produces dark-coloured lesions upon the leaf-sheaths and leaves. It spreads through the summer, until the lumen of the straw is often filled with light grey mycelium. There is much evidence that nitrogenous fertilizers and wet conditions increase the incidence of the disease, so that control by the avoidance of these conditions is still valid. The widespread distribution of mycological lodging makes it possible, however, to adopt further measures, such as long rotations to starve the fungus, and the wide separation of wheat and barley within the rotation.

Micro-Manipulative Studies of Virus-infected Plants

Miss F. M. L. Sheffield, of the Rothamsted Experimental Station, has adopted a fascinating technique for the investigation of virus-infected cells of *Solanum nodiflorum, Hyoscyamus niger* and other plants (*Proc. Roy. Soc.*, B, 126, 529–538, February 1939). Micromanipulative puncture of the cell, by the methods of Péterfi, followed by a suitable test, has shown that the relative acidity of both virus-infected and healthy cells of *S. nodiflorum* and *H. niger* is approximately the same, namely, pH 6·8. Non-crystalline intracellular inclusions of aucuba mosaic disease in tomato disintegrate immediately with slight mechanical pressure, or on pricking. The inclusion breaks down in 0·07*M*. concentrations of sodium, potassium or calcium chlorides, but can be removed in 0·1*M*. solutions of these salts. Infection experiments with such removed material have demonstrated that the inclusions contain virus. Striate material of tobacco mosaic and enation mosaic cannot be isolated, as it breaks down into needle-like fibres when touched.

An Electromechanical Transducer

The electromechanical transducer in the new Benioff seismograph is the subject of a paper by James J. Delvin, S.J. (*Bull. Seis. Soc. Amer.*, 28, No. 4, Oct. 1938). The original transducer was possessed of hysteresis difficulties and itself rendered the motion of the seismograph unbalanced. E. C. Bullard also questioned the validity of the shunt in the magnetic circuit and suggested a balanced transducer. The new transducer, it is suggested by the author, overcomes all these difficulties. A diagram of the pole pieces, armature piece and air gaps is given, and this is followed by a mathematical analysis of the working. It is found that the E.M.F. output, E, is governed by the equation

$$E = k\frac{\varphi_m}{x_0}\frac{dx}{dt},$$

where k is the number of turns in the coil, φ_m is the flux through the permanent magnet, x_0 is the length of the air gap in the central position of the transducer, and dx/dt is the rate of change of the air gap. In the new instrument the variations in flux are more nearly linear, the symmetry of the design renders unnecessary any calculations for the lack of symmetry such as the added stiffness of the spring in the vertical component, and there is now no such thing as an unbalanced horizontal component.

Seismological Data from the Far East

VALUABLE data of seismology are contained in publications of the Government of India Meteorological Department, and the Royal Observatory, Hong Kong. The former, contained in the *Seismological Bulletin* for April–June 1938, contains interpretations of seismograms for the Observatories of Agra, Bombay, Calcutta, Colombo, Dehra Dun, Hyderabad and Kodaikanal, together with non-instrumental reports. At Agra, 20 shocks were registered in April, 32 in May and 11 in June, commensurate numbers being registered at the other observatories. In the *Hong Kong Bulletin* of March 1939, detailed interpretations are given for 26 shocks registered there, together with all instrumental constants. This brings the total of shocks registered at Hong Kong during 1939, up to the end of March, to 74.

Crystal Structure of Glycine

ALTHOUGH there have been detailed studies of many proteins, less attention has been given to the simpler amino acids which are the basis of the more complicated structures. The crystal structure of glycine has been the subject of three investigations, which are in poor agreement. G. Albrecht and R. B. Corey (*J. Amer. Chem. Soc.*, 61, 1087; 1939) have now made an X-ray examination of the structure of glycine in which the Patterson-Harker analysis has been used. A full account of the parameters is given and the results indicate that the structure consists of nearly flat glycine molecules held together by hydrogen bonds between adjacent nitrogen and oxygen atoms to form continuous layers throughout the crystal. Interatomic distances in the molecule are: carbon-oxygen 1·25 and 1·27 A., carbon-carbon 1·52 A., carbon-nitrogen 1·39 A., each with a probable error of ±0·02 A. Hydrogen bond distances between nitrogen and oxygen in the same layer are 2·76 and 2·88 A., and between neighbouring layers 2·93 and 3·05 A. A discussion of the probable distances of hydrogen atoms leads to the conclusion that the atomic arrangement is a *zwitter*-ion structure for the glycine molecule in the crystal.

The Electron-Microscope and the Investigation of Viruses

THREE important articles on the use of the electron microscope have recently appeared in *Die Naturwissenschaften* (27, 281–299; 1939). The first, by von Borries and E. Ruska, deals with the nature of the image obtained by the use of the electron ultramicroscope, in which the object is traversed by a beam of electrons. The second article, by H. Ruska, deals with the technique of work with the instrument, and particularly with the preparation of the object to be observed. The various types of carrier for the object, corresponding to the glass slide in ordinary microscopy, are considered. The carrier must be perfectly transparent to a beam of electrons, and must be uniform in thickness, and free from irregularities which would be visible under the electron microscope. A collodion film is satisfactory, and the methods of preparing the specimen on the film for observation are dealt with. A process for increasing the sharpness of an image lacking in contrast is also described. The most interesting of the three articles is the final one, by Kausche, Pfankuch, and H. Ruska, which gives the results of the investigation of plant viruses with the electron ultramicroscope. Recent progress made in the determination of the size and shape of the tobacco mosaic virus molecule is reviewed. By drying the virus solution on the carrier film, a dry gel with a definite structure is obtained. By using a sufficiently diluted solution (10^{-8} gm. of virus protein per c.c.) the lateral aggregation of the particles to bands can be prevented, so that the rods and threads can be dried out isolated from each other. The dimensions of the particles can be obtained. They vary in length, but are usually multiples of 300 mμ long, though some are multiples of 150 mμ. The diameter is about 15 mμ, or multiples of this. It is considered that the virus molecule is 300 or 150 mμ long, by 15 mμ in diameter, other dimensions being due to aggregation. Infection is brought about by one particle. If the particles are broken down by chemical means, they cease to be active.

Determination of Stellar Diameters by Interferometer

Reinhold Fürth, Kurt Sitte, and Hans Peter Appel (*Mon. Not. Roy. Astro. Soc.*, 99, 3; January 1939) have described a modification of the Michelson interferometer method for the determination of stellar diameters. The Michelson interferometer method for finding stellar diameters is not applicable unless the air perturbations are very small. In most cases these are so great that the image of the star in the telescope moves quickly and it is impossible to see its interference fringes. If a diffraction grating is used to produce fringes and the grating is translated in its plane, the fringes do not move, and this principle has been used in the apparatus described in the paper. A secondary image of the primary interference image is produced by a suitable optical arrangement, and when the primary image is moving because of the air perturbations, the secondary image remains at rest. When the primary Michelson system of fringes disappears at a suitable distance of the slits, no secondary interferences are formed. In addition, when the contrast of the primary interferences has its maximum, the secondary will show at its optimal visibility. For these reasons the secondary interferences can be used instead of the primary to determine stellar diameters. Photographs of secondary fringes in still and disturbed air, produced by an artificial star with a diameter 0·32 mm., show that air perturbations have practically no effect upon the clearness of the interferences figures. The laboratory experiments show that stellar diameters can be measured even when there are strong air perturbations, and it is claimed that an accuracy of 10–15 per cent can be attained.

EXCAVATIONS AT AMARAH WEST, SUDAN, 1938-39

AN exhibition of antiquities, the results of an excavation carried out at Amarah West in the Sudan on behalf of the Egypt Exploration Society, was opened in the Department of Archæology and Egyptology of University College, in the University of London (Gower Street, London, W.C.1), on June 20, and will remain open until July 15 daily from 11 a.m. to 5.30 p.m.

AMARAH WEST: REMAINS OF AN ANCIENT TREE, ONE OF A SERIES, WHICH FLANKED THE ENTRANCE TO THE TEMPLE

The ancient fortified site of Amarah West in the Northern Province of the Sudan is situated between the second and third cataracts of the Nile, about 120 miles south of Wadi Halfa. It is on the left bank of the river, and consists of a small walled town overlooking the river, and cemeteries and other ancient remains in a wide circle round the town. The town crowns a small mound, and is so deeply buried by sand and other debris that before excavation no walls were visible. Originally a brick enclosure between 100 and 150 yards square, in which lie the temple and its magazines and other storerooms and dwellings, the town had spread outside the protection of its walls. A short distance to the north lies the New Kingdom Egyptian cemetery, and beyond this is a wide area covered by ancient remains, most of which appear to belong to a Sudanese culture of which little, if anything, appears to be known at present. Although the town now lies on the left bank of the river, excavation has shown that very probably it once lay on an island, the main channel running between the left bank and the town itself, giving it an admirable position for the control of river traffic. Some traces of the original landing stage have been discovered.

AMARAH WEST: EAST SIDE GATE WITH FORECOURT SHOWING FLOOR LEVELS OF DIFFERENT PERIODS.

The main work of the first season's excavation has been the examination and recording of the temple, which lies in the north-east corner of the enclosure, and consists of a forecourt, peristyle, hypostyle hall, and sanctuary area. The forecourt is built outside the north wall of the town, and in it, flanking the entrance, are pits in which were found the stumps of ancient trees still standing three feet high, two columns, and parts of two large stelæ built into niches, and bearing duplicates of well-known texts, in which Rameses II records his marriage with the daughter of the King of the Hittites and a dream in which the god Ptah appeared to him. In the Hypostyle Hall the twelve columns still stand some 9–10 ft. high, and here some of the most valuable discoveries of the season were made. Among these are the large hieroglyphic stelæ, which form a feature of the exhibits now at University College, while the walls were inscribed with scenes of a religious nature and with incidents from the Syrian wars of Rameses II, including an interesting view of a Syrian town, of which the walls are being undermined by Egyptian sappers. The most important discovery, however, and one which will prove ultimately of the greatest interest, both geographically and historically, is a long list of more than two hundred names of Syrian and Sudanese towns and peoples who owed allegiance to Rameses II. This list occupies the lowest register of all the walls of the Hypostyle Hall, and is the longest discovered in recent years. More than half the Syrian names have not occurred previously in hieroglyphic, and new identifications have been made, including what is probably the name Jericho, now appearing for the first time in an Egyptian text.

Beyond the Hypostyle is a small vestibule remarkable for the fine quality of many of its reliefs; and finally is the Sanctuary with side chambers and stone stairs leading to the roof.

The excavations have shown that the temple in its present form was built by Rameses II, but it was not completed until the sixth year of Rameses IX, some 140 years later. In its original state the temple consisted of the area covered by the Hypostyle and the present Sanctuary, which could not have existed then in the present form, as the entrance was on the south. Later, the Peristyle was added and acted as the Sanctuary. Later still, the entrance on the south was blocked up, a new gate was cut through the north wall of the town, and the original Sanctuary at the north end was pulled down and was rebuilt as the present Peristyle, while the forecourt was built outside the town to protect the new entrance. Occupation of the town goes back to at least the reign of Sethos I, father of Rameses II, and it is possible that the earliest occupation of the site dates so far back as the reign of Hatshepsut and Tuthmosis III in the Eighteenth Dynasty.

Owing to the exceptional height to which the walls now stand, a height rare on an Egyptian site, the town will probably prove the most complete and bes preserved town of Pharaonic Egypt yet discovered On the historical side, inscriptions of no less than ten kings have been found with details of wars, the names of new viceroys of Ethiopia, new materia concerning known viceroys, and the important new lists of Syrian and Sudanese towns. On the archæological side, the most important discoveries are the remains of a hitherto unknown Sudanese culture, and in addition sherds of the recently discovered 'Saharan' civilization. Hitherto 'Saharan' sherds have been found only in Egypt near Armant and in the Sahara as far east as Selima Oasis. It has been presumed that the Saharan people came from the desert and made their way to Egypt from the south; but the precise point of entry into the Nile Valley was unknown. The discovery of sherds of this civilization at Amarah, which lies at one end of the shortest caravan route to Selima, would appear to indicate that the first place in the Nile Valley to be reached by this people has now been discovered. It may have been one of their important centres, a resting place after the desert journey. Future excavation may be expected to bring to light new facts bearing upon the history and character of the culture. The exhibits, thought to belong to the previously unknown 'Sudanese' culture, consist of a number of agate, flint and chalcedony arrow-heads together with some basalt axe-heads.

The excavations have been under the direction of Mr. H. W. Fairman. It is expected that complete excavation of the site will take at least four to five seasons.

ANGULAR DISTRIBUTION OF SUBMARINE DAYLIGHT

THE angular distribution of the illumination under water, and its variation with depth and surface light conditions, is of interest for several reasons. In the first place, a comparison of the actual distribution not very far below the surface with that which we would expect to find below a perfectly smooth water surface, with the given daylight conditions, would enable us to estimate the amount of scattering caused by the surface, and so to check Clarke's suggestion that the considerable extinction produced by a wind-ruffled surface is chiefly due to the formation of bubbles the chief action of which would be to scatter some of the light and increase its average obliquity. Secondly, by comparing the distributions at different depths, we could judge the relative importance of absorption and of scattering in the extinction of the illumination, since absorption by the water, by matter in solution, or by dark and opaque matter in suspension, would cause enhanced extinction of the oblique rays and render the average light more nearly vertical, while scattering by particles would render it more diffuse. Thirdly, from a knowledge of the polar distribution and of the vertical illumination as measured by a photometer with a horizontal window, we could calculate the total illumination, which is the determining factor in photosynthesis. The latter could be measured directly with a spherical photometer if such could conveniently be employed.

Important advances in our knowledge in this direction have recently been made by Pettersson and his co-workers, and the latest paper on the subject by Johnson and Liljequist* describes numerous experiments in Swedish waters with two types of photometer; in the first, an opaque disk mounted axially at a variable distance above a wide-angle photometer enables all light above any desired altitude to be screened off, and the effect of each altitude zone to be obtained by difference. In the second, the sensitivity of the photometer is limited to a comparatively narrow-angled cone, the axis of which can be directed in any desired direction in altitude or azimuth, so that a complete polar distribution curve can be obtained.

The results show that in sunlight and comparatively smooth water, under which conditions the majority of the tests were made, the under-water light is chiefly limited to a cone of rays the axis of which is near the theoretical direction of the direct sunlight. With increasing depth, the axis of the cone becomes more nearly vertical, and its angle increases, the first effect being due to absorption and the second to scattering. The former, however, seems to be much the more important agent in the extinction. The authors also give figures for the ratio total/vertical illumination. This naturally falls as the light becomes more nearly vertical, either due to increasing solar altitude or to increase of depth of immersion. The authors' figures range from 1·23 to 1·51. H. H. P.

---

* Svenska Hydrografisk-Biologiska Kommissionen. Skrifter, Ny serie. Hydrografi 14: On the Angular Distribution of Submarine Daylight and on the Total Submarine Illumination. By Nils G. Johnson and Gösta Liljequist. Pp. 16. (Goteborg: Svenska Hydrografisk-Biologiska Kommissionen, 1938.)

AMERICAN SPECIES OF CREPIS

E. B. BABCOCK and G. L. Stebbins, jun., have published in a Carnegie Institute of Washington iblication in 1938 a comprehensive survey of the merican species of *Crepis*. About a hundred pages e devoted to the descriptions of species, including ys to species, sub-species and apomictic forms ithin the species. The types described fall within velve groups derived from twelve endemic diploid ecies in each of which $x = 11$, and which are obably all derived by hybridization and polyploidy om Old World species with 4 and 7 pairs of chromo-mes. It is suggested that the former arose in stern Siberia in the warmer middle and late ertiary times.

The diploid species occur in circumscribed areas, eing limited mainly by climatic, though in part by laphic factors. The *Crepis runcinata* group differs om the other species groups by being entirely iploid and sexually reproduced; evolution within his species has apparently been by mutation and ther agencies, followed by selection in response to limatic and edaphic influences; the extreme types how intergrading and are interfertile, so that all are ncluded within the *Rassenkreis* of the single species. he other species show evolution mainly by polyloidy. The 'gigas' autopolyploids show similar istribution to the parent diploid, whilst allopolyloids, with characters intermediate between the arent species, are also more tolerant of climatic and daphic factors than either parent and consequently end to have a wider range. With hybridization there s a strong tendency for the sterile intermediate forms o be maintained by apomixis; such apomictic forms re often sufficiently definite to warrant separate lescriptions and keys for identification. The discussion of the behaviour of the species showing polyploidy and apomixis includes comparison with other genera known to behave in a similar manner.

The whole survey is very complete, and it is of great interest to have the distribution of the species mapped and discussed in relation to the climatic changes since the probable time of origin of the species. The wider distribution of the polyploid types indicates the greater tolerance of these to factors, which have presumably exterminated the diploids except from localized centres. This history of the Crepis flora and the preference of particular species for certain climatic and edaphic conditions may enable this genus to serve as a guide in further studies of the development of the present day flora.

The use made of structural features in estimation of polyploidy is worth mention. In many cases the average length of the guard cells of stomata from fully developed basal leaves gives a good guide as to the degree of polyploidy, though care has naturally to be exercised where hybridization has involved species with different initial size of guard cells in the diploid species. It was also found that pollen grains from diploid forms are approximately uniform in size and have three germ pores, whilst those of tetraploids are also uniform, some being predominantly three-pored, some four-pored. Triploid and pentaploid forms have markedly irregular pollen, with at least some four-pored grains. Thus differentiation between adjacent chromosome numbers, 22 from 33 or 44 from 55, may be drawn from examination of pollen, whilst distinctions between 22 and 44 or 33 and 55 chromosome types is obvious from the size of the stomata.

MODERN METALLURGICAL RESEARCH

ON June 22, Prof. F. Wever, of the Kaiser Wilhelm Institute für Eisenforschung in Düsseldorf, delivered a lecture at the Royal Society on "The Development and Present State of Modern Metallurgical Research". The lecture was one of those arranged under the scheme for an exchange of visits between representatives of the Royal Society and the Kaiser Wilhelm Gesellschaft, but it was clearly impossible in the space of a single lecture to deal with such a wide field as the title indicates, and actually Prof. Wever confined his attention to certain aspects of research on the structure and constitution of alloys and the transformations that influence them.

In a brief review of the early development of the basic methods of metallographic investigation, he paid tribute to the German, French and British men of science who were the pioneers in microscopy, thermal analysis and the construction of constitutional diagrams. In this part of the lecture his theme was that microscopic examination reveals the arrangement of the crystals in solid metals, thermal analysis enables the changes which affect this to be studied, while the application of the laws of heterogeneous equilibrium to co-ordination of the data obtained by these methods results in the construction of diagrams which represent the relations between constitution on one hand and composition and temperature on the other.

After a brief reference to the more recently developed study of metals by means of X-ray analyses, which enables the arrangement of the atoms in the crystals to be ascertained, Prof. Wever went on to deal with modern investigations on the kinetics of the transformations in solid metals. This is a field of research with which he has been closely associated, and most of this part of the lecture was concerned with the work of his colleagues himself. As investigations of this kind have confined to the study of the transformation occur in steel during cooling at differe attention was confined to the effect of cooling on the temperature of the progress of these changes at diffe temperatures below the critical range, and the structures produced in steels of different carbon content cooled at different rates or allowed to transform at different constant sub-critical temperatures.

Since the investigations of Dejean in 1917 and Portevin in 1919, it has been known that a progressive increase in the rate of cooling results in the first place in a gradual lowering of the normal changes, and in the second place, when a certain critical rate is exceeded, in the discontinuous depression of the changes to a lower temperature at which martensite is formed. Researches carried out since 1930 in the Kaiser Wilhelm Institute have contributed to present knowledge about the various changes and the relations between them. It has been shown, for example, that once the rate of cooling is sufficiently rapid to prevent any changes taking place above the martensite point, further increase in the rate of cooling does not produce further lowering of the martensite change. Thus a line may be drawn in the iron-carbon diagram to indicate the temperature at which the martensite change begins in steels of different carbon content, or a three-dimensional diagram may be drawn to show the relations between carbon content, rate of cooling and the temperatures of the transformations. It has also been known for some time that when steel is cooled to about 500° C. at a rate that suppresses the normal change, and is then cooled more slowly or maintained at constant temperature, an intermediate transformation occurs. The investigations with whi Prof. Wever has been associated indicate, howev that this intermediate transformation may al proceed to some extent during continuous cooling certain rates. Thus by cooling steels at progressive increasing rates, three kinds of changes may obtained, namely, the normal, the intermediate a the martensitic.

By means of a magnetic balance, the progress of th normal and the intermediate changes at differe constant temperatures has been studied. This wo has shown that the rate of the normal austenit pearlite transformation increases to a maximum the temperature at which it is caused to take pla is lowered, but further lowering leads to a diminutio in the rate and it finally becomes extremely slow. characteristic of this change is that at all temperatur there is a period of delay before it begins. At tem peratures below that at which the normal chang can take place the intermediate change occurs. Th begins immediately, proceeds at a rate that become more rapid as the temperature is lowered, an continues to an extent that increases as the tempera ture is lowered. At still lower temperatures th martensite change takes place with great rapidity and investigations on iron-carbon-nickel and iron carbon-manganese alloys have shown that th martensite change in carbon steels corresponds to th $\gamma \rightarrow \alpha$ change in iron-nickel or iron-manganese alloys

---

FISSION OF URANIUM NUCLEI

PROF. OTTO HAHN of the Kaiser Wilhelm Institut für Chemie, Berlin-Dahlem, was guest lecturer, on the invitation of the Royal Society, at the Royal Institution on Friday, June 23. Prof. Hahn's subject was "The Fission of Uranium Nuclei by Neutrons", and his account was chiefly historical. As the first definitely to establish the production of elements of medium atomic weight (fission products) when uranium is bombarded by neutrons, Prof. Hahn naturally confined himself mainly to describing the chemical method of investigation used by his colleagues and himself.

He described in detail how, in the process of confirming and extending the earlier investigations of Fermi and Curie and Savitch, Dr. Strassmann and he were forced to conclude that short-lived isotopes of barium and lanthanum were produced from uranium. These bodies could be separated from radium and actinium isotopes, but not at all from inactive barium or lanthanum, respectively, either by fractionation or by chemical means. Meitner and Frisch discussed these results in terms of division of the heavy nucleus into roughly equal fragments and Frisch showed, for the first time by a physical experiment, *that* the predicted large amount of energy is released in the act of fission. Thereafter, d Prof. Hahn, the whole subject was widely d in a great many laboratories throughout the In his own laboratory, the chemical investi- was continued and the production of fission product together with stron- stablished. The active barium and this showing, arise chiefly as decay products following xenon and caesium isotopes.

Up to this point, Prof. Hahn had described only previously unknown activities, but he went on to show how first one and then another of the so-called trans-uranic elements, postulated to explain most of the early work on the uranium disintegration, were proved, by purely chemical means, also to belong to the middle, rather than the end, of the periodic table. This was established by physical methods in other laboratories; but his own experiments had carried the matter further in one particular respect. After a great deal of labour, he had been able to show that the eka-iridium of the earlier classification contained molybdenum as well as tellurium—even though the half-value periods of the two active isotopes were distressingly similar! There remained only the task of applying the same methods of exact chemistry to the other activities which had not so far been studied, Prof. Hahn said, for his own contribution to the problem to be complete.

In the discussion which followed this most interesting lecture, Prof. Niels Bohr gave an account of the theoretical treatment of the fission problem recently undertaken by Dr. J. A. Wheeler and himself in the United States, and further contributions were made by Prof. M. L. E. Oliphant, Dr. E. Bretscher, Prof. G. P. Thomson and others.

Dr. Bretscher mentioned the results of preliminary experiments using large quantities of lead tetra-ethyl, which appear to show that fission occurs (though with a very small cross-section) with lead under fast neutron bombardment.

N. F.

UNIVERSITY EVENTS

BELFAST.—Dr. R. H. Sloane has been appointed ecturer in experimental physics and Mr. G. Williams as been appointed lecturer in zoology.

W. R. Crawford has been approved for the degree f D.Sc. in mechanical engineering.

CAMBRIDGE.—Prof. D. M. S. Watson, Jodrell pro-essor of zoology and comparative anatomy, Univer-ty of London, has been appointed to give the Herbert Spencer Lecture in Trinity term, 1940.

EDINBURGH.—Mr. James Brough, of the University f Manchester, has been appointed lecturer in the logy of vertebrates in succession to Dr. C. H. Donoghue, and Mr. J. E. G. Raymont, of University lege, Exeter, has been appointed lecturer in the logy of invertebrates in succession to Dr. Peter y.

GLASGOW.—At Commemoration Day on June 21, the norary degree of doctor of laws was conferred on following, among others: Sir Andrew Duncan, airman of the executive committee of the British Iron and Steel Federation; Prof. W. J. Goudie, emeritus professor of the theory and practice of heat engines, University of Glasgow; Prof. I. M. Heilbron, professor of organic chemistry, University of London; J. McFadyen McNeill, naval architect, Glasgow; Prof. F. J. M. Stratton, professor of astrophysics, University of Cambridge; Prof. G. G. Turner, professor of surgery, University of London.

LEEDS.—Dr. M. G. Evans has been elected to the chair of physical chemistry, in succession to the late Prof. H. M. Dawson (see p. 15).

Dr. R. G. S. Hudson has been elected to the chair of geology which will become vacant on the retirement of Prof. A. Gilligan at the end of the present session (see p. 16).

Dr. J. B. Speakman has been elected to the chair of textile industries in succession to the late Prof. A. T. King (see p. 15).

The following appointments have also been made: Mr. Frederick Whalley, as lecturer in anæsthetics; Mr. Herbert Agar, as tutor in obstetrics and gynæcology; Mr. A. Stewart Johnstone, as lecturer in radiology; Mr. R. V. Riley, as research assistant in the Fuel Department.

LONDON.—Prof. Frank Horton, University professor of physics at Royal Holloway College, has been elected vice-chancellor for the year 1939–40.

Mr. Harry Stobie has been appointed, as from October 1, to the University chair of dental surgery and pathology tenable at the Royal Dental Hospital of London School of Dental Surgery. From 1932 until 1936 he was postgraduate instructor in oral surgery at the Royal Dental Hospital and since 1930 he has held the part-time posts of honorary dental surgeon, dean and director of teaching, and lecturer in dental surgery and pathology at that hospital.

Dr. Harold Heywood has been appointed, as from October 1, to the University readership in mechanical engineering tenable at the Imperial College of Science and Technology. From 1936 until 1938 he was lecturer in mechanical engineering at the City and Guilds College and since March 1938 he has been senior research officer at the British Coal Utilisation Research Association.

SCIENCE NEWS A CENTURY AGO

Equipment of Magnetic Observatories

THE study of terrestrial magnetism, which had made great strides in the early part of last century through the work of Hansteen, Gauss, Humboldt, Sabine and others was advanced another stage by the dispatch in 1839 of an expedition to the Antarctic under the command of Capt. James Clark Ross, for whom the Admiralty had fitted out the *Erebus* and *Terror*. The *Athenæum* on July 6, 1839, referring to this said: "We long since announced that a naval expedition was about to proceed to the Antarctic Seas, for the purposes of magnetic research and observation. In consequence the Royal Society have resolved to address a letter to such foreign societies as were most likely to take an interest in the subject, calling on them to aid, as far as possible, in executing a concerted system of observation". The *Athenæum* then printed the letter of the Royal Society which said that "Her Majesty's Government has ordered the equipment (now in progress) of a naval expedition of discovery, consisting of two ships, under the command of Capt. James C. Ross, to proceed to the Antarctic Seas for the purposes of magnetic research and also the establishment of fixed magnetic observatories at St. Helena, Montreal, the Cape of Good Hope, and Van Dieman's Land having for their object the execution of a series of corresponding magnetic observations during a period of three years. . . . The Court of Directors of the Honourable East India Company have also in compliance with the suggestion of the Royal Society, resolved to establish similar observations at Madras, Bombay, and at a station in the Himalaya Mountains. . . ." The communication was accompanied by a report made to the Council of the Royal Society by a joint committee of physics and meteorology. It was intended that a series of meteorological observations subordinate to, and in connexion and co-extensive with, the magnetic observations should be made.

Ross's expedition was a very successful one, and he penetrated to within less than twelve degrees of the South Pole. The Royal Geographical Society awarded him a gold medal in 1841 and after his return home in 1843 he was knighted.

Prevention of Steam-boat Accidents

IN consequence of the numerous accidents to steam vessels a century ago, the Government appointed Captain Pringle and Josiah Parkes to report on the causes and the prevention of such accidents. The first part of their report was printed in the *Mechanics' Magazine* of July 6, 1839. They recommended that a Board should be set up under the Board of Trade to register and classify all steam vessels, that surveyors should be appointed to inspect and report on the condition of vessels, that the Board should investigate all accidents, that an annual report should be made to Parliament on the state and progress of the mercantile steam marine, that instructions should be drawn up for the surveyors. that an abstract of the law relating to steam-boats should be placed in a conspicuous place in each vessel, that hulls should be surveyed half-yearly, that licences should be issued, and that the surveyor should ascertain that the safety valves in the boilers were the right size, and that no licence should be granted to vessels having the spindles or levers of the safety valves on deck.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ADVISER IN AGRICULTURAL BOTANY (MYCOLOGIST) in the University of Manchester—The Registrar (July 1).

LECTURER (WOMAN) IN NATURE STUDY AND EDUCATION in the City of Leeds Training College—The Director of Education, Education Department, Calverley Street, Leeds, 1 (July 3).

SUPERINTENDENT OF BALLISTIC RESEARCH in the Research Department, Royal Arsenal, Woolwich—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (July 7. Quote appts. /150 A).

SUPERINTENDENT FOR A WAR DEPARTMENT EXPERIMENTAL ESTABLISHMENT—The Under-Secretary of State (C 5), The War Office, London, S.W.1 (July 7. Quote Appts./151 A).

LECTURER IN MECHANICAL ENGINEERING in the Heanor Mining and Technical School—The Director of Education, County Education Office, Derby (July 8).

ASSISTANT BOTANIST at the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (July 10).

ADVISER ON PLASTICS in the Directorate of Scientific Research of the War Office (and later for the Ministry of Supply when formed)—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (July 10. Quote Appts./153).

ASSISTANT LECTURER IN ZOOLOGY in the University of Manchester—The Registrar (July 12).

ASSISTANT LECTURER IN GEOLOGY in the University of Leeds—The Registrar (July 12).

PROFESSOR OF CHEMISTRY in the University of Aberdeen—The Secretary (September 16).

PROFESSOR OF ENGINEERING in Auckland University College, New Zealand—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1.

CURATOR OF THE PITT-RIVERS MUSEUM in the University of Oxford—The Registrar.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Labour. Report for the Year 1938. (Cmd. 6016.) Pp. iv+136. (London: H.M. Stationery Office.) 2s. net. [26

City and County of Bristol: Bristol Museum and Art Gallery. Report of the Committee for the Year ended 31st December, 1938. Pp. 28+4 plates. (Bristol: Museum and Art Gallery.) [56

Proceedings of the Royal Society of Edinburgh, Session 1938–1939. Vol. 59, Part 2 (No. 14): Studies on Reproduction in the Albino Mouse, 2: Contributions on the Maturation of the Sperm Cells. By Hugo Merton. Pp. 145–152. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 9d. [56

Report by the Hydrographer of the Navy on the Surveys carried out by H.M. Naval Surveying Service, and on the Work of the Hydrographic Department for the Year 1938. Pp. 10. (London: Admiralty.) [56

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich. Pp. 45. (London: Royal Observatory.) [56

The Birds of Staffordshire. Issued as Appendices 1–9 to the Transactions and Annual Report of the North Staffordshire Field Club, Vol. 64, 1930, to Vol. 72, 1938. Pp. 238. (Stoke-on-Trent: North Staffordshire Field Club.) [56

University of Oxford: Committee for Advanced Studies. Abstracts of Dissertations for the Degree of Doctor of Philosophy. Vol. 11 (Dissertations accepted during 1938.) Pp. v+306. (London: Oxford University Press.) 3s. net. [66

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 788, Vol. 238: Investigations on Magne-Crystallic Action, 6: Further Studies on Paramagnetic Crystals. By K. S. Krishnan, A. Mookherji and A. Bose. Pp. 125–148. 2s. Series B: Biological Sciences. No. 563, Vol. 229: The Origin and Developmental Mechanics of the Avian Sternum. By Honor B. Fell. Pp. 407–463+plates 38–41. (London: Cambridge University Press.) [76

Royal Meteorological Society. Bibliography of Meteorological Literature. Vol. 4, No. 6 (July–December, 1938.) Prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office. Pp. 294–351. (London: Royal Meteorological Society.) 2s. 6d. [76

Proceedings of the Royal Irish Academy. Vol. 45, Section B, No. 7: River Liffey Survey—2: The Food Consumed by the Brown Trout (*Salmo trutta* Linn.) in Acid and Alkaline Waters. By Winifred E. Frost. Pp. 139–206+plate 24. 3s. Vol. 45, Section B, No. 8: On the Occurrence of *Gammarus duebeni* (Lillj.) (Crustacea, Amphipoda) in Ireland. By D. M. Reid. Pp. 207–214. Vol. 45, Section B, No. 9: Notes on the Ecology of the Sandy Beaches of North Donegal. By Colin B. Rees. Pp. 215–230. 1s. Vol. 45, Section B, No. 10: A Further Contribution to the Flora of Ireland. By R. Lloyd Praeger. Pp. 231–254. 1s. Vol. 45, Section B, No. 11: Some Observations on the Glaciation of North-East Ireland. By J. Kaye Charlesworth. Pp. 255–296+plates 25–27. 4s. Vol. 45, Section B, No. 12: Bathymetric Survey of Three Lakes in Co. Wicklow. By H. J. Seymour. Pp. 297–300+plates 28–30. 1s. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [76

The Carnegie United Kingdom Trust. Twenty-fifth Annual Repo January–December, 1938. Approved by the Trustees at their Gener Meeting held on Friday, 3rd March, 1939. Pp. vi+86. (Dunfermlin Carnegie United Kingdom Trust.) [

The Colonial Empire. Statement relating to the period 1st Apr 1938, to 31st March, 1939, to accompany the Estimates for Coloni and Middle Eastern Services, 1939. Presented by the Secretary State for the Colonies to Parliament by Command of His Majest May 1939. Pp. iv+98. (London: H.M. Stationery Office.) 1s. net. [

Report of the British Guiana Refugee Commission to the Adviso Committee on Political Refugees, appointed by the President of t United States of America. Presented by the Secretary of State f the Colonies to Parliament, by Command of His Majesty, May, 19 (Cmd. 6014.) Pp. 20. (London: H.M. Stationery Office.) 4d. net. [1

New Tendencies in Colonial Policy. With an Introduction by Leona Barnes. Pp. 16. (London: Pacifist Research Bureau.) 2d. [1

War and the Colonies: a Policy for Socialists and Pacifists. P 16. (London. Pacifist Research Bureau.) 2d. [1

International Tin Research and Development Council. Publicati No. 94. Report for 1938. Pp. 22. (Greenford: International T Research and Development Council.) [1

The Royal Society for the Protection of Birds. Forty-eighth A Report, January 1st to December 31st, 1938, with Proceedin Annual Meeting, 1939. Pp. 114. (London: Royal Society fo Protection of Birds.) 1s.

Ministry of Health. Report of the Inter-Departmental Comm on Abortion. Pp. vi+168. (London: H.M. Stationery Office.) net.

Other Countries

Export Trade In and Byproducts Uses of Tobacco: Letter the Secretary of Agriculture transmitting in response to S Resolution No. 291 (75th Session) a Report pertaining to the E Trade In and Byproducts Uses of Tobacco. (Senate: Document 39.) Pp. viii+56. (Washington, D.C.: Government Prin Office.) [

Forest Research Institute. Woodworking Series, No. 2: Laminate Wood. By W. Nagle. Pp. viii+7+7 plates. (Dehra Dun: Fore Research Institute.) [

Cornell University: Agricultural Experimental Station. Bullet 709: Marketing Fruits and Vegetables on Farmers' Markets, Ne York Metropolitan District. By M. P. Rasmussen. Pp. 60. Bullet 710: The Peach Enterprise in Western New York; Soil Relationship Costs and Returns, and Marketing. By Herrell F. DeGraff. Pp. Bulletin 711: Soils in Relation to Fruit Growing in New Yor Part 14: Tree Behavior on Important Soil Profiles in the Finger Lake Area. By Damon Boynton. Pp. 21. Bulletin 712: State Reforestatio in Two New York Counties; The Story of the Land and the Peopl By T. E. LaMont. Pp. 23. Bulletin 713: The Composition of Ru Households. By W. A. Anderson. Pp. 24. Bulletin 714: Problems the Production of Iceberg Lettuce in New York. By J. E. Kno E. M. Anderson and B. D. Sweet. Pp. 17. Memoir 218: The Effec of Temperature on the Photoperiodic Response of Spinach. By J. Knott. Pp. 28. Memoir 219: Neutralization Curves for the Humi Acids of Peat Soils. By B. D. Wilson and E. V. Staker. Pp. 1 (Ithaca, N.Y.: Cornell University.) [5

28 Bericht der Naturforschenden Gesellschaft. Die ältesten Räde uhren und modernen Sonnenuhren: Forschungen über den Urspru der modernen Wissenschaft. Von Ernst Zinner. Pp. 148+50 plate (Bamberg: Naturforschenden Gesellschaft.) [5

Fiskeridirektoratets skrifter, Serie Havundersøkelser. Vol. 6, No. 1 Fisken og Havet. Pp. 104. Vol. 6, No. 2: Torsken i Oslofjorden Av Johan T. Ruud. (Bergen: A.s John Griegs Boktrykkeri.) [5

League of Nations: Child Welfare Information Centre. Annu Report on Child Welfare for the Third Session of the Advisory Com mittee on Social Questions. Pp. 202. (Geneva: League of Nations London: George Allen and Unwin, Ltd.) 4s. [5

Colony and Protectorate of Kenya. Report on a Visit to Kenya By Dr. J. B. Pole-Evans. Pp. 36+18 plates. (Nairobi: Govern ment Printer.) 2s. 6d. [12

U.S. Department of Agriculture. Technical Bulletin No. 643 Food Habits of North American Diving Ducks. By Clarence Cottam Pp. 140+10 plates. (Washington, D.C.: Government Printing Office. 30 cents. [12

Catalogues, etc.

The Nivoc Supplement. No. 6, Industrial Series, April. Pp. 1 (London and Birmingham: W. and J. George, Ltd.)

'Ceramite' Resistance Units. Pp. 12. (London: Zenith Electr Co., Ltd.)

Radiography and Clinical Photography. Vol. 3, No. 1. Pp. 1 (London: Kodak, Ltd.)

Photographs from Exposure to Print. Pp. 24. (London: Burrough Wellcome and Co.)

Catalog and Price List of Eastman Organic Chemicals. Thirtiet edition. Pp. 124. (Rochester, N.Y.: Eastman Kodak Company.)

A Catalogue of Books on Botany, Agriculture, Forestry, Fruit Culture, Gardens and Gardening, Tobacco. (No. 563.) Pp. 100 (London: Bernard Quaritch, Ltd.)

Old Books: a Collection of Early Photographs and Books com memorating the Centenary of Fox Talbot and Daguerre, 1839–1939 (Catalogue 52.) Pp. 80+12 plates. (London: E. P. Goldschmid and Co., Ltd.)

Reagent Bottles with Sandblast or Enamelled Labels. (Pamphle No. 354.) Pp. 4. Dust Estimation: Measurement of Particle Size (Publication No. 356.) Pp. 2. (London: A. Gallenkamp and Co. Ltd.)

Editorial & Publishing Offices:
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

Telegraphic Address:
Phusis, Lesquare, London

Telephone Number:
Whitehall 8831

Vol. 144 SATURDAY, JULY 8, 1939 No. 3636

SCIENCE IN MODERN AGRICULTURE

IT is now twenty-nine years since the great forward step was taken which for the first time made agricultural research on any important scale possible in Great Britain. In 1910 Mr. Lloyd George set up the Development Commission, charged with the duty of developing agriculture and provided with an endowment fund which avoided the necessity of asking Parliament for money each year: it was thus able to take long views and to carry out important work which might otherwise have been impossible.

The wisdom of this method has been fully justified by the events of the succeeding years, and the twenty-eighth report of this Commission* now issued shows a remarkable range of activities, and a gratifying number of successful achievements of which all concerned may well be proud. The magnitude of the operations may be judged from the fact that the expenditure during 1937–38 amounted in all to £740,466, as compared with £641,126 in 1935–36. Of this sum £131,555 was devoted to fisheries, £2,300 to land reclamation, and £606,611 to agricultural and rural industries.

About £500,000 was in 1937–38 expended under the heading "research", the largest single item being the purchase of an estate at Compton for the provision of facilities for experiments, by the research institutes on livestock, which at present are difficult to carry out. The estate comprises 1,500 acres of easily farmed land on a chalk subsoil, and the herds include nearly 400 pedigree cattle and 450 pedigree pigs. The total price paid for land, buildings, equipment and livestock was £74,995. Nearly another £40,000 is to be expended on further developments.

A full account of the work on foot-and-mouth disease is given. This is one of the most serious and costly troubles in modern agriculture, and at present the only method known of dealing with it is to slaughter at once all infected animals. Slaughter is now compulsory; but of course compensation has to be paid to the owners, and the cost is very high. Successive ministries have ordered inquiries and carried out some investigations, and since 1924 a sum of about £200,000 has been spent on this side alone. In these circumstances, it is really distressing to read that until recently the study of the disease was only on a temporary basis: that "changes in the temporary scientific staff employed—changes due, in part at least, to the resignation of young workers seeking more permanent employment than could be offered by a committee constituted for a temporary inquiry—not only made the work very costly, but created something of a 'hope deferred' complex in those, including the commissioners themselves, who were responsible for expenditure". This happened, not as one might think, two hundred years ago, but in 1933! One wonders what is the use of our costly educational system that produces a community in which such complete disregard of the need for scientific investigation is possible. Happily this particular difficulty is now overcome and the investigation is to be put on a permanent basis.

A large part of the Commissioners' expenditure is on the agricultural research institutes at Rothamsted, Cambridge, Oxford, Aberystwyth, Aberdeen, Edinburgh, East Malling, Shinfield and other centres where the different branches of agriculture are shared out, each institute being responsible for a particular set of subjects. The arrangement works well, and the cordial relations between the staffs of the institutes on one hand, and the Development Commission, the Agricultural Research Council and the Ministry of Agriculture officials on the other, ensure adequate treatment of all the subjects. The general rule is that the Commission finds most of the money for annual maintenance and up to fifty per cent of approved capital expenditure, the institutions having to find the remainder.

---

* Development Commission. Twenty-eighth Report of the Development Commissioners being for the Year ended the 31st March 1938. Pp. 184 (London H.M. Stationery Office, 1939.) 1s. net.

The Development Commission spends its money wisely, but it is not the only body financing agricultural research. The Land Fertility Committee, the Sugar Commission, the various marketing boards all spend or can spend money under this name. In this awakening interest in agricultur history is repeating itself: "The farming tribe' wrote Arthur Young a hundred and fifty years ag "is now made up of all ranks, from a duke to a apprentice". So the promoters of agricultur research are in our time widespread and numerou Unfortunately, apart from the Sugar Commissio the so-called research is not infrequently n research at all, and indeed the effect of one of the bodies has been to put an end to some work permanent value that was being done. Happil the Agricultural Research Council is gettin into its stride, and when it is fully functionin it will prevent some of the wastage still liab to occur.

INTEGRATION IN THE CENTRAL NERVOUS SYSTEM

The Form and Functions of the Central Nervous System
An Introduction to the Study of Nervous Diseases. By Prof. Frederick Tilney and Prof. Henry Alsop Riley. Third edition. Pp. xxxvii+851. (London: H. K. Lewis and Co. Ltd., 1938.) 50s. net.

IN no part of the body is the relation of form and function so clear as in the central nervous system. Modern neurology owes its present position to advances in knowledge which have come from many sources. Comparative anatomy has shown clearly how the brain has altered and increased in size with the gradual evolution of the mammalian series, and the addition of new centres to the primitive brain can usually be correlated with changes in the habits or reactions of the new species. Anatomists have aided in the understanding of the human brain by two further lines of approach. Embryological investigation has helped in outlining the various components of the brain and, by a study of the gradual myelinization of tracts, has correlated structure with function. Finally, histological investigations iave shown that different parts of the nervous ystem contain highly differentiated cells, and ortical areas outlined by histological means ave been found to subserve different activities. n the other hand, detailed study of the functions the central nervous system has helped, in ny instances, to a clearer understanding of the ucture—study based both on physiological eriment and on clinical observation of patients rganic nervous disease.

Profs. Tilney and Riley, in their book, founde on a clear understanding of this important relatic of form and function in the nervous system, hav provided a model for a text-book, a model whic might well be copied for other systems in the bod Physiology and anatomy used to be regarded b students as two widely separated subjects. Th book provides detailed anatomical and histologic descriptions of the various component parts the nervous system, associated in each instan with an account of the evolutionary and embry logical significance of that part and followed b an account of its function, based partly c physiological principles, but illustrated by clinic syndromes. Case reports, used throughout th book, indicate to the student how dependen diagnosis is on a knowledge of detail, and ser as an excellent introduction to the study neurology.

To a clear account of the spinal cord ar the simple reflex arc, the authors gradual add details of the higher structures of th primate nervous system, and the increasin complexity of the control of the simple reflex, b the addition of new association tracts, both sensor and motor, is easy to follow. The development the cerebellum and its function in the 'synerg regulation of muscular patterns' is particularly we described.

Perhaps the most interesting sections of th book are those dealing with the cerebral corte The evolution of the cerebral hemispheres is se in its highest form in the human brain, and, follo ing a full account of the cortical localization of bo notor and sensory functions, the authors discuss the welding of the various afferent stimuli into cognition, based on memory of similar sensory patterns previously received. From this cognition, they follow the development of motor incentive patterns leading to activity, personality and intelligence. The authors reveal themselves as followers of the 'behaviourist' school of psychologists, explaining individualism largely on the basis of previous experience. They show how the structure of the silent parts of the cerebral cortex might well subserve such a function, but the exact correlation here of form and function must await fuller clinical, or perhaps psychological, analysis.

A few minor defects detract little from the achievement of this book, which is now in its third edition, but may be noted for possible correction in the further editions that will be called for. It is doubtful whether the "venosity" of the blood, rather than its carbon dioxide content, can be considered the chief source of stimulation of the respiratory centre, and Cheyne-Stokes respiration can no longer be regarded as due to a "vascular spasm so affecting the respiratory centre as to cause its exhaustion".

The illustrations in the book are excellent. They show clearly the points referred to in the text and, by their number, aid the reader in following the complex pathways as they track through the nervous system. The photographs of clinical cases, however, fall short of the high standard set by the other illustrations. It would be a diagnostic feat to recognize Fig. 568 as a case of juvenile paralysis agitans, and a more typical picture of an acromegalic should not be difficult to find. The authors state that in this edition an attempt has been made to reduce the bulk of the book and certain sections have been eliminated. In a book of this size it is a pity that space could not be found for a more detailed account of the cerebrospinal fluid and of the syndromes related to the obstruction of the various components of the circle of Willis and other arteries supplying the brain.

These are, however, minor points. Profs. Tilney and Riley have produced a book which will remain a classic, a fine introduction to the intricacies of neurology for the student and an invaluable work of reference both for anatomical detail and as an aid to the clinician attempting to localize baffling physical signs. M. L. R.

A CENTURY OF BRITISH PHILOSOPHY

A Hundred Years of British Philosophy
By Dr. Rudolf Metz. Translated by Prof. J. W. Harvey, Prof. T. E. Jessop, Henry Sturt. Edited by Dr. J. H. Muirhead. (Library of Philosophy.) Pp. 828. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1938.) 25s. net.

THE prodigious output of philosophical literature in Great Britain during the last hundred years makes it difficult for one to attempt a thorough examination of the various currents cutting across the field of speculative thought. Such an attempt involves a mastery of the manifold windings of that thought itself and a spiritual acquaintance with its distinguished representatives. A British scholar might have found it difficult to undertake such a task: living in the very atmosphere he would have to analyse, he might feel perhaps a lack of perspective for an unbiased outline of the controversial object of his inquiry.

It was left to a German scholar to provide us with a detailed account of the development of contemporary British philosophy. Though his book was originally written in German for the benefit of his own countrymen, it has aroused the interest of the editor and publishers of the "Library of Philosophy" and it has prompted three eminent British scholars to undertake its translation as a pure labour of love. The English translation, which amounts to a corrected and enlarged version of the original edition, brings the bibliographies up to date and contains valuable additions of new material, such as the enlargement of the sections on the Oxford moralists and the Logical Positivists. All these facts speak for the excellence of this work, which can be recommended not only for the accuracy of its information, but also for the candid opinions expressed on the leading philosophers of our time.

There are two parts in this book. The first one deals with the older schools of thought in the nineteenth century, such as the Scottish philosophers, the utilitarian-naturalist thinkers, and the group interested in religious philosophy. Although these schools are known in their main features, the general reader will find a new interest in them on account of the fresh material introduced by the systematic treatment of all their individual representatives.

The main attraction of the book, however, is the second part, which deals with the recent schools of thought, and which covers nearly three quarters of the volume. Beginning with the revival of interest in speculative problems initiated by Coleridge, it brings us down to the present day, through a panoramic display of the neo-idealist movement, pragmatism, the older and the new realism, mathematical logic, the philosophy of natural science, psychology and the philosophy of religion.

The older group of British idealists, such as Coleridge, Carlisle, Hamilton, Grote and Jowett, paved the way for the introduction of the German masters into our own philosophy. With Green and Caird, the powerful momentum of the thought of Kant and Hegel communicated itself to a variety of group of thinkers. Towering above them is the outstanding figure of Bradley, who has exercised a profound influence on our generation. Bradley's construction of the world begins with immediate experience, in which are combined feeling, know-
ng and being. The categories with which
he mind tries to grasp reality are in them-
elves mere appearances, though they may have
place in reality as fragments of it. But, the
timate and all-embracing reality is the absolute
the spirit, which comprehends and completes
finite experiences and appearances, and which
y be known through the ascending degrees of
lity, each fragment of which is dovetailed in
rger one until the absolute is reached. Similarly,
the field of action the self-fulfilment of the
vidual makes him gradually conscious of the
lute through his assimilation of wider social
, the mutual relations of which account for
luties and obligations.

his absolute idealism, Bradley is followed by
im and Bosanquet, who defend thought as
hway to absolute reality. Closely related
this group are the Hegelians, like Baillie,
ne, Mackenzie, Muirhead and Smith. With
al idealism are connected the names of
-Pattison, Rashdall and Sorley. The
strain is also found in the works of
-Carr and Hoernlé, and especially of lead-
of science like Eddington and Jeans, who
onceive the world of matter as something
independently of the mind. Compared
e dogmatic pronouncements of their
stic predecessors fifty years ago that
one was real, this attitude is particularly
. It is fair to add, however, that all
do not share these views. Writers like
the realist thinkers attempt a different
ion of the physical world.

The antagonism between spiritualism and materialism is more pronounced in the controversies about the philosophy of animate Nature, which keep alive the old feud between vitalists and mechanicists. The latter favour the view that life is a by-product of blind processes of dead matter; while the former maintain that life is something fundamental and creative, exhibiting its own purposes and ends. Hogben believes that there was never a time when biologists entertained more confidence in the usefulness of classical physico-chemical methods as instruments for arriving at predictable conclusions about the behaviour of organisms. Woodger goes even further by applying to the study of biological questions physical methods and an appropriate notation of mathematical logic leading to a gradual displacement of the notion of 'stuff' by that of 'system'; so that the notion of protoplasm or living matter will have to go the way of hereditary substance, if the biologists can learn to think of cells more in terms of systems and less in terms of stuff.

Against these mechanistic views, Thomson and J. S. Haldane claimed the independence of biology from physics, while admitting that the advances of physics during the present century have made it much easier to realize the true relations between these sciences. Thomson defended a "methodological vitalism" in which the physico-chemical phenomena of living organisms and groups cannot find a complete explanation without the biological concept of the organism as a historic being in which a racial as well as an individual past lives. J. S. Haldane went much further in maintaining that the mechanicist conception has been upset by the discovery that atoms are not mere inert elastic bodies, but centres of intense specific and persistent internal activity, and that on this internal activity their physical and chemical properties depend. Atoms seem now to have properties similar to those which are attributed to living organisms as co-ordinated wholes. Hence, if biology may retain the old physical and mathematical conceptions for practical purposes, the more fundamental of these very conceptions are assuming characters similar to those of biology. It may be added here that a remarkable feature of the philosophy of both these eminent representatives of vitalism is the indispensable part which God plays in their world-view.

It is as a reaction against idealism that the realist movement began in 1903 with Moore's famous essay "The Refutation of Idealism". In his defence of the objectivity of the external world, the existence of values and the external character of the relation between subject and object, Moore was soon followed by an increasing umber of thinkers such as Russell, Johnson, oseph, Ross, Price, Wilson and especially Alexnder, Lloyd Morgan and Broad. With these st three thinkers is connected the theory of mergence, which develops the view that physical vents manifest an ascending hierarchy of kinds of elatedness in the case of the various strata of xistence. Emergence is the explanatory principle hich accounts for every advancing stage of comlexity into the psycho-physical world. The echnical aspect of Lloyd Morgan's world-descripion is supplemented by Alexander's view that mergence stirs the spatio-temporal ultimate tuff of reality and thus produces in succession the arious ontological details of the world, from the tomic events of the physical nature to the mergence of deity.

A different realist strain pervades the conceptions of Russell and Whitehead, with whose names s connected the epoch-making "Principia Mathematica". This work crystallized the long controversies on the significance, the methods and the utual relations of mathematics and logic. It is lso a permanent source of inspiration to a score f logicians like Wittgenstein, Stebbing, Ramsay, Braithwaite, Heath, Mace and others. Russell's pistemological realism, however, becomes a neutral monism' in so far as it considers the ltimate stuff of reality as neither mental nor aterial, but neutral; while his analysis of our omplex experience breaks it into 'atoms' and has o be expressed as a 'logical atomism'. Whitehead's hilosophy becomes also a kind of monism with is explanation of the dynamic effort of the world passing into everlasting unity, and of God's vision ccomplishing his completion by absorbing the world's multiplicity of effort.

It cannot be said that all realists agree about the various problems of philosophy; some of them even go dangerously near idealism, in spite of common attitude to the fundamental problem of knowledge they profess. It is difficult to see, however, how their generous efforts can bear fruit when one takes into account their tacit acceptance of Hume's criticism of the fundamental notions of philosophy. Without the secure foundations afforded by such notions as substance, causality and deity, it is almost hopeless to build permanent constructions on such vague conceptions as 'the ultimate stuff of reality', 'enduring events', 'emergent qualities' or 'progressive deity'. If we submit these conceptions to a destructive analysis, would we not run the risk of seeing them also dissolve into nothingness? Scepticism and realism cannot thrive together; and, after all, realism cannot expect to win the fight for supremacy by surrendering its best weapons before the battle is joined.

Various practical characteristics and national peculiarities stand out from a close study of contemporary British philosophy. Individualism, distrust for comprehensive systems, empiricism, optimism, and in some cases mysticism, are among the most prominent. The fusion of these qualities with the traditional British common sense, has promoted a friendly relationship between philosophy, religion and the positive sciences. Indeed, without the theoretical and practical data of the sciences and of religious experience, philosophy alone could neither undertake conclusively its scrutiny of reality, nor carry our minds to the highest flights of purposive thinking. There is no reason why philosophers should reject the conclusions of faith while they welcome the results of experimental science. The world-view of philosophy embraces every aspect of human activity. British philosophy will no doubt be judged by future generations according to its power to promote and maintain co-operation with both religion and science. The trend of English thought, as it is excellently outlined in the present volume, bears out this belief.

T. GREENWOOD.

MANAGEMENT THEORY AND PRACTICE

The Principles of Rational Industrial Management

By James J. Gillespie. Pp. xv+229. (London: Sir Isaac Pitman and Sons, Ltd., 1938.) 10s. 6d. net.

A BOOK which claims to be "the boldest and most vital contribution to management thought in the past decade" must expect to be judged by a high standard. Unfortunately, whatever may be the intrinsic merits of this study, it is decidedly marred by jargon which both obscures the meaning, and occasionally descends to the coining of words. Nor can it be said that the author contributes anything that is very novel to management theory or practice. The limitations of scientific management in the narrower sense have been widely recognized in recent years. The social aspects of management and the social responsibilities which industrial leadership involv are being increasingly recognized, as well as the service basis of industry in its truest sense. Whatever mistakes have been made in the past, and however far industry may need to go in the future to link up its economic and social functions, it is a large claim that rejects entirely the term 'scientific management' in the way that is done by Mr. Gillespie, and substitutes for it what he describes as 'rational management'. His claim is unlikely to be accepted without demur by many concerned with the theory or with the practice of management.

When this has been said, however, it must be admitted that the author has written a stimulating book. Those who have the patience and perspicuity to penetrate the jargon in which some of his chapters are clothed will find much to repay them. Without detracting from the value of the scientific method, Mr. Gillespie indicates its limitations, particularly in the analysis of phenomena which involve social and economic factors. The failures of scientific management indeed arise not so much from its methods or tools, as from the narrow outlook with which it has sometimes been applied. Mr. Gillespie shows very clearly the importance of the other elements which may involved in the situations with which managem in industry is confronted. He indicates, too, h much industry itself has to hope from advan in the social sciences, as well as from the utilizat of the physiological and psychological d acquired, for example, by such investigations those of the National Health Research Board the National Institute of Industrial Psychology

The author includes a highly suggestive sect on leadership and lays a timely emphasis on importance of the principle of authority a obedience in management—not only the obedie of authority by employees, but also the obedience management itself to the whole purpose wh industry is serving, no less than to the regulati laid down by itself. Mr. Gillespie undoubte writes with vision but the book would have gai in value not only by some attempt to avoid jarg but also if the numerous cross-references to found in some of the chapters had been collec in a systematic bibliography as a basis for wider reading which the volume might stimulate.

R B

GRAHAM LAND

outhern Lights
e Official Account of the British Graham Land
pedition 1934–1937. By John Rymill, with
o Chapters by A. Stephenson, and an Historical
roduction by Hugh Robert Mill. Pp. xv+296
0 plates. (London: Chatto and Windus, 1938.)
6d. net.

OUTHERN LIGHTS" is the record of just over two years' work in the Falkland ids' Dependency of South Shetland by an dition which was probably the largest in the nt style, wherein every member is a volunteer often a material contributor to the expedition.

reat value of the book lies in the amount of of method contained in it and in the stration of the manner in which experience, ought and choice of the correct means can the success of polar journeys. In addition, irectly emphasizes how such a mode of ch will avert 'adventures', so many of it may be suggested, are induced by those perience them.

ugh it may be labouring a well-recognized t is as well to emphasize the fact that in of work, aerial survey, valuable as it is, supported and checked by ground work, is demonstrated almost with violence by the contrast between the present map of Grah Land and its more immediate predecessor. (Th is here, indeed, an aspect of the first principle warfare—that the final decision depends occupation by the poor infantry.) The sledg parties attained the success they deserved for th efforts in a country of almost unnatural savag and, it may be added, beauty.

There is naturally and properly no more th passing reference to the scientific results, and may look forward to the publication of them w interest. The finding of fossils in Alexande Land is of great importance and at once remi one of the collection made by the Nordensk expedition on the other side of the igneous ro which form the visible mass of Graham Land. is known that very substantial collections and d were acquired by the biologists, and it is to hoped that one or two of the fifty-two aeropl flights were devoted to elucidating the obsc problems connected with the breeding of crab-eating seal in the pack.

Although the style is rather pedestrian, Rymill is to be congratulated on the productio a very useful book and also for not having ador himself with laurels, or a cap and bells.

J. E.

FACTORS IN POPULATION GROWTH

he Natural History of Population
y Raymond Pearl. (University of London: eath Clark Lectures, 1937, delivered at the ondon School of Hygiene and Tropical Medicine.) p. xii+416. (London: Oxford University Press, 939.) 10*s.* 6*d.* net.

THE student of population problems has received recently many additions to his brary, and the appearance of yet another volume ight fail to arouse interest unless it contained new facts or presented the known facts in a fresh light. Prof. Raymond Pearl's book on "The Natural History of Population" may justifiably claim to do both. Although some preliminary results of the researches which are described have een published in reports of the Milbank Memorial Fund, no comprehensive account of the work which formed the basis of the author's Heath Clark Lectures in London in 1937 has been available hitherto, and it is to be welcomed.

This investigation of the prevalence and effectiveness of contraception in twenty-six American cities was based upon information obtained by medical officers from 30,949 women free from disease who gave birth to children in the obstetric departments of 139 hospitals in those cities during 1931–32. Unlike previous data on this question, the material is not biased by having been collected in birth-control clinics but, as the author has taken great pains to show, may be regarded as fairly representative of conditions in the urban population of the United States. It necessarily excludes, however, the histories of women who were infertile by reason of complete success of contraception or for other reasons, and the material is likewise overweighted by the more fertile women, but the latter defect has been overcome to some extent by separate treatment of the primiparous and multiparous groups.

Prof. Pearl approaches the general problem of fertility from the point of view of the biologist and biometrician, and he has not hesitated to include on his questionnaire and to reduce to numerical terms most of the important factors, no matter how intimate. Whether we like this or not, it is only by this means that the intellectual fog surrounding the real causes of the recent decline in the birth-rate is likely to be dispelled. It is necessary to remember, however, that answers to questions of this kind may not be true answers, and that the deviations from truth will not necessarily cancel out when mass statistics are prepared from them. Psychological factors such as personal pride may lead to conscious or unconscious exaggeration for some questions and to understatement for others, and the book leaves in the mind of the critical reader some doubt as to whether adequate allowance has been made for this. A probable understatement of the frequency of induced abortion is admitted and recognized, but the possibility of overstatement of their marital activities by the married persons who provided the information needs to be considered, before accepting the conclusion that the average chance for a woman of reproductive age that conception will result after a single attempt is as small as 1 in 250.

In the material analysed, about 46 per cent of the white married women admitted or were believed to have practised contraception. When divided according to economic status, the proportion increased from 30 per cent among the poorest group to 80 per cent among the well-to-do and rich. It is estimated that in the general population from which the sample was taken the proportion was 55–60 per cent. The class differences in fertility are similar to those met with in Great Britain, and it is concluded that the chief factors responsible for them are the increase with advancing economic position of (1) age at marriage, (2) prevalence of contraceptive efforts and (3) the effectiveness of these efforts.

The observed differences between the fertility of Negro, native born and foreign born white women cannot be explained satisfactorily by birth control, however, and the author's conclusion that the steady decline in fertility which recent years have witnessed within each class of the population is not due solely, nor perhaps even primarily, to the increase in conscious contraceptive practices, seems to be justifiable. The great changes in mode of life which have resulted from the present type of civilization must have affected the urge for reproduction in many ways, and may have produced an unconscious diversion into new activities and interests of a great deal of vital energy which was previously directed to this end. It may now be too late to prove for the white races how important a factor this has been in bringing about the great fall in the birth-rate, since the comparative data of fifty years ago are not available, and it may be that the only way of proving it lies in the application of Prof. Pearl's method of inquiry over a long period of time in some country where the process of 'civilization' according to the white pattern is only now beginning.

NEW RESEARCHES IN STEEL METALLURGY*

BY DR. W. H. HATFIELD, F.R.S.,

DIRECTOR OF THE BROWN-FIRTH RESEARCH LABORATORIES, SHEFFIELD

RESEARCH in steel metallurgy is directed in the main to three principal aspects: (a) elucidation and improvement of the processes of steel manufacture and manipulation; (b) investigation of the properties of steel under variable conditions approximating to those of service; and (c) exploration of the influence of added elements and of the effect of heat treatment in advantageously modifying the properties of steel producing those best required under (b). It n truth be said that great progress has taken under each heading of late years.

progress of steel metallurgy is perhaps d at one of its industrial maxima in the produced for the aero engine. Enterprising aginative engineers like Dr. Fedden with gine developments must, indeed, demand nd more of us in strength and reliability of materials, and such demands, as I hope I shal be able to show, have drawn us along from on development to another. It is instructive, fo example, to compare the composition, microstructure, and properties of a marine engine crankshaft made from ductile Siemens Martin steel, with a modern aero engine connecting-rod made fro alloy steel produced in the electric furnace (Fig. 1 and Table 1). Of course the former is a massive structure, not highly stressed, whilst the latter is small and light in construction and very highly stressed.

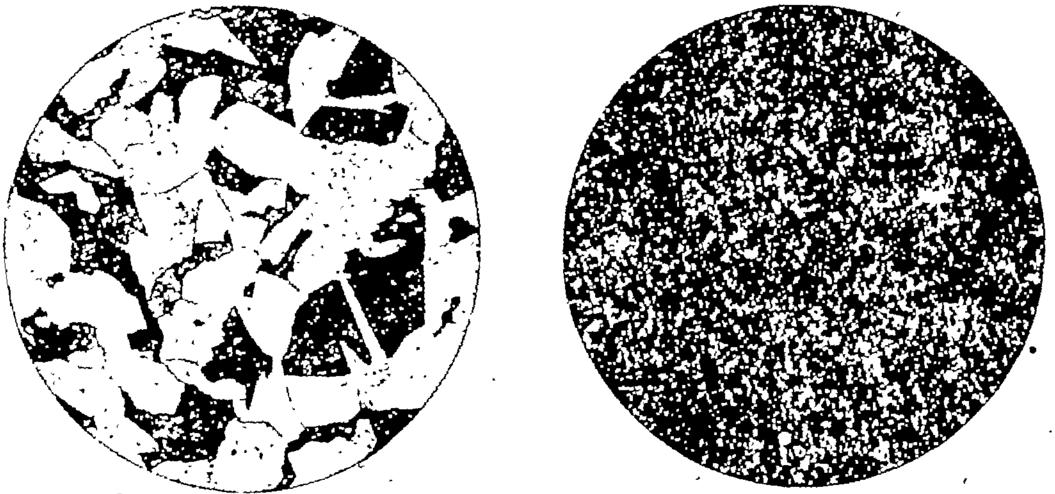


Fig. 1.

STRUCTURE OF MARINE CRANKSHAFT, × 100 (left); AND AERO ENGINE CONNECTING-ROD, × 500.

MECHANICAL PROPERTIES OF TYPICAL AERO CONNECTING-ROD AND MARINE CRANKSHAFT

	Aero connecting-rod	Marine crankshaft
nt (tons/sq. inch)	90	15·8
ss (tons/sq. inch)	112	31·0
n (per cent)	14	32
of area (per cent)	42	50
ct (ft. lb.)	28 to 32	12 to 15
nit (tons/sq. inch)	± 48	± 14

MANUFACTURE AND MANIPULATION

It will be appreciated that in studying the refining process the physical chemistry relates to very high temperatures. What are the actual reactions between the liquid metal and the superimposed liquid slag? The refined liquid steel is poured into the mould and freezes. Liquid steel being a solution of various elements or their compounds in iron, which by differential freezing solidifies into a crystalline mass quite heterogeneous in character, one of the principal studies of recent years has been the determination of the nature and degree of this heterogeneity as affected by process, composition and conditions of casting. Ingots of various sizes and shapes in various

---

iday evening discourse delivered at the Royal Institution steels have been sectioned and the implications of this heterogeneity in the forged or rolled product have been studied in order that the most suitable ingot as regards process, form and composition can be selected.

As a result of the reactions of the steel-making process, the liquid steel contains disseminated through it small quantities of oxides of silicon, iron, manganese and other elements, but during the cooling and freezing process these oxides coalesce and orientate themselves in well-defined design; along with these oxides are sulphides resulting from the sulphur content of the steel. Such oxides and sulphides form weakness transversely to the direction of forging and rolling, and any mitigation of the trouble by reduction of the oxide and sulphide content is much to be encouraged.

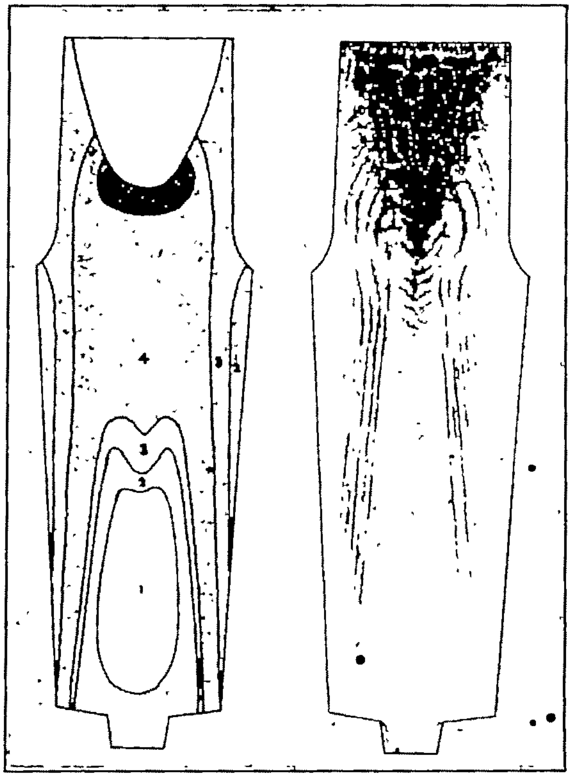
This problem is steadily yielding to inquiry and experiment, although the experimental difficulties are great. The compounds in equilibrium or indeed in existence at 1600° C. in the liquid phases are not necessarily those encountered at 15° C. Solubilities are different, and hence, for example, the difficulties of studying the solubility of gases. It is important to know the oxygen content and its condition in the liquid steel; one great step forward has been the development of the vacuum fusion method of determining the total oxygen in the final steel, but we have not as yet quite mastered the technique of determining the form in which the oxygen occurs. The nitrogen and hydrogen contents of steel are also having much attention, and these, particularly the hydrogen content, may prove of consequence.

In small masses, modern technique gives very good results as regards homogeneity, but if you pour 100 tons or 200 tons of liquid steel into a mould and allow it to freeze, the differential freezing produces a heterogeneity of a more serious order which is clearly transmitted in the structure of the final forging. If a large ingot is sectioned along its axis and the plane exposed is studied for variable composition and segregates, the nature of the result of the inquiry is indicated in Fig. 2.

Whether the ingot be small or very large, it has to be heated to a sufficiently high temperature for forging and/or rolling. Also steel in varying mass has to be reheated and cooled in the heat-treatment processes such as annealing, hardening, tempering and stress-annealing. Thus, much research has of late been devoted to studying temperature gradients within the mass with different rates of heating and cooling, the reason being that temperature gradients produce internal stresses under certain conditions high enough to produce rupture, and when of even much lower order may in part be permanent in character.

EFFECT OF TEMPERATURE ON THE PROPERTIES OF STEELS

Perhaps one of the most complex studies is that of the changing properties of steel with varying temperature. It is of the utmost importance to the engineer that he should know the stresses the material will withstand under such changing and different conditions. Important steam-raising and power-generating units operate at temperatures up to 500° C., whilst items such as exhaust valves, superheater and furnace parts operate at 700° to more than 1000° C. On the other hand, steels used in aeroplane construction and special engineering must encounter very low temperatures; indeed, for experimental work, steel has been supplied to operate at −180° C.



(a) (b)

Fig. 2.

180-TON INGOT SHOWING (a) ZONES OF VARIABLE COMPOSITION; (b) DISTRIBUTION OF SEGREGATES. (a) The lighter the zones the lower the percentage of the elements which were in solution in the liquid steel. (b) Streamers of segregates are shown.

This study includes a knowledge of the properties of steel at ordinary temperature and at the special temperatures after a lapse of time comparable with the later stages in the length of life of the part under service conditions.

To instance the nature of research in this field one must emphasize that, whereas until comparatively recent years the understanding of the mechanical properties of metals has been based upon rapidly applied stresses at the normal temperature resulting in destruction, as in the case of the well-known tensile, torsion, bending or notched bar impact tests, the experiments to which I am about to refer concern stresses of a known magnitude applied over long periods of time at temperatures well above the normal and in conformity with temperatures of service. Permanence of form and dimensions, except for elastic deformation under service stresses with a practical absence of plastic deformation, is fundamental to the successful operation of much modern mechanism, whereas the rapid destruction tests just referred to provide information of plastic deformation under rapidly applied stresses of sufficient magnitude to cause rupture, which has little bearing upon the problem of safety in design. The data really required concern the range of stress which can be safely carried without producing plastic deformation in excess of previously determined very small permissible values.

Nearly ten years ago I put in hand an experiment which is still proceeding. This experiment consists of placing a strip of steel in tension under a stress of 25 tons per square inch. The material was a old-worked austenitic steel with a limit of proortionality of 27·4 tons per sq. inch and yield oint of 77 tons per sq. inch. Since June 1929 e permanent extension has been *nil* within e accuracy of measurement applied, namely, sensitivity of 1/40,000 of an inch and a gauge gth of 8 inches. Clearly, if deformation is oceeding, it is at a less rate than 4×10^{-11} or 5,000,000,000 of an inch per inch per hour, and nay be claimed that evidence is still lacking of nge of dimensions in this case under a stress igh as 25 tons per sq. inch. The temperature his case is 23° C. and the data from the ordinary ile test broken at atmospheric temperature led the stress employed to be selected. The riment now constitutes a creep test over a d of 85,000 hours.

th the introduction of temperature above n values, this phenomenon of creep becomes inating one, and the problem is to determine stress which will not produce creep or nation beyond postulated values under the ions we are considering. The facts differ ifferent steels for the same ranges of temre and for different temperatures with the steel, and therefore only selected experidata can be given to illustrate the ena.

ke the range of steam temperatures and the behaviour of two steels, namely, bon steel and a similar steel containing molybdenum, at a temperature of 400° C., o tensile tests give the following values :

	0·5% Proof Stress (tons/sq. in.)	Max. Stress (tons/sq. in.)	Elong. (per cent)
Mild steel at 20° C.	20·25	34·1	40·8
" " 400° C.	16·2	32·54	38·5
Molybdenum steel at 20° C.	23·5	38·0	29·0
" " " 400° C.	20·5	36·7	30·0

If constant values of stress are applied t two steels at a temperature of 400° C. period of 1000 hours, and careful determi made of the effect of the loads, it will be fou deformation proceeds at stresses well bel tensile test yield point. With a stress of per square inch the mild steel creeps dur 24th to 72nd hour period at a rate of 26 inch per inch per hour, and even in the 5 hour period at a rate of $1 \cdot 4 \times 10^{-6}$; whi a stress of 7 tons per square inch creep in the 24th to 72nd hour period at a $1 \cdot 1 \times 10^{-6}$, and in the 500–1000 hour p a rate of 6×10^{-8}. The addition of moly to the other steel enables a stress of 15 t square inch to be sustained with a rate of $1 \cdot 25 \times 10^{-6}$ in the 24th to 72nd hour and so low a rate as $1 \cdot 4 \times 10^{-7}$ for the 5 hour period. Thus, it is shown that, experiments of this character, the influ added elements is determined as regards important characteristic of the material.

The results of experiments conducted peratures of 900–1000° C. over very long of time will be of interest. A heat-resistin that is, a steel having the necessary re to oxidation as well as some strength temperatures, containing carbon 0·21 p nickel 12·32 per cent and chromium 21·09 p was maintained under a load of 280 lb. pe inch for the period of 10,000 hours at The load produced an initial rate of cree diminished with time to a value of m which became constant after about 200 Over the whole period of 10,000 hours the permanently extended in length about (cent.

The microstructure in Fig. 3 (*a*) is tha test piece as not exposed to the high temp whilst (*b*) illustrates the change in structu the 10,000 hours exposure at 900° C. atmosphere ; (*c*) illustrates the structur the surface, and it is seen that oxidation h place, but must have been slowed up protective oxide formed during the expos

This experiment shows that with this ste these conditions the rate of creep does to a constant minimum rate, but that, creep or deformation under the applied str continues at that rate. Similar experiments indicate, however, that the course of this particular experiment is not always repeated.

Such long time tests are quite impractical as a means of comparing the creep properties of large numbers of alloys. This was foreseen many years ago, and a short time test, extending over a period of only three days, was devised, which is applicable to the whole range of temperature from 300° C. to 1000° C., and has been used on an extensive scale in the testing of many alloys. The applied stress is permitted to produce deformation over the first 24 hours not exceeding 0·5 per cent of the gauge length, but during the next 48 hours no further change in dimensions shall take place within the accuracy of measurement, which is to 1/40,000 inch. On a gauge length of two inches, this is approximately equivalent to one millionth of an inch per inch per hour. The maximum stress not producing a deformation in excess of that so postulated has been named the *time yield*, and produces data which can be interpreted usefully with the assistance of data for longer period and more sensitive experiments. Table 2 schedules results on different steels obtained within the steam practice range of temperatures, whilst Table 3 gives comparative data for a number of steels within the higher range of temperature.

TABLE 2. EFFECT OF COMPOSITION UPON 'CREEP' CHARACTERISTICS OF STEELS

Composition (per cent) C	Si	Mn	Ni	Cr	Mo	Time Yield (tons/sq. in.) 300° C.	400° C.	500° C.	550° C.
0·24	0·14	0·59	(0·08)	(0·04)	nil	12	7	3½	1¾
0·28	0·22	0·53	(0·16)	(0·11)	0·66	19	13½	8	3½
0·34	0·29	0·57	3·06	nil	nil	21	10	3¾	2
0·34	0·18	0·65	3·22	0·87	nil		10	3¾	
0·28	0·13	0·51	2·76	0·67	0·61	43	21	9¼	4
0·35	0·18	0·71	(0·22)	2·41	0 51	40	22	10	4
0·43	0·20	0·60	(0·21)	1 30	0·85	—	21½	7½	4

One important line of investigation concerns the effect of exposure to temperature for a long time upon the mechanical properties of the steels. Extremely important mechanical units have to operate for a life of many years at elevated temperatures, and owners are not very free in scrapping valuable parts so that tests can be made to see whether the mechanical properties of the materials are being maintained.

Some time ago we installed substantial furnaces for long-time experiments of this character and have many steels exposed, for example, at 400° C.,

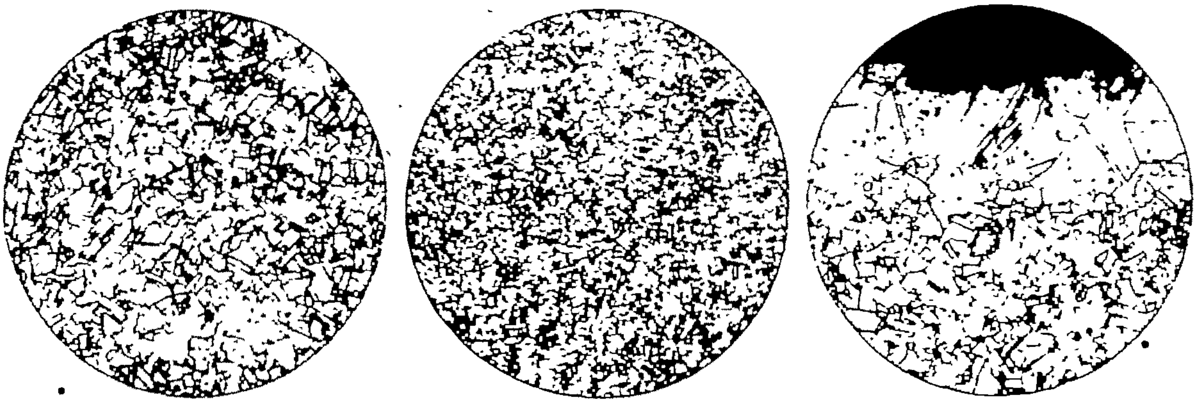

(a) (b) (c)

Fig. 3.

EFFECT OF PROLONGED EXPOSURE AT 900° C. ON MICROSTRUCTURE OF A HEAT-RESISTING STEEL.
(a) Before exposure; (b) after exposure for 10,000 hours; (c) edge after exposure for 10,000 hours. All × 100.

TABLE 3. RESISTANCE TO 'SCALING' AND 'CREEP' STRENGTH OF SPECIAL STAINLESS AND HEAT-RESISTING STEELS.

	Scaling index 800°	900°	1000°	1100°	1200° C.	'Time Yield' creep value 400°	500°	600°	700°	800°	900°	1000° C.
Mild (28/32 ton) steel	84	250	—	—	—	8	4	1	400	—	—	—
13% chromium stainless steel	0 28	32	250	—	—	14½	5¼	1350	240	125		
3½% silicon—8% chromium steel		0·33	0·64	76	—	19	4	1	300	180	—	—
30% chromium steel		0·41	2·3	5·7	19	17	11½	1	320	350	200	70
18% chromium—8% nickel steel	0·12	6·7	175	750	—	12½	11	5	2	1000	200	70
13% chromium—14% nickel—3% tungsten steel	0·08	3·5	25	—	—	18	8	3¼	1¼	800	190	70
25% chromium—20% nickel steel		0·22	5·1	11	31	13	10½	3¾	1¼	900	250	70
23% chromium—12% nickel—4% tungsten steel		0·41	2·0	15	1,000	19	12	4½	1¾	1,200	280	90

"Scaling" index expressed in milligrams per sq. cm. increase in weight.
"Creep" strength expressed in tons/sq. inch above 1 ton and in lb./sq. inch below.

450° C. and 500° C. Each test piece is substantial in size and enables a very complete study of the material to be made. Samples of a particular steel are taken out after one month, six months, twelve months, and so on, and already valuable data have been derived.

We have already found that some steels maintain their properties; others, whilst maintaining their tensile test values, offer less resistance to notched bar impact fracture, and others by a type of precipitation proceeding even after twelve months exposure have a progressively increasing strength and a decreasing ductility. Tests done at normal temperatures after exposure are not an adequate indication of the actual properties at the elevated temperature at which they have been exposed, and therefore since the temperatures selected simulate service conditions, the mechanical tests are also being performed at these temperatures. In the main, the experiments to date indicate a more ductile condition at the temperature than in the cold.

EFFECTS OF ALLOYING OTHER ELEMENTS

The metallurgical processes in industrial use produce in bulk an *impure* iron, that is, mild steel, which is iron with a residual carbon content of 0·10–0·20 per cent and a residual manganese content of 0·40–0·8 per cent, having very useful mechanical and fabrication qualities for structural urposes, marine engineering and many other urposes. By increasing the carbon content the trength of the steel is increased and its ductility ecreased, but qualities suitable for rails, tyres r even tools are so prepared.

The multiplicity of alloys which it would be cessary to make to exploit thoroughly the sibilities of the influence of added elements is vious, and, therefore, it is clear that only the ge of the subject has yet been explored. Much cess, however, has been achieved.

High tensile steels are available through the luence of small quantities of added elements, the more outstanding advances relate to the uence of larger additions of the special elements. high percentage of nickel produces a steel a very low coefficient of expansion, whilst in percentages of nickel, manganese and mium enable steel to be produced with a coefficient of expansion comparable with of the aluminium alloys.

gh percentages of cobalt, or of nickel and inium, enable permanent magnets of amaz- high coercive force to be produced. The nce of small quantities of chromium and nium enable hardened surfaces to be pro- by the influence of ammonia at temperatures as 500°–550° C.

High manganese content produces a steel of excellent wearing properties under abrasion, whilst high chromium or high chromium and nickel contents produce a range of steels which are rust- and acid-resisting. Add to the last category other special elements and the interesting heat-resisting steels are produced which not only resist scaling at high temperatures, but have also considerable strength under such conditions.

Perhaps the most outstanding achievement of recent times is the development of the rustless and heat-resisting steel metallurgy. Brearley in 1913 had shown that a stainless knife could be made by hardening and tempering a steel containing 13 per cent of chromium. This led to the search for steel which was rustless in the ductile condition, and so the 18 per cent chromium, 8 per cent nickel, and the 12 per cent chromium, 12 per cent nickel, and other combinations were produced. Such steels are indeed stainless under normal conditions, and form the basis now of a great industry.

One is invariably asked, Why are the rustless steels rustless? The answer is, that they are cases of passivity, induced by composition and normal environment in the production of a passive external film. This is in part proved by the fact that under certain conditions local corrosion will take place even with so defined rustless steels, as a result of *shielding action*. Shielding action is the effect of a deposit of material resting on the surface of the steel, which by its presence partially or completely prevents free access of oxygen to this surface of the steel, and thereby retards or prevents the repair of any minor breakdown of passivity. It is obviously necessary, in order that corrosion should develop, that the shielding agent should not entirely prevent access of the corroding solution. Such a conception is in line with the explanation which Faraday advanced in 1836 in explanation of the chemically induced passivity in the case of ordinary iron surfaces; he visualized that "the surface of the iron is oxidized on the superficial particles of the metal and in such relation to the oxygen of the electrolyte as to be equivalent to oxidation." It was left to Dr. Ulick Evans to isolate such passive films.

The following experiment has reference to the gradual and visible thickening of this passive film under rather special conditions with time. In December 1924 (more than fourteen years ago), a cylinder of plain 18 per cent chromium, 8 per cent nickel steel was placed in a bottle of nitric acid of strength slightly higher than 1·20 sp. gr. After a year or two a clouding of the surface was noticed, and, accordingly, in June 1928 a second cylinder was immersed under similar conditions; again the same effect was noticed with the passing of time. In

June 1931 a further cylinder followed. These three cylinders have now been exposed for periods of 14 years, 10½ years and 7½ years respectively. The first is covered with a dark brown film, the second with a straw-coloured film, whilst the third as yet shows only a slight dulling of the surface. This evidently slower rate of film thickening, in the case of the third cylinder, may be due to its having a mirror finish as compared with a fine emery finish in the case of the other two cylinders.

The solutions were examined in August 1938, and from these figures the weight of iron and of chromium dissolved from the cylinders was calculated, and it was found that there was a deficiency of chromium in relation to the iron when the relative proportions in which these two elements were present in the steel were taken into account. It was then assumed that this *missing* chromium is present in the form of Cr_2O_3 in the films on the surfaces of the cylinders, and the amounts were calculated.

It is interesting to note that the calculated thicknesses of the films on the first two cylinders are not far removed from the value of about 4×10^{-6} which is obtained from the work of several investigators for the thickness of films giving a similar coloration. In the case of the third cylinder, the calculated film thickness is less than the minimum thickness required to give a definite coloration.

It was quite accidentally discovered that a cylinder of 13 per cent chromium steel which is apparently not affected by nitric acid but is soluble in sulphuric acid, became passive for long periods in sulphuric acid after immersion for a period in nitric acid. This observation was made some fifteen years ago and before we had obtained the interesting data from the three cylinders of 18/8 material. Evidence indicates that the corrosion-resisting properties of the rustless steels are due to the chromium facilitating the spontaneous production of a protecting film of the necessary characteristics for resistance, which film if damaged is spontaneously renewed.

Experimenting upon the basis of the rustless steel compositions, it has been found that by modifying the chromium and nickel and also by adding other elements such as tungsten, molybdenum, cobalt or titanium, steels are produced which maintain a reasonably protective film at temperatures even in excess of 1000° C., and also have useful strength.

THE ROYAL AGRICULTURAL SHOW

By Prof W. B. Brierley

IN English agriculture the "Royal Show" is the peak of the year, and the occasion in 1939 is of special significance as it marks the centenary of the Royal Agricultural Society of England. It is fitting, therefore, that the Show should be held during July 4–8 in the Royal Park of Windsor, and that the University of Reading, which increasingly plays a leading part in agricultural education and research, should have been invited to accept responsibility for the scientific exhibit. The exhibition in the building devoted to education, research and marketing was arranged by the Faculty of Agriculture and Horticulture of the University (including the National Institute for Research in Dairying and the British Dairy Institute) with additional exhibits by the counties of Buckingham (acting in co-operation with the Buckinghamshire Producers) and Northampton.

For many years, the scientific exhibit at the Royal Show has been of very high calibre, and this is all the more creditable when it is remembered that agricultural teaching does not lend itself to exhibition, and that agricultural research is of a somewhat plodding nature and that it possesses none of the more spectacular qualities of research in many other branches of science. Each year, however, it has become increasingly difficult to improve on the interest of former exhibits or to vary them in kind, and for the special occasion of a centenary show the young University of Reading was faced with an exceptionally difficult task. It achieved a notable success due, primarily, to two facts: first, the entire exhibit was arranged on the central theme of the progress in agricultural research and its application to practice during the last hundred years, and, secondly, the individual exhibits were merged in a common decorative scheme designed and produced by the School of Art of the University of Reading. The many scientific exhibits were excellent, but it was the happy marriage of science with art which remains the outstanding impression left by the scientific building.

In any scientific exhibition the benches are occupied by specimens, instruments, etc., but it is always difficult to know what to do with the wall space. Sometimes it is just left as a blank and rather depressing area; more usually it is filled with graphs, tabular or textual matter which few people look at and which frightens many people away. It is, however, in the efficient and attractive use of wall space that the artist can render such valuable aid and, in the Royal Show exhibit, probably more people looked at the walls than at the benches. The scientist gave specific information, but the artist gave the general mental impression which synthesized the data, and which remained when specific facts were forgotten.

All interested know of the serious reduction in the total cultivated area of Great Britain, the reversion of the relative importance of arable and grass, the fall in the cereal acreage, especially wheat, the partial replacement of the old root break and the appearance of the new sugar beet crop, and the increase in the acreage under potatoes and fruit, but few things could do more to bring home to the general public the reality of these changed conditions than the economics exhibit, with its pictorial representations in the form of large colourful wall panels occupying the centre of the building. Similarly, a number of smaller but very attractive panels depicted corresponding changes in the numbers of dairy cows, poultry and pigs, and the decrease in the numbers of horses and sheep. A further panel portrayed one of the most lamentable facts of British farming, the exodus from the land.

With the National Institute of Research in Dairying and the British Dairy Institute contributing to the exhibition, it was only natural that milk and milk products should occupy a prominent place. Their joint exhibit was designed to present a picture of the progress of dairying and dairy science during the last hundred years, and its success was very evident. Two flanking panels, '1839" and "1939", showed in vivid contrast the hange in the organization of the dairy industry uring this period, and a central panel indicated ndmarks in dairying; one very important landark being the foundation of the National Institete itself so recently as 1912. Other panels ustrated progress in more specific aspects of earch, such as the better breeding and feeding dairy cattle, vitamins in milk, and the value clean milk as food.

Cattle have always been recognized as important stock but, during recent years, the despised has also acquired merit and its numbers have espondingly increased. In pig breeding a basic or is accurate recording, and the importance of was well illustrated in a special exhibit.

lso, during recent years, the poultry industry, the Cinderella of agriculture, has developed rapidly that it now stands third in economic importance. An excellent exhibit, backed by mos attractive wall panels, showed this progress and demonstrated some of the changes in poultry husbandry and marketing which made it possible

But farm animals like human beings are heir to many maladies, and the veterinary scientis plays the same important part in agriculture that the medical man plays in human society. During the last hundred years notable progress has been made in this field, and this was portrayed in an interesting exhibit in which particular attention was given to tuberculosis, parasitic gastro-enteritis and contagious abortion.

An important line of research carried out at Reading is soil surveying, a science of pedology only some fifteen years old. This work was illustrated by some beautifully coloured maps and by the profiles of twelve different soils occurring in Berkshire and Hampshire. Somewhat related to this was an exhibit illustrating the Land Fertility Scheme. The Government's scheme came into operation in September 1937, and the work carried out under it has already given valuable insight into fertility problems as a whole and certain special problems in particular.

In all agricultural matters and problems we return inevitably to the soil. As St. Francis sang, "Praised be, my Lord, for our sister, Mother Earth, which doth sustain and keep us, and bringeth forth divers fruits, and flowers of many colours, and grass". But the soil is not just dead matter, a physico-chemical system for pedologists and chemists to dissect. It is a vast unexplored realm of living things, a land of Lilliput with teeming populations of microscopic plants and animals, eating, breathing, reproducing their kind, and fighting for existence in a struggle as relentless as any in our Brobdingnagian world. The most important of these soil microbes are the bacteria and fungi for, ultimately, all life and all living things are dependent upon them for existence. In two interesting exhibits, backed by decorative and informative wall panels, the story of these soil microbes was well told.

It would be almost impossible to construct any scientific exhibition relating to agriculture in which pointed attention was not given to the vital necessity of grassland improvement. Progress in this field was well illustrated by an exhibit "Two blades of grass where one alone was seen before", which showed clearly the improvement in the management of grassland due to the use of the best herbage plants and pedigree strains, aided by controlled cultivation, manuring and grazing.

A complete representation of a century's progress in arable crops would have been extremely interesting, but the difficulty of showing improvement in roots rendered such an exhibit practically impossible. There was, however, a valuable and finely staged exhibit showing improvement in cereals, which included mature growing plants, of varieties of wheat, oats and barley that were grown approximately a hundred years ago and an equal number of well-known modern varieties.

With the increasing recognition of the value of protective-foods, horticultural crops in many ways now rival agricultural crops in importance, and the value of scientific research in horticulture is rapidly attracting attention. Under modern competitive conditions high quality produce only is demanded, and this is unobtainable from neglected and pest-ridden orchards and gardens. This was exemplified partly in an exhibit designed to stress the differences between the old-fashioned ill-kept orchard and the modern plantation run on commercial and scientific lines, and partly in an exhibit of vegetables, salads and fruits grown in the intensively farmed area of Buckinghamshire.

Finally must be mentioned the garden in front of the scientific building, which was laid out by the University Department of Horticulture to a design prepared by the Department of Landscape Architecture. A magnificent centre bed displayed the carpet bedding fashion of a century ago, whilst two flanking beds showed a modernistic treatment.

The entire exhibition was a notable success, informative and stimulating in its portrayal of the interest of agricultural and horticultural research and of its value in practice, and not only colourful but also satisfyingly beautiful in the artistry of its design and production. The exhibit was worthy of the Royal Centenary Show and set a standard which it will not be easy to maintain.

OBITUARIES

Dr. W. M. Childs

DR. W. M. CHILDS, principal of University College during 1903–1926 and first vice-chancellor of the University of Reading during 1926–1929, died at his residence, Grimsbury Bank, Hermitage, Berkshire, on June 21, aged seventy years.

In the history of the modern English universities, no one has played a part corresponding at all closely to that of William Macbride Childs. With the exception of Reading, the universities which have arisen during the past fifty years have developed from earlier colleges, with an established tradition of teaching and research as the justification for their academic independence. But the whole history of the movement which created the University of Reading is comprised within a period of less than half a century. The institution to which Childs went as a lecturer in 1893 was little more than a centre at which work initiated by university extension classes could be carried to a further stage; it had scarcely the rudiments of an academic organization, and its financial resources were meagre and uncertain. It is the supreme distinction of Dr. Childs that he saw the possibilities latent in this small and anomalous institution, devoted his life to their realization, and impressed the stamp of his personality on the college and university which came into being through his efforts.

Childs was enabled to succeed in what seemed at first a hopeless task by the intensity of his belief in his ideals, and by his power of imparting his own convictions to others who could help him. He possessed the rare faculty of constructive imagination. To him, the ideal university was a community of teachers and students, informed by a life and spirit which transcended the achievements of individuals. From the pursuit of this ideal he never turned aside. But unlike many idealists, he had the habit of mind which finds pleasure in practical details, and his patience could never be exhausted. He planned every stage in the long process through which the college at Reading came to university independence. The addition of one department after another to the nucleus of a college with which his work began, the creation of an academic organization, the establishment of halls of residence for students, were all, to him, matters of intense personal interest. For thirty years he concentrated the abilities of one who was by nature a man of affairs upon the details which gave form and substance to an ideal.

In course of time, the influence of Childs' personality and work spread beyond the circle of his immediate associates. It was his devotion to his chosen task, and the transparent sincerity of his conviction that the creation of a university in Reading was a work which any man might be proud to advance, which brought to the college the endowments essential to its growth. On the general history of the modern universities, his influence, though indirect, was real. The most original part of his work at Reading was the establishment of a system by which all students not drawn from the immediate neighbourhood live in halls of residence. To-day, the value of life in a collegiate environment for students of a modern university is recognized everywhere. But when Childs conceived the idea of basing the University of Reading upon a residential system, little had been done in this direction elsewhere, and the opening of Wantage Hall in 1908 was the first effective demonstration of the fact that life under conditions similar to those which have prevailed for centuries at Oxford and Cambridge was possible for students of a modern university. It was not until 1926 that Childs' work was crowned by the grant of university independence to the college at Reading. But the opening of Wantage Hall, which symbolized his most significant contribution to the idea of a modern university, was probably the event in his career from which he derived the greatest pleasure, and it is the event which comes first to the memory of some, at least, of his associates on the morrow of his death.

F. M. STENTON.

Prof. A. E. Kennelly

WE regret to report the death on June 18 of Prof. Arthur Edwin Kennelly, emeritus professor of electrical engineering both at Harvard University and at the Massachusetts Institute of Technology. He had laboured for many years enthusiastically and successfully to further the interests of humanity by lightening manual and mental drudgery and promoting international co-operation for the interests of all. His work led him to associate with experimental and theoretical physicists, with mathematicians, inventors and engineers.

Kennelly was born at Bombay in India in June 1861 of British parentage. He was educated at private schools in Scotland, France and Belgium, and for four years at University College School, London. His first post was that of assistant secretary of the Society of Telegraph Engineers of London (now the Institution of Electrical Engineers). In 1876 he was a telegraph operator in England with the Eastern Telegraph Co. and in 1878 he was an electrician in Malta. In 1881 he was chief electrician in a cable engineering ship. In 1887 he went to the United States and became the principal electrical assistant to Thomas A. Edison, which position he held until 1894. In 1893 he was in addition consulting electrician to the Edison General Electric Co. (now the General Electric Co. of New York).

In 1902 Kennelly was appointed professor of electrical engineering at Harvard University and occupied that chair until his retirement as emeritus professor in 1930. During the years 1913–24 he was professor of electrical engineering at the Massachusetts Institute of Technology, being appointed emeritus professor of that Institute also.

From 1894 until 1902 he was in partnership with E. J. Houston, the firm acting as consulting engineers. He was president of several societies, including the American Institute of Electrical Engineers, and the Illuminating Engineering Society during the early years of that organization. He was also president of the Metric Association.

In the international field, Kennelly's services have been of the highest distinction. He was a United States delegate to the Electrical Congresses of 1900, of 1904, where he carried out the onerous duties of general secretary, and in 1932. He was also delegate to the International Radio Conferences in Paris in 1921 and in Washington in 1927, where allocations of radio transmission frequencies were made to the nations of the world. He was a member of the International Committee of Weights and Measures and attended the meeting at Sèvres in 1933. Durin the year 1921–22 he represented seven co-operatin American universities as first 'exchange' professor i engineering and applied science at several French universities. In 1931 he gave a series of lectures i Japan under the Iwadare Foundation. He ha published many books and is the author of more than 350 papers, many of which were presented befor scientific organizations at home and abroad. He wa unflagging in his attendance at committee meeting and was the chairman of the committee on electrica definitions which has done very useful work.

In 1900, Kennelly was very interested in the progress made by Lodge, Fleming and Marconi in wireless transmission. When many mathematicians were proving that the transmission of wireless waves round the curvature of the earth was a physical impossibility, Marconi transmitted waves from Poldhu in Cornwall to Newfoundland. Kennelly, on March 15, 1902, was led to believe that the wireless waves were reflected by some kind of cloud producing a 'mirror' effect which bent the waves round the earth's surface. Kennelly and Heaviside both thought of a reflecting layer of ionized gas which could reflect the rays. This layer has since been called the Kennelly-Heaviside layer.

In 1924 Appleton demonstrated the real existence of a 'mirror' layer. The regular variation in reception, as the wave-length was changed, proved its existence, and later experiments proved that there was more than one reflecting layer in the atmosphere.

One of the most useful mathematical methods popularized by Kennelly was the use of Argand's method of using complex numbers to aid computers, thus saving much arithmetical labour. In April 1893 in a paper published by the A.I.E.E. under the title "Impedance", he applied complex qualities to technology and to the extension of Ohm's law to alternating current theory. He calls the inductance multiplied by 2π times the frequency, the "inductance speed". The impedance is therefore the geometrical or vector sum of the resistance and the inductance speed. We thus find what is often called the Ohm's law for alternating currents, which simplifies the everyday theory of the practical electrician. The impedance of inductive coils in series is readily determined, and when two or more inductive coils are in parallel the component currents are easily found. This can be done both graphically and algebraically. In the latter case, the solutions are expressed in terms of hyperbolic functions, which in the absence of tables are sometimes very laborious to compute. He therefore edited charts and tables of hyperbolic functions to several decimal places, for which there has been a great demand by practical electricians all over the world, as by the use of the tables and charts there is a great saving in the time taken by computers, and the accuracy required nowadays is much greater than that required thirty years ago. They are much used in long-distance telegraphy and telephony.

Kennelly was very popular with his old students, who used to go from all parts of the world to study under him. I remember that before the Great War

I sent one of my students who was a graduate of London to do research under Kennelly. He often wrote saying how kind the professor was to him, having him to his house every week and going for a picnic into the country on holidays. Unfortunately, war broke out and he returned to join the army and paid the great sacrifice. I communicated the sad news to Prof. Kennelly and received a long letter back telling how popular the student was at Harvard, and how he took a leading part in all their sports and how they would ever remember him. They placed a memorial at Harvard.

By all who knew him, Kennelly will be sadly missed, but it is pleasant to remember that to him it was given to have a long and useful life spent in the service of his fellow men.

A. RUSSELL.

WE regret to announce the following deaths:

Prof. J. Grinnell, professor of zoology and director of the Museum of Vertebrate Zoology in the University of California, on May 29, aged sixty-two years.

Mr. F. W. Jones, O.B.E., known for his work on the chemistry of explosives, on June 24, aged seventy-two years.

Dr. Witmer Stone, emeritus director of the Academy of Natural Sciences of Philadelphia, on May 23, aged seventy-two years.

Prof. A. E. Wells, professor of metallurgy in Harvard University during 1926–31, on May 24, aged fifty-five years.

Prof. J. E. Woodman, emeritus professor of geology, in New York University, on May 19, aged sixty-five years.

NEWS AND VIEWS

Prof. V. Gordon Childe

PROF. V. GORDON CHILDE, whose election as an honorary member of the Prehistoric Society of Switzerland in recognition of his services to prehistoric archæology is announced, has been professor of prehistoric archæology in the University of Edinburgh since 1927. This chair, which he is the first to hold, was founded in memory of the late Lord Abercromby, himself distinguished as a pioneer in study of the Bronze Age in Europe. Prof. Childe, who is an Australian by birth, has travelled extensively in Greece, the Balkans, central Europe, and the East. His early visits to eastern European sites strongly influenced the line of his development in archæological thought, leading him to appreciate, more fully, perhaps, than had been done by archæologists previously, the importance of the Danube Valley and adjacent regions as a key position in the study of European prehistory. During his tenure of the chair in Edinburgh, Prof. Childe has not only been active in promoting general interest in archæological studies in Scotland, but he has also taken a leading part in the organization of field research on Scottish sites. Of his own work in the field, the excavation of the stone age village settlement of Skara Brae in the Orkneys ranks as the most remarkable revelation of a complete prehistoric cultural unit which has yet been made in Northern Europe. His contributions to the literature of prehistoric archæology are all remarkable for their grasp of detail, combined with an unusual breadth of view in tracing the general trends of development, as well as for insight into the interplay of the underlying forces, especially such as belong to the field of prehistoric economics.

Newton's Correspondence

THE Royal Society has formed a committee for the purpose of collecting and publishing the whole of the correspondence of Sir Isaac Newton. It is hoped that a substantial part of the work will be completed and that some of the volumes will be issued by the time of the celebration of the tercentenary of Newton's birth in 1942. The members of the committee are as follows: Sir Charles Sherrington (chairman), Prof. E. N. da C. Andrade, Prof. G. N. Clark, Sir William Dampier, Sir Arthur Eddington, Sir Thomas Heath, Dr. H. Spencer Jones, the Librarian of Trinity College (Mr. Adams) and Prof. H. C. Plummer. The Council invited Prof. Plummer to be the editor of the correspondence and he has accepted this great responsibility. It is hoped to obtain the co-operation of all librarians in the various libraries of America and of Europe, and notifications of any original letters appertaining to Newton in their collections should be sent to the Assistant Secretary of the Royal Society, Burlington House, London, W.1.

Malaya and India: Early Cultural Relations

CONFIRMATION of a conclusion, which ran counter to generally accepted opinion, as to the archæological possibilities of Malaya in the study of early cultural development in south-eastern Asia, has been afforded by the results of a fourteen months' archæological investigation undertaken by the Greater India Research Committee during 1937–38. Excavations were carried out in Kedah, Perak and Johore under the field direction of Dr. H. G. Quaritch Wales, by whom the results have been described recently (*Illustrated London News*, June 24), and with the financial assistance of the Governments of the States interested. The most extensive and important of the excavations were in Kedah, some thirty sites, ranging in date from the fourth to the thirteenth century of our era, being thoroughly examined. The earliest remains are scattered and do not suggest any very large settlement before the sixth century. The oldest site found was on an isolated hill on the Sala River, some twenty miles north of Kedah Peak. Here was found the massive laterite basement of a *stupa* and a small stone inscribed with a Buddhist formula in a South Indian script, not later than the second half of the fourth century. Another *stupa* site to the south on the Bujang stream produced a sun-dried clay tablet, inscribed with three stanzas of a Mahayana text in Sanskrit, which previously was known only in Chinese. This antedates previous evidence from Sumatra of the introduction of Mahayana Buddhism into Indonesia by more than a hundred years.

EXCAVATION of mounds on the site of the ancient city of Lankasuka revealed remains of Shiva temples and established the Pallava affinities of the art of the colonists in the seventh and eighth centuries, while foundation deposits from temples excavated on Kedah peak consisted of caskets, which, though undoubtedly Indian in character, are of a type unknown in India and are explicable only by reference to Java. The ruined state of the temple buildings made it possible to excavate the foundations more thoroughly than is usually possible, with the result that much valuable information as to dating and cultural relations with southern India was obtained from this source. Especially noteworthy is evidence of a revival of Hinduism in the eleventh to fourteenth centuries. These results, as well as those of earlier expeditions of the Greater India Research Committee, for which Dr. Wales has been responsible, suggest that the criticisms directed against the projected exhibition of the art of Greater India (see NATURE, July 1, p. 20) are outweighed by the advantages which will accrue to Indian cultural studies from the enhanced knowledge and interest in the art and archæology of Greater India which such an exhibition must arouse. This should result in stimulating further exploration and research. By tracing and exemplifying local developments of Buddhistic and Hindu art, the exhibition should in itself supply the unifying link, of which the absence has been imputed as one of the gravest defects of the proposal.

Civil Defence

THE second Bulletin of the Air Raid Defence League gives an outline of civil defence in which the general framework is reviewed as a whole, so that the various technical, social and economic problems fall into their proper prospective in the defence of the whole living organism of a nation in a war zone. After discussing the nature and object of air attack and the policies which might be used by the attacker, the Bulletin concludes that evacuation of the congested target areas is the most radical strategic move and is called for on a much wider scale than is at present announced by the Government. It is urged that all who can should be evacuated and only special classes should stay. Careful planning of evacuation and action before war is in being could vastly reduce the dislocation caused by evacuation. A priority scheme, however, is required as the basis of defence measures in which the proportionate risk has been roughly calculated on scientific principles. Bomb-proof accessible shelter both for work and for rest is advocated for those whose duty it will be to remain at work in the congested target areas and for the protection of those engaged in running vital services such as telephones or first aid. For less congested and vulnerable areas shallow shelters of the Anderson or other types or strengthened basements must be provided, and small communal shelters or strengthened basements for large blocks of flats or offices are necessary.

THE apathy of local authorities and the lack of staff for effective training are criticized as the chief hindrances to the effective utilization of volunteers in national service. The Bulletin then urges the importance of policy being designed to make the economic system of Great Britain strategically less vulnerable. The Government should give a clear lead to industry to organize itself to meet war conditions and to undertake the preparation of suitable alternative premises and services of supply and to provide pools of reserve plant. Similarly the maintenance of food supply is of paramount importance. Reserve stocks of food must be accumulated and protected. Facilities for handling and storing food and essential commodities at ports at present little used but likely to be important in time of war in view of their comparative safety should be improved. Much of our present storage is in highly vulnerable positions; so production of food should be greatly increased. Special stress is also laid upon the mobilization of science, the full resources of which are insufficiently utilized by the Government. Among subjects for urgent team research methods are food and storage, optical instruments, special drugs and shelter problems. The importance of full publicity is emphasized and establishment of a Ministry of Information is recommended.

Earthquakes in California

ON the morning of June 23, an earthquake of considerable intensity was felt along the whole of the coast of Southern California. It was particularly severe at Hollister and Salina, where it was said to be the worst since 1906, though no material damage was done. California is particularly prone to local earthquakes and tremors, and a glance at the geomorphic map prepared by the Earthquake Investigation Commission shows that considerable movement has taken place from time to time along the great fault systems which chiefly run parallel with the coast line. In this particular instance it is difficult to state exactly where the epicentre may have been, but it is possible that slipping may have taken place along the San Andreas Fault which runs practically along the whole length of the affected area and lies approximately midway between Hollister and Salina. A second shock was felt at Pasadena and San Diego in the early afternoon of the same day. This probably had its epicentre in the mountainous region of Nevada; it was sufficiently intense to have caused considerable damage had it occurred in a densely populated region. California has several seismological observatories, so that thorough investigations will no doubt be made of these shocks. A descriptive catalogue of earthquakes of the Pacific coast of the United States from 1769 to 1928 was published in January 1939 by the Seismological Society of America. The recorded shocks for California occupy 231 pages whilst those for the remainder of the coast occupy 44 pages.

Soviet Census

More complete figures relating to the census of the Soviet population taken on January 17, 1939, have been issued by the State Planning Commission of the U.S.S.R. The figures cover the entire population of the Union with the exception of the far north, where the census will be taken in the latter half of this year. The figures issued reveal that on January 17 last, the population of the Soviet Union numbered 170,467,186, including 81,664,981 males and 88,802,205 females. As compared with the census of 1926, the Soviet population has increased by 23,439,271 or by 15·9 per cent, the urban population being 55,909,908 or 32·8 per cent of the total, as against 26,314,114 in 1926, or 17·9 per cent of the total. Owing to a typographical error in the note which appeared in Nature of June 3 (p. 936), relating to preliminary figures of the Soviet census, it was stated that the entire population had more than doubled. This should have read "the urban population has more than doubled". The average annual increase of population in the U.S.S.R. during the period 1926–39 was 1·23 per cent. The increase in the birth-rate is illustrated by figures relating to some of the big towns of the Union. In 1938 the average number of births per thousand of population in Moscow was 28·5, Leningrad 27·4, Kiev 27·4, Kharkov 27·7, Baku 33·9. There are 174 towns in the U.S.S.R. with populations of more than 50,000; 82 have populations of more than 100,000 and eleven have populations of more than half a million. The population of Moscow has increased from 2,029,425 in 1926 to 4,137,018 in 1939, or by 103·9 per cent, and that of Leningrad from 1,690,065 in 1926 to 3,191,304 in 1939, or by 88·8 per cent. Four towns are included in the 1939 census which did not figure on the geographical maps in 1926, namely, Karaganda which now has a population of 165,937, Magnitogorsk with a population of 145,870, Stalinogorsk with a population of 76,207, and Komsomolsk-on-Amur with a population of 70,746. During the period 1926–39, 1,536 new urban centres, 213 of which have been constituted as towns, have sprung up on the territory of the Soviet Union.

Pulkovo Observatory

The chief observatory in the U.S.S.R., situated at Pulkovo, a few miles outside Leningrad, celebrates the hundredth anniversary of its foundation this year. To-day a number of buildings devoted to astronomy and related sciences surround the original central edifice, with its circular hall through the middle of which runs the Pulkovo meridian. This hall is now used as the observatory's museum, and it contains some extremely interesting exhibits, including a working model of the solar system, made by an unknown craftsman 150 years ago. Not only do the earth and planets revolve around the sun in this model, but also the glass shade which covers it is utilized for representation of the stars and constellations. The library, situated in a gallery around the main dome, contains some very valuable unique works, including Kepler manuscripts. The Pulkovo Fundamental Catalogues of Stars are widely known for the accuracy of the observations entered in them. Needless to say, the observatory is also rich in astronomical photographs and similar research materials. At the time of its foundation the refractor installed in the observatory, one with a lens of fifteen inches diameter, was the largest in the world. It was added to in 1885 by the installation of another refractor with a thirty-inch lens.

Positive Eugenic Policy

In his Galton Lecture, Dr. C. G. Darwin discussed a positive eugenic policy (*Eugenical News*, 31, No. 1). He pointed out that a eugenic policy could only exist under conditions of civilization. In centuries up to the nineteenth, populations were stationary or increased but slowly. Then wages began to rise or the price of wheat went down, and with it the mortality rates in infancy and adulthood. It was no longer essential to have a certain level of intelligence in order to stay alive. Natural selection ceases to operate in civilization, and the things on which surpluses shall be spent are determined by advertisements. The relative absence of natural selection inevitably leads to degeneration unless eugenic selection can take its place. As regards negative eugenics, the propagation of mental weakness is much more serious than the transmission of a bodily weakness with a high intellect. As regards positive eugenics, we need not wait for full knowledge of the human genetic constitution, to construct human beings as an engineer constructs a bridge. Quite enough is already known with reasonable probability for immediate eugenic action. Bohr's principle of complementarity, implying a mutual effect of subject and object, comes in here. The need is urgent for a simple national eugenic policy which will induce the better endowed to have larger families, and history will not spare us if we do not set to work at once to carry it out.

Forestry at Oxford

A statute amending the regulations for the School of Forestry at Oxford has recently been approved and comes immediately into force. Hitherto the normal avenue to the final examination has been a special preliminary examination of a comparatively simple nature that could be taken by the student, if he wished, before he came into residence. Now the prior qualifications required of candidates for the final examination are so much higher that the School becomes, in part at least, a post-graduate one. Candidates are now required to have obtained honours in the new Science Moderations examination or in some final school or to be graduates of another university and they must have passed approved examinations in botany, geology, physics and chemistry if these have not been taken in the degree courses. The reason for this change, and the concurrent change in the curriculum of the School, is found in the requirements of the forest services and the development of forestry in the Empire. It has been decided also that after August of this year the Imperial Forestry Institute, established in 1924 and controlled by a director other than the professor of forestry since 1936, is to be joined to the professor's department as a self-contained unit under the immediate charge of the professor. Between 1920 and 1938, 324 men have been trained in the School of Forestry, 258 of whom have passed into the various forest services. During the fifteen years of the independent existence of the Institute, there have been 350 students in attendance.

International Bibliography of Agricultural Economics

THE International Institute of Agriculture at Rome has just issued the first number of a new quarterly publication—the *International Bibliography of Agricultural Economics*—compiled under the technical direction of the librarian, Dr. S. von Frauendorfer. The need for a bibliography of this nature was realized in 1932, and since 1933 twelve publications on these lines have appeared in the journal *Berichte über Landwirtschaft* (Parey, Berlin). The thirteenth issue, giving the literature up to June 1, 1938, will be found in the *Berichte* as usual, but subsequent publications are given in the new volume. The *International Bibliography of Agricultural Economics* covers the economic and social aspects of agriculture, such as agricultural economics, agricultural policy, settlement, credit, co-operation, insurance, marketing, prices, statistics, farm organization and management, valuation, labour, accounting, rural sociology, agricultural history and geography, legislation and education and all other agricultural problems, in so far as they are considered from the economic and social point of view. Only publications of purely technical character are excluded. Titles of all publications, whether books, bulletins, pamphlets or articles in periodicals, are indicated, including all bibliographical details required for proper identification. All languages receive equal treatment, and titles in the less known languages are provided with a translation. The bibliography, which is the only one covering systematically the world literature on agricultural economics, is carefully classified by subjects. An author index will be supplied at the end of each volume. The annual subscription, postage included, is 6*s*. 6*d*.

Seale-Hayne Agricultural College

THE criticism is frequently made that the investigations of colleges and research institutes are not reported to the farmer in a form that can be easily understood. To meet this need, and at the same time to make the work of the College more widely known, Seale-Hayne Agricultural College, Newton Abbot, Devon, is issuing an annual in which it is hoped to deal with a wide variety of subjects in a manner likely to prove of real value to the practical man. The first number has just been published. It contains articles on the chemical composition of broccoli, potato eelworm, varieties of winter oat, and on the animal husbandry side, efficiency factors in the production of bacon pigs, milk production costs and the building up of a tuberculosis-free dairy herd. A list of investigations in progress at the College and of pamphlets already published is appended. Though of particular value to farmers and growers in the south-west of England, the volume will no doubt be also of interest to agriculturists in other districts.

The John Innes Horticultural Institution

THE John Innes Horticultural Institution is unique in Great Britain in combining research in genetics, cytology and biochemistry with pomology and horticulture. The twenty-ninth annual report contains the results of the investigations during the year 1937–38. Two interesting discoveries in cytology were that the chiasmata in the megasporocytes were less randomly distributed than in the microsporocytes of *Lilium testaceum* and that the centromere could divide sometimes transversely as well as longitudinally. The genetical analysis of *Tropaeolum*, *Streptocarpus*, *Verbena*, *Zea*, *Lotus* and *Primula sinensis* is proceeding. There are two linkage groups of most of the identified colour genes in *Streptocarpus*; both groups exhibit tight linkage between the genes. 16 genes of *Verbena* may be assorted into five linkage groups. The investigation of *Rubus* species has shown that different varieties, usually polyploid, may be (1) sexual, (2) apomictic, or (3) partly sexual and partly apomictic in reproduction. Even the apomictic varieties can segregate, thus indicating that the first division of meiosis occurs in these forms. The Biochemistry Department has been investigating several interesting new plant pigments such as dunnione in *Streptocarpus Dunnii* and anthocyanins from ferns and unusual sap-soluble substances in *Celosia*. The training of gardeners and the investigation of suitable soil composts again met with success and good use was made of the provision of research facilities for visitors.

Bibliography of Seismology

WE have recently received vol. 12, No. 19 (July, August and September 1938) of the Bibliography of Seismology, published by the Dominion Observatory at Ottawa. This time 117 works are listed and there are twenty-six collaborators representing 12 countries. It contains references among many notable works to Dr. C. Davison's "Studies on the Periodicity of Earthquakes" and works by Gutenberg and Richter, Lynch, and Bullen all bearing on the problem of the earth's central core. Particularly interesting is the notice of the article on Frank Lloyd Wright from *Readers Digest*, directing attention to the importance of the design of buildings in earthquake-troubled countries. Wright designed the Imperial Hotel in Tokyo to withstand earthquake shocks, and it has done so.

World Bibliography of Bibliographies

THE need for the making of bibliographies arises om the multiplicity of books, the excessive pro-uction of which was a matter for complaint before e invention of printing. Bibliographies, or lists books, existed before the Christian epoch. Not ng after the introduction of printing, the recording all books made became impossible and the difficulty came one of keeping track of bibliographies. ventually the ever increasing number of biblio-aphies of bibliographies has justified the publication Mr. Josephson's bibliography of bibliographies of bliographies. To-day the aggregate of existing bliographies is countless. Thanks to the work of e International Federation for Documentation, an creasing number are produced according to a andard system. Such bibliographies can be amal-amated into a single index, where all references to particular topic, collected from a variety of sources different languages, can be found immediately in ne place. The great mass, however, are arranged ccording to a variety of systems, mostly alphabetical, hich make amalgamation impossible. The adoption f individual systems gives rise to the need for a ork by which to ascertain what bibliographies have een compiled on a given subject, and Mr. T. esterman is attempting to meet the need by a "World Bibliography of Bibliographies" to contain bout 24,000 entries of separately published biblio-raphies of all countries on all subjects. In addition o printed books, it will cover every sort of written atter as well as the subject classes of Patent Office bridgements from 1617 until 1930. It is promised n two volumes, the first on October 1, 1939 and the econd early in 1940. Orders should be sent to Mr. T. Besterman, 98 Heath Street, London, N.W.3.

International Federation for Documentation

THE fifteenth International Conference of the International Federation for Documentation, which s being organized by the Swiss Association for Documentation, will be held at Zurich under the residency of Dr. Philipp Etter, president of the Swiss Republic, during August 10–13. The International Federation for Documentation, the seat of which is at The Hague, was founded for the purpose of studying all particulars concerning the publication of new information and of developing means whereby it may be made available as required. At the World Congress on International Bibliography two years ago at Paris, the Federation was adopted unanimously by delegates of more than forty Governments as the international authority in such matters. One of the main objects of the Federation is the great work of promoting the subject-indexing of information, since information that has not been catalogued by subject cannot be found unaided except by accident, by the individual research worker. It can be made available only by systematic and comprehensive indexing. Consequently the Federation endeavours to bring together in direct collaboration all bodies and individuals interested in the mobilization of knowledge.

AMONG the methods adopted by the Federation is the promotion of international conferences. Full conferences are held biennially in different countries: that held last year at Oxford under the patronage of the British Government and the presidency of Sir William Bragg will be remembered by many. In alternate years smaller conferences, restricted to selected topics, are held. The subjects for discussion at the Zurich Conference comprise: (1) the division of work between librarians and documentalists, (2) documentation in connexion with administration, (3) documentation in industry and (4) photographic reproduction methods for documentation purposes. The Conference includes visits and excursions to works and places of interest in the neighbourhood. Everyone concerned with the increase or organization of knowledge should make a point of attending. Special travelling facilities are afforded in connexion with the Swiss National Exhibition. The membership fee is 20 Swiss francs and the papers will be printed in advance and sold at the price of 10 Swiss francs. The address of the secretary is Herr E. Mathys, Chemins de Fer, Bern, Switzerland.

Zoology in China

IT is gratifying to note that the *Bulletin of the Fan Memorial Institute of Biology* of Peiping (Pekin), now in its eighth volume, has been able to continue publication notwithstanding the disturbed condition of internal affairs prevailing in China. The last issue to hand of the Zoological Series (No. 3, July–August 1938) contains eight articles, all of which are written by Chinese zoologists. The most extensive are S. C. Yu's studies on Chinese Crustacea of the group Caridina and those by Messrs. Hsu and Chow on helminths of the human intestine. The articles are all written in English and have Chinese summaries.

Royal Commission Science Research Scholarships

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 announces the following appointments for 1939. *Senior Studentships:* On the recommendation of the University of Cambridge: Mr. S. Devons, for research in nuclear physics at the University of Cambridge; Dr. E. F. Gale, for research in biochemistry at the University of Cambridge; Mr. F. Hoyle, for research in theoretical physics at the University of Cambridge; Dr. W. J. C. Orr, for research in physical chemistry at the University of Cambridge. On the recommendation of the University of Oxford: Dr. F. C. Frank, for research in physical chemistry at the University of Cambridge. *Overseas Scholarships:* On the recommendation of McGill University, Montreal: Dr. H. B. Newcombe, for research in genetics and cytology at the John Innes Horticultural Institution, Merton, and the California Institute of Technology, Pasadena; Dr. R. L. McIntosh, for research in physical chemistry at the University of Cambridge. On the recommendation of the University of Toronto: Dr. H. E. Johns, for research in physics at the University of Cambridge. On the recommendation of the University of Sydney: Miss R. H. Harradence, for research in organic chemistry at the University of Oxford; J. W. Cornforth, for research in organic chemistry at the University of Oxford. On the recommendation of the University of New Zealand: A. J. C. Nicholson, for research in physical chemistry at the University of Cambridge. On the recommendation of the University of Cape Town: C. B. Coetzee, for research in geology at the University of Cambridge. On the recommendation of the University of Dublin: B. P. Beirne, for research in entomology at the British Museum (Natural History), London. On the recommendation of Benares Hindu University: Dr. P. B. Mathur, for research in plant physiology at the University of Cambridge.

Announcements

PROF. L. J. HENDERSON, Lawrence professor of chemistry at Harvard University, who is distinguished for his investigations on the physico-chemical structure and organization of the body, has been invited by the Royal Society to deliver the next Pilgrim Trust Lecture which is to be given in London. Prof. Henderson has accepted the invitation. In referring to the Pilgrim Trust Lectures in NATURE of July 1, p. 15, it was incorrectly stated that the selection of Sir William Bragg to deliver the second lecture of the series had been in the hands of the Royal Society; the Royal Society invites American men of science to lecture in England under the scheme, while the National Academy of Sciences invites a representative of science in Great Britain to lecture in the United States.

AT a meeting held in Paris on June 30, the president of the Société des Ingénieurs Civils de France, M. Raymond Berr, presented the Gold Medal of the Société (Prix Annuel) to Mr. W. T. Halcrow, for his paper entitled "Tapping a Lake at 32 metres below the Surface" read before the Société in Paris on May 27, 1938. This is the first occasion on which the premier prize medal of the Société has been presented to a British subject since its award was instituted in 1861. Mr. Halcrow, who is the president of the British Section of the Société des Ingénieurs Civils, described in his paper the Ben Nevis tunnel through which water from Loch Treig is delivered to the British Aluminium Company's power station at Fort William.

THE following have been elected honorary members of the Royal Society of Edinburgh: Harvey (Williams) Cushing, emeritus professor of neurology, Yale School of Medicine, Newhaven, Conn.; Otto Loewi, lately professor of pharmacology, University of Graz; Bernard Lyot, of the Observatory, Meudon.

THE following have been elected to the Physical Mathematical Class of the Prussian Academy of Sciences: Prof. A. Butenandt, director of the Kaiser-Wilhelm Institut für Biochemie in Berlin; Prof. K. Meyer, director of the Institut für Ackerbau und Landbaupolitik, Berlin; Prof. A. Ludin, professor of hydraulic and agricultural hydraulic engineering, Berlin; Dr. F. Seewald, director of the Deutsche Versuchsanstalt für Luftfahrt, in Berli and Prof. J. Bartels, professor of geophysic Berlin.

DAME HELEN GWYNNE-VAUGHAN, professor botany in Birkbeck College, London, has bee appointed director of the Auxiliary Territorial Se vice, Army Branch, with rank of Chief Controller, from July 3.

THE Council of the Institution of Civil Enginee has approved of the formation of a Railway Enginee ing Section which will include within its scope a matters appertaining to the study of railway enginee ing relating to planning, construction, maintenanc and research, and including structures, rolling-stoc and equipment, the matters akin thereto.

THE Council of the Royal Meteorological Societ has awarded the Howard Prize (an aneroid barometer given annually for the best essay on a selecte meteorological subject, to Cadet V. A. McMillan, o H.M.S. *Conway* School Ship. Cadet C. D. Thorpe also of H.M.S. *Conway*, was placed second in th competition. The subject of the essays was "Th Barometer and its Use in Meteorology"

THE International Society for the Investigation o Biorhythms will hold its second conference a Utrecht, Holland, on August 25–26, under th presidency of Dr. E. Forsgren. Dr. H. Holmgren of the Karolinske Institutet, Stockholm, is th secretary. Further information can be obtaine from Dr. Frits Gerritzen, Lunteren, Holland.

THE eleventh Congress of the International Unio against Tuberculosis will be held in Berlin on September 16–20 under the presidency of Dr. Ott Walter. The main subjects for discussion will be the problem of the virulence of the tubercle bacillus; the value of systematic examinations for the detection of tuberculosis in subjects more than fifteen years of age; and the rehabilitation of the tuberculous. Further information can be obtained from the National Association for the Prevention of Tuberculosis, Tavistock House North, Tavistock Square, W.C.1.

A JOINT meeting of the Royal Meteorological Society and the American Meteorological Society will be held in Toronto on the occasion of the meeting of the International Union of Geodesy and Geophysics in Washington early in September. The joint meeting will be held during August 28–29, and is being organized by Mr. J. Patterson, controller of the Canadian Meteorological Service. Seminars on radiation and on extra-tropical cyclones will be held. It is also hoped that a Canadian branch of the royal Meteorological Society may be inaugurated at this meeting. Further information can be obtained from Mr. J. Patterson, Meteorological Office, 315 Bloor Street West, Toronto, Ontario, or from the Assistant Secretary of the Royal Meteorological Society, 49 Cromwell Road, South Kensington, London, S.W.7.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 79.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Glutamic Acid of Tumour Proteins

IN a recent paper, Kögl and Erxleben[1] record some interesting observations which suggest that the proteins of malignant tissues are partially 'racemized'. From several normal tissues they were able to isolate, after short acid hydrolysis, relatively good yields of the usual $l(+)$ glutamic acid, showing, in 9 per cent hydrochloric acid, the normal rotation of $[\alpha]_D$ +31·6°, whereas the products isolated from an ovarian tumour, an ovarian carcinoma and from two different mammary carcinomas showed rotations of $[\alpha]_D$ + 21·8°, + 4·6°, + 11·6° and + 16·1°, suggesting that they contained 15·6, 42·7, 31·7 and 24·6 per cent respectively of $d(-)$ glutamic acid. The importance of these findings needs no emphasis, and confirmation in other laboratories is clearly desirable.

During the past two years, an extensive research has been in progress at the Imperial College on the dicarboxylic acid content of various standard proteins. This has given the workers here considerable experience in the rapid isolation of glutamic acid hydrochloride from protein hydrolysates, and opportunity has accordingly been taken of investigating some tumour proteins. The method of analysis employed in these particular cases was essentially that of Foreman[2], modified so that the precipitation of the insoluble calcium salts (from an aqueous volume corresponding to 1 gm. total nitrogen per 60 ml.) with 9 volumes of (95 per cent) ethyl alcohol, was repeated a second time under the same conditions. Provided that the protein had been hydrolysed for twenty hours with 20 per cent hydrochloric acid, previous experience had shown that the fraction recovered from the insoluble calcium salts prepared in this way had all its nitrogen in the amino form and consisted essentially of dicarboxylic acids. Furthermore, on acidifying the solution with hydrochloric acid and concentrating *in vacuo*, the major part of the glutamic acid separated at once as its hydrochloride (cf. Sharp[3]). Since in the case of the tumour proteins the object was to prepare this hydrochloride in reasonable amount for further characterization, no attempt has yet been made to increase the yield by appropriate treatment of the mother liquors. Brief details of four analyses are as follows.

(1) *Crocker Sarcoma* 180. 206 gm. of Crocker sarcomata, from 46 mice, were minced and treated twice with 824 ml. of acetone. The insoluble matter, after drying at 110°, weighed 30 gm. 24·5 gm. of this material were hydrolysed for seven hours with 130 ml. of concentrated hydrochloric acid. The dicarboxylic acid fraction contained only 90·8 per cent of its nitrogen in the amino form, and on concentration in the presence of excess hydrochloric acid 2·43 gm. of material separated. On recrystallization from concentrated hydrochloric acid (charcoal) this gave 1·83 gm. of glutamic acid hydrochloride (found: N = 7·61 per cent; $[\alpha]_D$, in 9 per cent HCl = + 31·4°).

(2) *Carcinoma of Bronchus.* (*a*) A solid trabecular polygonal-celled carcinoma of right bronchus from a man (A.T., aged 59 years). There were metastases in the left lung, spleen, adventitia of aorta and brain. Tumour tissue (600 gm.) from the primary tumour was finely minced and extracted with six volumes of 0·6 per cent sodium chloride, the mixture being shaken at a temperature not exceeding 5° for twenty-four hours. The extract, separated by centrifuging and filtering, was treated with four volumes of alcohol and the precipitate separated, washed and dried at 110° to give 26 gm. of dry material. 14·4 gm. of this were hydrolysed for twenty hours with 20 per cent hydrochloric acid (10 volumes). The dicarboxylic acid fraction, all the nitrogen of which was in the amino form, gave 1·57 gm of insoluble hydrochlorides. On recrystallization 1·2 gm. of glutamic acid hydrochloride were obtained (found: N = 7·64 per cent; $[\alpha]_D$, in 9 per cent HCl = + 31·7°).

(*b*) The material insoluble in the 0·6 per cent sodium chloride solution was treated with 80 per cent alcohol and dried at 110°, giving 73 gm. of dry material. 48 gm. of this were hydrolysed with 20 per cent hydrochloric acid for twenty-four hours. The insoluble hydrochlorides from the dicarboxylic acid fraction gave, on recrystallization from concentrated hydrochloric acid (charcoal), 3·21 gm. of glutamic acid hydrochloride (found: N = 7·65 per cent; $[\alpha]_D$, in 9 per cent HCl = + 31·5°).

(3) *Extension in Neck from Carcinoma of Bronchiole.* An oat-cell carcinoma arising from a bronchiole in the apex of the left lung of a man (N.H., aged 56 years) had extended along the lymphatics into the neck and had invaded the jugular vein, brachial plexus, cervical sympathetic and vertebral bodies. Material (266 gm.) from the growth in the neck was minced and extracted with 0·6 per cent sodium chloride. The extract, on precipitation with alcohol and drying as in 2(*a*), gave 9·1 gm. of dry protein, while the insoluble residue, treated as in 2(*b*), gave 16 gm. of dry material. The two products were mixed and 17·6 gm. were hydrolysed with concentrated hydrochloric acid for seven hours. The insoluble hydrochlorides (1·525 gm.), on recrystallization from 20 per cent hydrochloric acid, gave 1·2 gm. of glutamic acid hydrochloride (found: N = 7·64 per cent; $[\alpha]_D$, in 9 per cent HCl = + 31·2°).

These preliminary results are not in agreement with those of Kögl and Erxleben, and show the need for a more extended investigation. Of course, no claim is made that the material which was used in these analyses was composed wholly of cancer cells; thus tumour (3) above contained a large proportion of fibrous tissue. The difficulty of obtaining large quantities of malignant cells free from other materials is familiar to all engaged in cancer research. But there is no doubt that all three tumours contained enough cancer tissue to show the character in question, if this were present.

We are indebted to Dr. W. G. Barnard, pathologist in charge of the Central Histological Laboratory of the London County Council, and to Dr. L. M. Hawksley, pathologist of the Royal Cancer Hospital, for supplying and identifying the human malignant tissues used.

A. C. CHIBNALL.
M. W. REES.
Imperial College, G. R. TRISTRAM.
London, S.W.7. E. F. WILLIAMS.

Research Institute, E. BOYLAND.
Royal Cancer Hospital (Free),
London, S.W.3.
June 13.

---

[1] Kogl and Erxleben, *Z. physiol. Chem.*, 258, 57 (1939).

[2] Foreman, *Biochem. J.*, 8, 463 (1914).

[3] Sharp, *Biochem. J.*, 33, 679 (1939).

Interaction between the Phosphatides of the Plasma and the Corpuscles

PLASMA and corpuscles both contain appreciable amounts of phosphatides, that is, about 80 mgm. per 100 c.c. of plasma and 200 mgm. per 100 c.c. corpuscles. To determine if any exchange takes place between the phosphatides of the plasma and those of the corpuscles we carried out the following experiment.

Labelled sodium phosphate was administered to rabbits and hens. Labelled phosphatides, formed in the liver and to a minor extent in other organs, penetrate partly in the course of the following 24 hours into the plasma. The plasma thus obtained, containing labelled phosphatides, was shaken at 37° under the usual conditions with corpuscles from another rabbit. They were then separated by centrifuging, the corpuscles washed with non-active plasma, and the specific activity (activity per mgm. phosphorus) of the phosphatides extracted from both the corpuscles and the plasma was determined. The results are seen in Table 1, while results obtained in experiments *in vivo* are recorded in Table 2. The results show that, while some of the corpuscle phosphatides are replaced at a remarkable rate by plasma phosphatides, the greater part of the phosphatide molecules present in the corpuscles do not exchange with those of the plasma. Even after the lapse of a week, as experiments carried out on human subjects show, more than one half of the corpuscl phosphatides remains unchanged[1]. In considering thi result we must take into account that in the cours of a week an appreciable number of corpuscles wil have been replaced by new ones which necessaril contain labelled phosphatides, since they are forme in an organism containing such molecules. A possibl explanation of the results obtained is that the phosphatide molecules present in the outer part of the cel membrane are readily exchangeable with the impinging molecules present in the plasma, while the constituents of deeper layers of the corpuscle membrane are not accessible. Most of the phosphatides present in the corpuscles are located in the membrane.

TABLE 1.

Extent of equipartition of labelled phosphatides originally present in the plasma between the phosphatides of the corpuscles and the plasma in experiments *in vitro*.
(Plasma containing labelled phosphatides shaken with corpuscles of another rabbit.)

Animal	Time in hours	Extent of equipartition (percentage)
Rabbit	0·5	1·8
	1·5	3·6
	3·0	4·0
	4·5	5·0
Hen	1·5	1·5
	2·0	2·0
	3·0	1·5

TABLE 2.

Extent of equipartition of labelled phosphatides originally present in the plasma between the phosphatides of the corpuscles and of the plasma of rabbits in experiments *in vivo*.

Time in hours	Extent of equipartition (percentage)
24	16
24	18
24	17
25	16
42	34

In previous work[2], we have shown that almost all the acid soluble phosphorus compounds present in the corpuscles are resynthesized at a very appreciable rate, and that the corpuscles at the end of their lifetime do not contain any significant amount of those molecules of acid-soluble phosphorus compounds which were present in the corpuscles at the time of their formation. The phosphatide molecules present in the corpuscles show a very different behaviour; they are not resynthesized inside the corpuscles to an appreciable extent (we find in experiments *in vitro* that in the course of 3½ hours 1 per cent of the phosphatides present in the corpuscles got labelled); however, a part of them exchanges with phosphatide molecules present in the plasma. The majority of the phosphatide molecules present in the corpuscles remains, however, unchanged during the lifetime of the latter.

The above considerations apply to the average phosphatide molecules. We are engaged in the study of the behaviour of different types of phosphatides.

L. HAHN.
G. HEVESY.

Institute of Theoretical Physics,
University, Copenhagen.
May 11.

---

[1] Hevesy, G., and Aten, A. H. W., *Kgl. Dansk. Vid. Selsk. Medd.*, 14, 5 (1939).

[2] Aten, A. H. W., and Hevesy, G., NATURE, 142, 871 (1938); compare also footnote 1.

Activity of β-Alanine in Stimulating Growth of Young Rats on a Diet Deficient in 'Filtrate Factor'

WE have for some time been engaged in a study of the 'filtrate factor'[1] using young rats as test animals and following the technique described by Edgar, El-Sadr and Macrea[2]. The first attempts to purify the material gave evidence that at least two unknown active principles are present in crude preparations of filtrate factor from liver. When the acidified aqueous extract containing the filtrate factor was extracted with ether, a separation was observed. The material from the ether extract gave a definite growth response, which, however, was less pronounced than that obtained with the whole crude filtrate factor, even if large doses were administered. On the other hand, the material from the aqueous layer after complete extraction with ether also produced a definite increase of growth. The combination of both parts gave a greater effect, similar to that obtained with the original material.

The following average increases in weight were observed during the test period of 14 days (average of eight rats in each group). The amounts of supplements correspond to 15 gm. of fresh beef liver. Larger doses had no greater effect.

Negative controls	12 ± 4 gm.
Concentrate of crude filtrate factor	40 ± 9 gm.
Purified ether extract	30 ± 6 gm.
Portion not extractable	25 ± 6 gm.

The component extractable by ether from liver extracts was either absent from yeast extracts or only present in relatively small amounts.

Various known pure compounds were checked for their capacity to replace the ether-soluble portion of the filtrate factor. With β-alanine, positive results were obtained at a level of 0·1 mgm. per day per rat. The results with smaller doses are not yet available. The average increases in weight during the test period of 14 days are given below :

Negative controls	12 ± 4 gm.
1 mgm. β-alanine	18·5 ± 5
0·2 mgm. β-alanine	21·5 ± 6
0·1 mgm. β-alanine	17 ± 3

We have found that rats which have been fed on a diet free from the 'eluate' and 'filtrate factors' until their weight remains stationary, do not give a definite reaction to the addition of β-alanine or acid ether extract of liver, although they show a considerable increase in weight when crude filtrate factor is added to their diet.

While these experiments were being carried out, two remarkable notes appeared dealing with related subjects. T. H. Jukes[3] stated that the "chick-antidermatitis factor"[4] is probably identical with pantothenic acid[5]. This was confirmed by Elvehjem *et al.*[6], who furthermore give proof that pantothenic acid is a derivative of β-alanine containing a hydroxy acid linked to the amino-group. They were able to hydrolyse pantothenic acid into its two components, which were entirely inactive when tested on chicks, but could be linked together again by chemical means to yield a material which again showed the original activity.

The part of the filtrate factor from liver, which is extractable with ether and which stimulates the growth of young rats, contains no free β-alanine. It is quite likely that it is identical with the chick-antidermatitis factor or pantothenic acid. This hypothesis has already been suggested by several investigators, but we could not find any definite proof of it in the literature. The supposition is based chiefly upon the fact that both factors can be obtained from the same sources and by exactly the same methods.

If this supposed identity, as well as our preliminary results, can be confirmed by further experiments, it would indicate that for rats, β-alanine is the essential part of the whole molecule of pantothenic acid, since rats react in a similar way to free β-alanine and to pantothenic acid, and probably to all ordinary esters and acyl derivatives of β-alanine. Chicks and perhaps other animals, under the conditions used in the test for the antidermatitis factor, unlike rats, give no response to free β-alanine but only to the combined form as pantothenic acid. A simple analogy for such behaviour is already known. Mueller *et al.*[7] reported that β-alanine and pantothenic acid both can stimulate the growth of the diphtheria bacillus, and that pantothenic acid can be built up from β-alanine by *C. diphtheriæ*, whilst certain strains of the lactic acid bacteria are apparently unable to effect the synthesis of pantothenic acid from β-alanine.

Addendum. We have meanwhile received an account of work done on similar lines in the Lister Institute, London, and the University of Manchester. Dr. Macrae kindly sent us the manuscript of the letter below. Our results with β-alanine were obtained with 38 rats, using a further 24 animals as negative controls. Experiments are in progress with the object of demonstrating the effect of β-alanine in rats by another method. We fully agree with the British authors that the growth-promoting action of β-alanine on rats is only slight and that it can at most only be regarded as an accessory to the action of the other factors of liver extract.

M. HOFFER.
T. REICHSTEIN.

Pharmaceutical Department,
University,
Basle.
May 16.

[1] Lepkovsky, S., and Jukes, T. H., *J. Biol. Chem.*, 114, 109 (1936); 117, 11 (1937). Edgar, C. E., Macrae, T. F., *Biochem. J.*, 31, 886 (1937); 31, 893 (1937).

[2] Edgar, C. E., El-Sadr, M. M., Macrae, T. F., *Biochem J.*, 32, 2200 (1938).

[3] Jukes, T. H., *J. Amer. Chem. Soc.*, 61, 975 (1939).

[4] Woolley, D. W., Waisman, H. A., Mickelsen, O., Elvehjem, C. A., *J. Biol. Chem.*, 125, 715 (1938).

[5] Williams, R. J., Weinstock, jun., H. H., Rohrmann, E., Truesdail, J. H., Mitchell, H. K., and Meyer, C. E., *J. Amer. Chem. Soc.*, 61, 454 (1939).

[6] Woolley, D. W., Waisman, H. A., Elvehjem, C. A., *J. Amer. Chem. Soc.*, 61, 977 (1939).

[7] Mueller, J. H., and Cohen, S., *J. Bact.*, 34, 381 (1937). Mueller, J. H., and Klotz, A. W., *J. Amer. Chem. Soc.*, 60, 3086 (1938).

Vitamin B Requirements of the Rat

Two or three years ago some of us[1], in common with other investigators[2], recognized that the rat required at least four factors of the vitamin B complex—aneurin, riboflavin and two materials, then unidentified, which we named yeast eluate factor and yeast filtrate factor respectively. The yeast eluate factor has since been isolated and identified[3] with vitamin B_6. We have prepared from extracts of liver a fraction replacing the yeast filtrate factor in the diet of the rat[4]; this fraction we believe to contain a single factor, which we have named the liver filtrate factor. We have been for some time engaged on experiments having as their object the purification and eventual isolation of this factor.

This factor is not adsorbed from aqueous solution by fullers' earth nor precipitated from aqueous solution by lead, mercury, silver, quinine or brucine salts, nor by the more common precipitants for bases ; it is, however, precipitated from alcoholic solution by barium hydroxide. From weakly acid solution the factor may be extracted by amyl alcohol, ether or phenol ; after acetylation it is readily extracted with chloroform and the material obtained by hydrolysis of the chloroform-soluble portion is biologically active.

During the past year, further investigation of the essential nutrients contained in aqueous extracts of yeast and liver has led us to the conclusion that the vitamin B complex contains even more than four factors[3] and we have now obtained evidence that this vitamin complex, as required by the rat, has at least six constituents. Although in this brief communication it is impossible to present all the evidence in support of this further complexity, the following experiments give some indications. Young male rats were prepared as for tests for filtrate factor[4] and received, as sources of B vitamins, aneurin, riboflavin and eluate factor (vitamin B_6), the last being given as a nicotinamide-containing concentrate prepared from yeast or liver. When growth had slackened the animals were given various additional supplements as indicated in the following table, all supplements being supplied in optimal amounts. The body-weight of the animals was then observed for periods of two weeks.

Additional supplements given	No. of rats in group	Average total weight increase during 2 weeks (gm.)
None	15	12
Purified liver filtrate factor (soluble in amyl alcohol)	14	43
Acid autoclaved whole extract of liver	4	36
Purified liver filtrate factor + acid autoclaved extract of liver	6	68
Purified liver filtrate factor + the portion of liver extract not extracted by amyl alcohol and not absorbed by fullers' earth	3	64
Whole extract of liver	4	86

Consideration of the growth-rates supported by the various supplements makes it clear that acid-autoclaved whole extract of liver contained an essential factor distinct from liver filtrate factor, and whole liver extract contained at least one further factor. The residue obtained after fullers' earth treatment followed by amyl alcohol extraction of a liver extract also contained a growth factor not present in our purified liver filtrate factor; whether this is the same as that present in the acid-autoclaved extract of liver is undetermined. The rat thus appears to require at least six different factors contained in the vitamin B complex: aneurin, riboflavin, vitamin B_6 and three further substances at present unidentified. We have not been able to demonstrate that nicotinamide is an essential nutrient of the rat but, since the eluate fraction given in our basal diet contained that substance, it is not identical with any one of the three unidentified factors mentioned above.

Although yeast and liver filtrate factor replace each other in the diet of the rat, certain differences have been observed in the behaviour of concentrates of these materials, notably with regard to lability towards acid and alkali and to extraction from acid solution by organic solvents. The possibility that this disparity in behaviour may be due to a fundamental chemical difference between the two factors is at present under investigation.

We have also tested certain substances for vitamin B activity by administration to rats receiving aneurin, riboflavin and eluate fraction; among these β-alanine has been tested at a dosage of 0·5 mgm. and found to give only a very slight growth response. Evidence of a growth effect of β-alanine is recorded in the accompanying communication of Hoffer and Reichstein, whose results we have been privileged to see. From our results, however, we conclude that the growth effect of β-alanine is insignificant and that this substance certainly does not replace our yeast filtrate factor or our liver filtrate factor. In agreement with Robinson *et al.*[7] we found chondroitin sulphuric acid had some growth-promoting action but its effect even in large doses (100 mgm. daily) was slight compared with that of the filtrate factor.

Our experiments have been confined to rats and we are therefore unable to decide the relationship of our factors to pantothenic acid[8], which is probably identical with the chick anti-dermatitis factor[9]. Our liver filtrate factor shows great resemblance in properties to both the chick anti-dermatitis factor and the rat factor termed[10] factor *W*. A decision as to the exact relationship of these factors must await further work.

M. M. EL-SADR.
H. G. HIND.
T. F. MACRAE.
C. E. WORK.

Lister Institute of Preventive Medicine,
Chelsea Bridge Road,
London, S.W.1.

B. LYTHGOE.
A. R. TODD.

The University,
Manchester.

June 14.

---

[1] Edgar and Macrae, *Biochem. J.*, 31, 886 (1937).

[2] Lepkovsky, Jukes and Krause, *J. Biol. Chem.*, 115, 557 (1936). Halliday and Evans, *J. Biol. Chem.*, 118, 255 (1937).

[3] El-Sadr, Macrae and Work, *Biochem. J.*, 33, 611 (1939).

[4] Edgar, El-Sadr and Macrae, *Biochem. J.*, 32, 2225 (1938).

[5] Edgar, El-Sadr and Macrae, *Chem. and Ind.*, 57, 1111 (1938).

[6] Edgar, El-Sadr and Macrae, *Biochem. J.*, 32, 2200 (1938).

[7] Robinson, Gray, Chesley and Crandall, *J. Nutrit.*, 17, 227 (1939).

[8] Williams, Truesdail, Weinstock, Rohrmann, Lyman and McBurney, *J. Amer. Chem. Soc.*, 60, 2719 (1938). Williams, Weinstock, Rohrmann, Truesdail, Mitchell and Meyer, *J. Amer. Chem. Soc.*, 61, 454 (1939).

[9] Jukes, *J. Amer. Chem. Soc.*, 61, 975 (1939). Woolley, Waisman and Elvehjem, *J. Amer. Chem. Soc.*, 61, 977 (1939).

[10] Frost and Elvehjem, *J. Biol. Chem.*, 128, 23 (1939).

Pyruvate Oxidation System in Brain

WE have recently reported[1] that the oxidation of pyruvate by finely ground preparations of pigeon's brain is catalysed by fumarate and adenylic acid (or adenosine triphosphate). The effect of fumarate can be obtained in non-dialysed preparations, that of adenylic acid after short dialysis (two hours), when the activity of the system can be fully restored to the value before dialysis. Inorganic phosphate is another component of the system (Table 1). After two hours dialysis the preparations still contain some phosphate (about 0·001 m.) and certainly some fumarate[2], hence the oxygen uptake in the absence of added phosphate or fumarate is slightly higher than in the controls without pyruvate. These facts have now been confirmed with preparations from rabbit's brain.

TABLE 1.

Enzyme from pigeon's brain dialysed for 2 hours. Air, 38°.

Enzyme	Pyruvate (mol × 10^{-6})	Phosphate (mol × 10^{-6})	Adenylic acid (mol × 10^{-6})	Fumarate (mol × 10^{-6})	μl O_2 in 30 min.
1·5	—	50	0·14	5	80
1·5	9·1	50	—	5	88
1·5	9·1	—	0·14	5	102
1·5	9·1	50	0·14	–	150
1·5	9·1	50	0·14	5	350

It is well known that removal of cozymase by dialysis from enzyme systems requires long dialysis periods[3]. Little or no effect of added cozymase is observed after two hours dialysis, but increasing activations are obtained after increasing periods of dialysis (Table 2), thus showing cozymase to be another component of the pyruvate oxidation system.

TABLE 2.

All samples contain dialysed enzyme from pigeon's brain (1·5 ml.) and the following additions (conc. mol × 10^{-3}). Pyruvate (9·1); fumarate (5); phosphate (50). Air, 38°.

Duration of dialysis	μl O_2 in 20 min.			Increase due to cozymase (per cent)
	Enzyme	Enzyme + adenylic acid ($0·14 \times 10^{-3}$ m.)	Enzyme + adenylic acid ($0·14 \times 10^{-3}$ m.) + cozymase ($0·14 \times 10^{-3}$ m.)	
2 hours	71	245	275	12
4 hours	62	189	227	20
6 hours	74	161	232	44
8 hours	46	68	124	82

Although our preparations contain adenylpyrophosphatase, small amounts of easily hydrolysable phosphate (7 min. at 100° in normal hydrochloric acid) appear on incubation with adenylic acid and pyruvate (5 min. at 30°).

Lipmann[4] has recently reported on esterification of inorganic phosphate with adenylic acid, coupled with dehydrogenation of pyruvate, in preparations of lactic acid bacteria. In his system, however, the phosphorylation does not appear to be necessary for the dehydrogenation of pyruvate, which proceeds equally well in the absence of added adenylic acid. Furthermore, dehydrogenation of pyruvate in our brain preparations takes place in the absence of adenylic acid, the ratio oxygen uptake : pyruvate disappearing, fulfilling approximately reaction (1) (Table 3):

$$CH_3.CO.COOH + \tfrac{1}{2}O_2 = CH_3.COOH + CO_2, \quad (1)$$

TABLE 3.

Enzyme from pigeon's brain dialysed for 3 hours (1 5 ml.) with phosphate, fumarate and pyruvate as in Table 2. Air, 28°. 20 mm.

Additions	Extra O_2 uptake due to pyruvate (mols × 10^{-6})	Pyruvate disappeared (mols × 10^{-6})	Ratio O_2/pyruvate	
			Found	Theory (for reaction)
None	0 656	0·873	0·75	(1) 0·5
Adenylic acid ($0·14 \times 10^{-3}$ m.)	5·850	3·960	1·50	(2) 2·5

whereas in the presence of adenylic acid the oxidation of pyruvate proceeds more nearly to completion and the above ratio approaches the theoretical value for reaction (2) (cf. Long[5]):

$$CH_3.CO.COOH + 2\tfrac{1}{2}O_2 = 3CO_2 + 2H_2O \quad . \; . \; . \; (2)$$

It thus appears that the adenylic acid in our system is involved in an oxidation stage beyond that of oxidative decarboxylation and that the further oxidation of pyruvate is connected with a phosphorylation cycle.

The brain dispersions can be resolved by centrifugation into a solid residue which contains the pyruvate dehydrogenase (for reaction (1)) and a solution containing enzymes which, together with the residue, provide for the complete oxidation of pyruvate. The soluble enzymes can be precipitated with acetone or ammonium sulphate without loss of activity.

Thus far our analysis has shown the following substances to be required for the oxidation of pyruvate in brain: (a) cocarboxylase[6]; (b) fumarate; (c) inorganic phosphate; (d) adenylic acid; (e) cozymase. Fumarate can be replaced by malate or oxaloacetate in this brain system but not by citrate; hence a citric acid cycle, such as postulated by Krebs and Johnson[7] for the oxidation of carbohydrate in muscle, appears to take no part in the oxidation of pyruvate in brain.

We are indebted to the Nuffield Trustees and the Rockefeller Foundation for grants in aid of this work.

I. BANGA.
S. OCHOA.
R. A. PETERS.

Department of Biochemistry,
Oxford.
May 30.

[1] Banga, Ochoa and Peters, *Chem. and Ind.*, 58, 471 (1939)

[2] Banga, *Z. physiol. Chem.*, 249, 200 (1937).

[3] Meyerhof and Ohlmeyer, *Biochem. Z.*, 290, 334 (1937).

[4] Lipmann, NATURE, 143, 281 (1939).

[5] *Biochem. J.*, 32, 1711 (1938).

[6] Banga, Ochoa and Peters, NATURE, 143, 764 (1939)

[7] *Enzymologia*, 4, 148 (1937).

Bile Production in Tumour-bearing Mice and the Use of Bile in Filtration

THE growth of a mouse sarcoma (Mal. sarcoma) produced originally by a derivative of 1 : 2 : 5 : 6-dibenzanthracene[1] when inoculated into the peritoneum of mice, is accompanied by various changes which resemble those produced by X-radiation[2]. Among these changes is a marked increase in bile secretion. This suggested the use of such bile: (a) in filtration experiments, as an addition to the material to be filtered, and (b) as a preliminary injection in order to damage the tissues at the site of a subsequent inoculation of filtrate.

The methods (see the accompanying table) have yielded a number of tumours of which two are known to have been produced by cell-free materials. Filtration was carried out on lines previously described[3] and it was found that the addition of bile to a concentrated extract of tumour produces quick and easy filtration.

		Group	Method of removal of bile from excised gall bladder	Number of mice	Tumours
1	One injection of bile only	*A*1	By puncture, syringe or capillary after scalding gall bladder 3 times	16	1
		*B*1	By puncture. Bile then filtered	23	0
	One injection of filtrate of tumour extract with bile	*C*		21	0
			Total, *A*1, *B*1 and *C*	60	1
2	Bile injected 1–4 days before filtrate of tumour extract with bile	*A*2	Same as *A*1	31	14
		*B*2	Same as *B*1	39	2
			Total, *A*2 and *B*2	70	16

It will be seen that the experiments in the two classes are arranged in pairs: *A*1 and *A*2, *B*1 and *B*2, in which the technique is similar. The *A*2 group show by far the highest proportion of positive results (14 in 31); this can scarcely be due to the inclusion of tumour cells with the bile, for the injection of bile alone obtained in exactly the same way (*A*1) gave only one positive in 16. In the $B2$ group the presence of cells was excluded by filtration of all materials injected, and the number of positive results (2 in 39) which occurred, although low, was higher than that (2·5 per cent) found in earlier experiments with tumour filtrate alone[3]. The much smaller number of tumours in $B2$ than $A2$ may be due, if contamination with cells in $A2$ can be excluded, to a considerable reduction in the amount of some tumour-producing agent caused by: (*a*) loss of the agent on the membrane and filter apparatus; (*b*) oxidation taking place during prolonged collection of the bile and filtration.

L. DOROTHY PARSONS.

Research Institute,
Royal Cancer Hospital (Free),
Fulham Road,
London, S.W.3.
June 3.

[1] Cook, J. W., *J. Chem. Soc.*, 3277 (1931).

[2] Clarkson, J. R., Mayneord, W. V., and Parsons, L. D., *J. Path. and Bact.*, 46, 221 (1938).

[3] Parsons, L. D., *J. Path. and Bact.*, 43, 1 (1936).

Autocatalysis and Blood Coagulation

THE autocatalytic behaviour of blood coagulation is thought, by several authors, to be due to the autocatalytic formation of thrombin from its precursor prothrombin[1]. So far, thrombin seems similar to the enzymes studied by Northrop and co-workers[2].

Experiments have now shown the reaction to be a more complicated one. In a neutralized solution containing purified fibrinogen and prothrombin, together with calcium chloride, it was not found possible to obtain a formation of new thrombin upon inoculation with preformed thrombin. By inoculation from such a mixture to a new solution, and so on, the clotting power was exhausted in the course of a few passages, which is in contrast to the results obtained with fresh plasma as a clotting medium[3]. The clotting power of the mixture was in accordance with the amount of thrombin added, and only the further addition of thrombokinase yielded new amounts of thrombin. In fresh plasma it was possible, by the addition of small amounts of acetic acid, to inhibit the autocatalytic properties.

Thrombin thus does not seem to be formed by an autocatalytic reaction in the common sense, and the autocatalysis takes place only in native plasma.

TAGE ASTRUP.

Biological Institute,
Carlsberg Foundation,
Copenhagen,
June 6.

[1] Gratia, A., and Fredericq, P., *C.R. Soc. Biol.*, 126, 906 (1937)

[2] Compare Northrop, J. H., *J. Gen. Physiol.*, 21, 335 (1938).

[3] Fischer, A., NATURE, 136, 1075 (1935).

Isolation of Oestrone from the Adrenal Gland

IN a former communication to Nature[1] reporting the isolation of progesterone and allopregnanolone from the adrenal gland, reference was made to the work of Engelhart[2]. He obtained lipoid extracts of this gland which produced oestrous and progestational effects in the uterus of the immature rabbit. Later, Callow and Parkes[3], who confirmed these findings, fractionated the active materials by the method of Allen and Meyer[4].

Now a further investigation of the oestrogenic principle of the adrenal has been made, using a concentrate kindly supplied by N. V. Organon Oss to Dr. A. S. Parkes, who placed it at my disposal.

The concentrate, from which the adrenalin and the greater part of the cortical hormone group of steroids had been removed, was saponified, practically all the oestrogenic activity being found in the saponifiable material. This was separated into non-ketonic and ketonic fractions, both of which were oestrogenic. Oestrone has been isolated from the latter as the benzoate, melting at 215–217° alone or at 215–216° when mixed with authentic oestrone benzoate (melting point 215–217°).

A bioassay on the isolated benzoate, carried out by Mr. Emmens of the National Institute for Medical Research, gave an 80 per cent response in a group of ten mice, each receiving a single dose of 0·5 γ in nut oil. Authentic oestrone benzoate under similar conditions gave a 90 per cent response.

Full experimental details of the isolation of the oestrone will be published in full elsewhere. The oestrogenic material in the non-ketonic fraction is still under investigation.

D. BEALL.
(Beit Memorial Fellow.)

British Postgraduate Medical School,
London.
June 8.

[1] Beall, D., and Reichstein, T., NATURE, 142, 479 (1938).

[2] Engelhart, E., *Klin. Wschr.*, 9, 2114 (1930).

[3] Callow, R. K., and Parkes, A. S., *J. Physiol.*, 87, 28*P* (1936).

[4] Allen, W. M., and Meyer, R. K., *Amer. J. Physiol.*, 106, 55 (1933).

Precipitation of Protein Fractions in Solutions Particularly Poor in Proteins

THERE are some technical difficulties in the handling of small amounts of protein fractions precipitated with neutral salts, such as sodium sulphate, in the usual way, because of the comparatively large quantities of liquid to be employed. We have therefore made attempts to find a method permitting the precipitation of the different proteins by direct addition of the salt to the protein solutions in the desired proportion.

Experiments have been made with human blood serum as well as with virus solutions of Shope rabbit papilloma. As a control, we employed the usual method of precipitation: addition of 30 parts of the salt solution in the desired concentration to 1 part of protein solution. After allowing to stand for about three hours, filtration was performed through Schleicher-Schüll No. 602 filters; the total and residual nitrogen content in the filtrates was controlled by micro-Kjeldahl estimations.

For the new method we added a weighed amount of the dry, well-powdered salt (sodium or ammonium sulphate) extremely slowly to the protein solution with continuous shaking, avoiding in this way an abrupt increase of concentration; if necessary the manipulation was carried out in a water-bath. Thus we needed about 30 minutes for dissolving 1·5 gm. in 5 c.c. of protein solution. Three hours afterwards, filtration and estimation were done as usual.

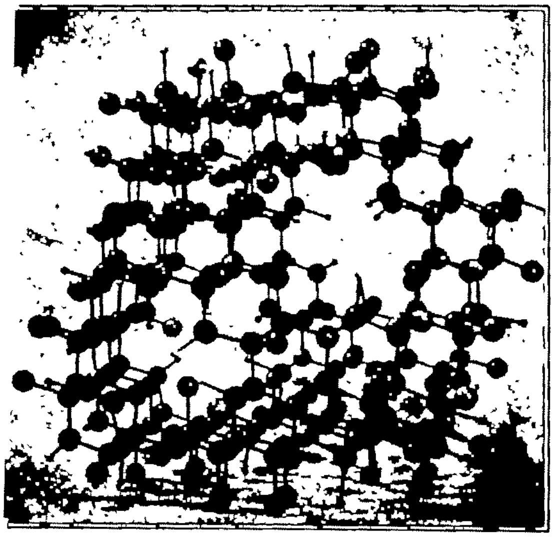
By this method a quantitative yield of the precipitated protein can easily be obtained, and sedimentation of large amounts of liquid in big centrifuges can often be avoided.

PETER LADEWIG.

Cancer Research Laboratory,
University, Istanbul.
June 1.

The Tuberculin Protein TBU-Bovine (523)[1]

As has been increasingly emphasized lately, the idamental problem of protein structure is to explain existence of very large but chemically and ysically well-defined molecules. It is evident that y two-dimensional pattern of amino-acid residues l either be incapable of folding to form a closed ge-like structure, or will form such a structure only certain ways which correspond to definite numbers residues. Irrespective of the particular nature of e characteristic protein fabric, the idea of closed uctures (such as a cage[2] or torus or surfaces of gher connectivity) has therefore been offered as an planation of the existence of these protein megaolecules.



The particular fabric known as the cyclol fabric as been shown to yield cage structures C_1, C_2, . . . he skeletons of which are built on a ground plan f 72, 288, . . . residues, and it has already been hown that the actual numbers given by Svedberg or his molecular weight classes correspond to simple r compound C_1, C_2, . . . units or to colonies of C_1 units alone[3]. As was pointed out, the smallest f these classes corresponds to a dimeric structure nade up of two C_1 cages. It is therefore of interest to find that, in studies of the tuberculin protein moleules, a protein, TBU-Bovine (523), with molecular weight about 10,000, has been isolated, which is homogeneous in sedimentation, diffusion and electrophoresis. Such a molecular weight is of the right order of magnitude to correspond to a single C_1 structure.

DOROTHY WRINCH.

New York.

---

[1] Seibert, Pedersen and Tiselius, *J. Exper. Med.*, 68, 413 (1938).

[2] Wrinch, Cold Spring Harbor Symposium on Proteins, 6 (1938).

[3] Wrinch, *Phil. Mag.*, 26, 313 (1938).

Structure of Aromatic Polynitro Compound-Hydrocarbon Complexes

THE most obvious evidence of interaction of some kind between aromatic polynitro compounds and other aromatic substances is the isolation of many crystalline compounds containing the two components in simple molecular proportions. The evidence, particularly of colour and heat of interaction, points to something stronger than mere van der Waals' binding between the molecules, but it is not certain that they are linked by ordinary valency bonds. Existing X-ray work[1] and the theoretical work of Briegleb[2] are against this type of bonding.

We have examined the crystal structures of a large number of these compounds and find that, although the molecules are arranged in parallel planes, there are usually at least two sets of planes inclined to each other, and owing to overlapping of many atoms in projections of the structures, a clear decision as to the exact position is difficult. We have now, however, found a structure in which this difficulty is removed and a convincing proof provided that there are no bonds between the molecules.

The 1 : 1 molecular compound of picryl chloride and hexamethylbenzene is orthorhombic: $a = 14 \cdot 0$, $b = 9 \cdot 0$, $c = 15 \cdot 4$, and the space group *Amam* or *Ama*. There is no pyro-electric effect detectable by the liquid air method; the crystals therefore probably have a symmetry centre (space group *Amam*), but the conclusions we draw are valid for both space groups. Patterson analyses and general space group considerations show that all picryl chloride molecules lie in two sets of planes parallel to (100) separated by a distance of 7 A. All hexamethylbenzene molecules lie in two sets of planes parallel to and halfway between these, that is, separated from them by 3·5 A. This is supported by optical properties and by quantitative agreement of calculated and observed relative intensities of reflections *h*00. In this special case there cannot be any valency bonds between the nitro compound and the hydrocarbon whatever the arrangement of the molecules in their own planes. Anomalous X-ray diffraction effects suggest the possibility of a cell of three times the *b* dimension and show that there is some degree of disorder in the structure. Comparison with the corresponding bromide and iodide shows that it is the nitro molecules that are disordered. Of particular significance is the fact that the structure of the hexamethylbenzene layers is identical to within fractions of an angstrom unit with that of a single layer in the crystal of hexamethylbenzene itself.

A more detailed account of this work will be published elsewhere.

H. M. POWELL.
G. HUSE.

Department of Mineralogy,
University Museum,
Oxford.
May 27.

---

[1] Hertel and Römer, *Z. phys. Chem.*, B, 11, 77 (1930); Hertel and Bergk, *Z. phys. Chem.*, B, 33, 319 (1936).

[2] Briegleb, *Z. phys. Chem.*, B, 26, 63 (1934); 31, 58 (1935). Briegleb and Kambeitz, *Z. phys. Chem.*, B, 32, 305 (1936).

Classical Dynamics of the Meson

THE interaction energy between two nuclear particles in the case of interaction transfer by single Bose particles, that is, $g^2 e^{-K_0 r}/r$, can be obtained either by identifying it classically with the Green's function of, for example, $\Delta\varphi - K_0{}^2\varphi = 0$ $(K_0 = mc/h)$ for the field of mesons transferring the interaction, or by a computation on the lines of quantum electrodynamics. The latter method leads to the same result, because the quantum-mechanical expression for interaction,

$$g^2 \frac{\varphi(\vec{r_1})\ \varphi(\vec{r_2})}{S},$$

where $\varphi(\vec{r_1})$ is potential acting on the first particle, and S is the operator of the Schrödinger equation describing the interacting particles, reproduces the bilinear Fourier expansion of Green's function (Mercer's expansion), just as in the electrostatic case[1].

There is another classical way of arriving at the Coulomb formula, when one starts, namely, not from the Laplace equation, but from $\Delta\varphi - \ddot{\varphi}/c^2 = 0$. The solution of the wave equation in functions of the four-dimensional distance $R = \sqrt{r^2 + x_4^2}$ is $\varphi = 1/R^2$, which not only leads to the r^{-1} law, upon integration over x_4, but also yields in the known manner retarded potentials, etc.

It may be of interest to get the similar fundamental invariant solution for the case of Proca equations. The solution of the equation $\Delta\varphi - \ddot{\varphi}/c^2 - K_0^2\varphi = 0$ is found to be

$$\varphi = \frac{K_0}{2} \frac{H_1^1(iK_0R)}{R},$$

where H_1^1 denotes Hankel's function of the first kind and of the first order; this special solution has the right limit at $K_0 = 0$. Upon integrating this solution over the time (x_4) in the static case where r is a constant, for the point heavy 'charge' g, we obtain the required expression, e^{-K_0r}/r.

This method of reasoning not only gives a new deduction of the Proca-Yukawa potential but can be used also for investigation of other special cases of classical 'mesodynamics', such as the analogue of retarded potentials, rate of emission of mesons by heavy particles, etc.

The most important problem is the construction of a classical model of the heavy mass by means of a mesonic field in the same manner as the electronic mass is built up from an electromagnetic field. We may mention here only three possible lines of attack on this problem: (1) the rough method of introduction of a radius d of the heavy particle. We get easily the following expressions for the self-energy of a heavy particle in the cases of a surface and a volume[2] 'charged' heavy mass respectively:

$$E_s = \frac{1}{2} g^2 \left(\frac{1}{d} + K_0\right) e^{-2K_0d};$$

$$E_v = \frac{9}{4} \frac{g^2}{d^6K_0^2} \left\{\frac{2}{3}d^3 - \frac{1}{K_0}\left(d^2 - \frac{1}{K_0^2}\right) - \frac{1}{K_0}\left(d + \frac{1}{K_0}\right)^2 e^{-2K_0d}\right\}.$$

The empirical value $d \sim 10^{-13}$ cm. gives too small an energy or heavy b mass. (2) Dirac's method of direct omission of infinite terms in the expression for the electronic mass can be applied also in our case of heavy mass and mesonic field. Clearly, the non-electromagnetic and non-mesonic fields respectively must be introduced here in some manner, as it is impossible to obtain the equations of motion from linear Maxwell and Proca equations. (3) The last mentioned extra-field playing the part of Poincaré's pressure can be associated with the non-linearities of the field. Following the Born-Infeld theory, say, as the most elaborated non-linear scheme, we can construct non-linear generalizations of Proca equations, which seem to be particularly appropriate in the case of neutral mesons.

We shall discuss in *Journal of Physics*[3] the bear of this non-linear limitation of quantum mecha on cosmic ray phenomena, as well as other det of the above considerations.

D. IWANENKO

State University,
Sverdlovsk, U.S.S.R.

---

[1] Iwanenko, D., *Sov. Phys.*, 13, 172 (1938).

[2] Cf. Iwanenko, D., *C.R. Acad. Sci. U.S.S.R.*, 21, 33 (1938).

[3] A new journal of the Academy of Sciences, Moscow.

A Pure Strain of *Trichomonas eberthi* in Tissue Cult

IN May 1937 we found in an explantate fron spontaneous leukæmia tumour in a fowl numer specimens of *Trichomonas eberthi*. Since then have maintained the strain continuously on colon of chicken fibroblasts. About 180 passages he been made up to the present time.

The flagellates are being cultured together wi chicken fibroblast in hanging drop cultures accordi to the standard tissue culture technique of Carr For the culture medium, we used chicken plas and chicken embryonic extract in 10 per cent dilutio As a rule the passages are made every third da To every passage a piece of an embryo chick's hea or a piece of a pure fibroblast culture is added as substitute for the cells which are gradually destroye

T. eberthi multiplies intensively among the fibr blasts and in the immediate neighbourhood of t tissue. They slowly liquefy the plasma coagulu while spreading towards the periphery. After period of forty-eight hours, the culture is pervad and surrounded by a dense mass of active flagellat

The presence of living cells is essential for t permanent culture of this species in the plasm embryonal coagulum. Several attempts were ma to culture *T. eberthi* in the same medium in t presence of cells which had been previously kill by X-rays or heat, but all of them failed and t flagellates died out in the second passage. On t other hand, when *T. eberthi* was cultivated in dilut embryonic extract alone, rich cultures were obtaine up to the twelfth passage during forty-five days.

E. TENENBAUM.

Department of Experimental Pathology
(Cancer Laboratories) and
Department of Parasitology,
Hebrew University,
Jerusalem.
May 5.

"Introduction to Modern Genetics"

WE are surprised at the review of Waddington' "Introduction to Modern Genetics" by Dr. F. W Sansome in NATURE of June 17, p. 1002. We a at a loss to know what the reviewer means when h says that Waddington's book does not "contain balanced statement of modern genetics". It appea to us to be much the most satisfactory book on th subject written in recent years. Doubtless the scop could have been enlarged (for example, the treatment of adaptation and the mechanisms of speciatio seems in places inadequate), and equally doubtless book written ten years hence would adopt a differen balance of subjects. Meanwhile, however, the mos conspicuous feature of recent advance in genetics ha the laying of a firm cytological foundation, and ur opinion it is important that this should be y presented at the outset in any text-book. iological genetics has not yet reached the point which simple general principles have emerged; even so, Waddington's treatment of it appears e the best available in any general text-book.

n the interests of genetics and of biology as a le, we hope that Waddington's book will be ely used both as a general account for teachers research workers and as a text-book for advanced dents.

J. B. S. Haldane.
J. S. Huxley.
H. J. Muller.

---

r. Waddington's book was reviewed as an troduction to Modern Genetics". The writers of above letter would seem to agree with me in not ommending it as an introductory book, but her as a book for teachers, research workers and vanced students.

If we consider the book not as an introduction but as a presentation of modern genetics, I still consider that the book stresses the cytological approach to the problem at the expense of formal genetics. While fully aware of the importance of establishing the relationship between chromosomes and genes, I think this might have been made clear in less space than that allotted (one half to one third of the book). The space so saved could have been used with advantage in providing more experimental and biological data (little of which are given) and some idea of the methods used and difficulties encountered in obtaining them. If phenomena such as gametic and zygotic viability and genetical and biological evidence had been more fully referred to, I feel sure that the book would be more sympathetically received by the general biologist.

The cytological approach is, as stated in my review, well presented and probably the book will be most used by advanced geneticists who require information on modern cytological theories.

F. W. Sansome.

June 28.

Points from Foregoing Letters

A. C. Chibnall, M. W. Rees, G. R. Tristram, E. F. illiams and E. Boyland are unable to substantiate e recent claim of Kogl and Erxleben that the tamic acid given on acid hydrolysis by the protein malignant tissues is partially racemized. The oducts isolated by the former workers from Crocker rcoma and from two human carcinomas had the rmal specific rotation of + 31·6° in 9 per cent drochloric acid.

L. Hahn and G. Hevesy state that a minor part of e phosphatide molecules present in the corpuscles changes readily with those present in the plasma; large part of the phosphatide molecules present in e corpuscles is not replaced during the lifetime of e corpuscles.

According to experiments by M. Hoffer and T. eichstein, a purified ether extract from liver, the only tive constituent of which was probably pantothenic id, produced a small increase of growth in rats fed a diet free from filtrate factor. Nearly the same ffect could be produced by β-alanine.

Experiments with rats carried out by a group of vestigators from the Lister Institute and from the niversity of Manchester indicate that the rat requires t least six different factors contained in the vitamin B omplex: aneurin, riboflavin, vitamin B_6 and three rther substances at present unidentified.

I. Banga, S. Ochoa and R. A. Peters report on rther results of their analysis of the pyruvate oxidaion system in brain. Cocarboxylase, fumarate, organic phosphate, adenylic acid and cozymase are omponents of the system. A cycle of phosphorylation ppears to be involved in the oxidation of pyruvate eyond the stage of oxidative decarboxylation.

Excessive bile production occurs in mice grafted ntraperitoneally with a sarcoma, which bile, hen utilized in filtration experiments, has been ound by Mrs. L. Dorothy Parsons to promote tumour production. Of the sarcomas obtained, two were produced by cell-free materials.

T. Astrup finds that the blood-clotting enzyme thrombin is not formed by an autocatalytic reaction in the usual sense, since thrombokinase has to be added in order to form new amounts of thrombin.

The isolation of oestrone from the adrenal gland by D. Beall adds another compound to the long list of steroids isolated from this organ. This is the third tissue from which oestrone has been obtained, it having been isolated previously from sow ovaries and human placenta by Doisy and his co-workers in the United States.

Peter Ladewig describes how small amounts of protein fractions can be precipitated directly by dry powdered neutral salts.

Dorothy Wrinch points out that the molecule of the tuberculin protein TBU-bovine, which is homogeneous in sedimentation, diffusion and electrophoresis, has a molecular weight of 10,000, of the right magnitude to correspond to a single C_1 cage structure.

H. M. Powell and G. Huse state that in the molecular compound of picryl chloride and hexamethylbenzene the component molecules are arranged in parallel layers. The hexamethylbenzene layer is almost identical with a single layer in the structure of the hydrocarbon itself, but there is partial disorder in the picryl chloride layer.

It is suggested by D. Iwanenko that a classical theory of the mesonic field may be useful for purposes such as the construction of various potentials or the discussion of the nature of heavy mass.

E. Tenenbaum states that he has been able to grow the flagellate *Trichomonas eberthi* in hanging-drop cultures of chicken fibroblasts, using chicken plasma and chicken embryonic extract in 10 per cent dilution as culture medium.

RESEARCH ITEMS

Family Life of Rajputs

IN the foot-hills of the Himalayas north-east of Dehra Dun is the Doon district occupied by Rajputs who came from farther south in comparatively recent times. Dr. D. N. Majumdar (*Calcutta Review*, March 1939) has given an account of the family life of these people, who are tall and fair with long heads, leptorrhine noses, hazel or blue eyes, curly hair and jovial disposition. They have maintained the purity of their Indo-Aryan descent although surrounded by the Mongoloid Gharwalis and other hill tribes. They build substantial timber houses of three or four stories against the severe winters and have small terraced farms with cattle and sheep. Like the Todas and Kotas and the Tibetans, they are polyandrous, several brothers having one or more wives in common under the same roof. The eldest born child is conventionally fathered upon the eldest brother, the next child on the second, and so on. In case of partition the eldest brother receives the largest share of the property. In a village investigated, the number of married males was four times that of the married females. The number of children is low, four or five brothers between them having only three or four children, and there is a preponderance of male children. The number of barren women is high, divorce of the wife is frequent and is followed by remarriage. A woman who has produced children fetches a much higher bride-price than one who has not. This fraternal polyandry they believe is derived from their Aryan ancestors, the Pandaras, but Dr. Majumdar gives reasons for thinking that it has been borrowed from other sources more recently. He also agrees with Westermarck that there are other causes of polyandry besides a paucity of women.

Morphological Characters of Bacteria and Viruses

IN his presidential address delivered to the Royal Microscopical Society last January, entitled "Towards the Smallest Living Things", J. E. Barnard contrasts the morphological similarities and differences that occur in micro-organisms of regularly decreasing size (*J. Roy. Micro. Soc.*, 59, 1; 1939). As the smaller objects are beyond the limit of visual microscopic resolution, the contrasts have been made by means of ultra-violet photomicrographs taken with a wave-length of 2750 A., some by transmitted light, others by dark-ground illumination. From a study of these microscopical images, Mr. Barnard concludes that some at least of the filterable viruses are similar to some of the recognized bacteria. No viruses appear to be exactly similar to ordinary bacilli, but the resemblance of some viruses to cocci is much closer. Thus, ectromelia and vaccinia viruses are essentially coccoid in form. There is, however, a change with influenza and herpes viruses, which are types of virus growing in dense opaque masses, and the individual particles or units of which these are made up are very difficult to identify, as their size is very small, being less than 50 μμ. It is therefore suggested that below some size, to which a precise value cannot yet be assigned, there is a change in constitution—not so much an alteration in form as a change in behaviour. These animal viruses may at th stage bear a closer resemblance to the plant virus which recent work suggests are chemical in natu

Mutant Body Colours in a Parasitic Wasp

ANNA R. WHITING has recently described h investigations into this subject and with reference the species *Habrobracon juglandis* (*Proc. Amer. Ph Soc.*, 80, No. 1; January 1939). It appears that wil type individuals vary in colour from honey-yell to almost black. This wide range of colour variati is confusing to the taxonomist, who is prone to l much stress upon colour in diagnosing species. Ter perature is of prime influence in connexion wi coloration, the higher temperatures producing mo yellow and the lower temperatures more blac Heredity also plays some part in the process, for t reason that some races may differ consistently their coloration when subjected only to a consta temperature. In the type known as honey-yellow exception is found to the rule that more black deposited under low temperatures. The various fac are discussed in the light of Wright's theory of pi ment formation in mammalian hair. It was four that this theory fits the facts observed in *Habrobrac* so well that, using it as a basis, the appearance double and triple recessives was predicted with con siderable accuracy before they were actually obtaine The various types referred to are well figured in th accompanying nine coloured plates.

Tobacco Necrosis Virus

N. W. Pirie, K. M. Smith, E. T. C. Spooner an W. D. McClement (*Parasitology*, 30, 543; 193 isolated two nucleo-proteins with similar chemic composition from the leaves of tobacco plants ir fected with tobacco necrosis virus (*Nicotiana* virus II One of them was crystalline and had a sedimentatio constant of 130×10^{-13}, the other was amorphou and its principal component had a sedimentatio constant of 58×10^{-13}. Each preparation infecte plants at a dilution of 1 in 10^{6} and precipitate specifically with serum at a dilution of 1 in $3 \cdot 2 \times 10$ The nature of the difference between preparation in the two states is obscure, and it has not bee possible to convert one into the other.

Vacuolar Stain in Fungal Hyphæ

S. R. BOSE, of the Carmichael Medical College 1 Belgachia Road, Calcutta, has found a very fain pinkish stain in the vacuoles of very young hyphe not only of *Polypores* but also of diverse groups o fungi like *Mucor*, *Rhizopus*, yeast, *Penicillium Ascoidea*, *Aspergillus*, *Fusarium*, *Cladosporium*, *Beau veria*, etc. (*Curr. Sci.*, 8, No. 4, April 1939). It doe not agree with the tests of anthocyanin as found i higher plants. The nature of the pigment remain unknown. Evidently the stain has some connexio with the metabolic stage of the fungus, for it has bee found only in actively growing hyphæ and becomin scarce in very old hyphæ and older cultures. Prof Bose will be glad to have the experience of othe workers on the point.

Chromosome Structure

R. RUGGLES GATES has published a valuable review of chromosome structure accompanied by a bibliography to recent work (*J. Roy. Micro. Soc.*, 58; 1938). There is considerable evidence that appearances which have previously been described as chromomeres may in many cases be an optical effect due to spiral coiling of chromonemata. Whether all cases of chromomeres will finally be interpreted in this way is doubtful. Direct observation also seems to show that the chromonemata are at least double in anaphase and telophase, quadruple in metaphase. The light thrown upon such problems by X-ray treatments are at variance and of doubtful reliability until more is known of the exact effects produced in this way. A relatively new line, possibly of considerable value in genetics and analysis of species, is the recognition of the universality of satellited chromosomes and their relation to nucleoli. The probable fact that a primary diploid usually has two *SAT*-chromosomes, opens possibilities of recognizing the presence of polyploidy by more than two nucleoli at telophase, the number of bivalents attached to the nucleolus at zygotene to diakinesis and the presence of secondary pairing.

Attachment for a Milne-Shaw Seismograph

AN ingenious and interesting addition to a Milne-Shaw seismograph has been fitted by J. H. Peters at the Observatory of the University of Hawaii in Honolulu (*Bull. Seis. Soc. Amer.*, 29, No. 2, 341–343; April 1939). The need for a strong motion instrument was particularly felt on the occasion of the Hawaiian earthquake of January 22, 1938, which disconnected the recording mirror, but as such instruments were not immediately available, additions to the existing equipment were made on the spot at very little cost. The instruments originally had $T = 12$ sec., $V = 150$ sec. and $\varepsilon = 20:1$, recording photographic, and paper speed 15 mm./min. This was constituted for teleseismic work, which is the main need as strong local shocks are rare, but should local shocks occur the magnification was too great for photographic recording of high accelerations, and the paper speed too slow for recording the short periods. Recording mirrors have now been fixed to the top of a 2-inch long aluminium stem secured to the boom less than one half inch from the point of rotation and practically at the centre of the column. Lamps and auxiliary recorders have been placed at right angles to the boom line at a distance of about 23 inches from the mirrors to give a satisfactory magnification. The new recording works independently and in addition to the old recording which has been maintained, and the new would continue to function should the original be disconnected by a strong local shock. The new attachment is not constantly recording but is switched automatically into operation as soon as a local shock occurs which is strong enough to actuate the control. The new device should form a very valuable addition to the observatory's equipment.

Earthquakes registered during February 1939

ACCORDING to E. Peterschmitt (*Bull. Bur. central séismol. Strasbourg*) there were 174 earthquakes registered by seismographs throughout the world during February. The largest number in one day was fourteen on February 2, and there was only one day on which none was registered, namely, February 22. Some of these were recorded by only one station, several were registered by about six stations and nine were of such magnitude that it was possible to determine the epicentre, depth of focus and initial time accurately. These were: February 2, epicentre south-east of Tripoli, February 3, epicentre near Solomon Islands, February 5, Venezia Giulia and Dalmatia (Italy), February 6, a repetition of February 5. February 9, near Central America, February 11 near Mugello (Italy), February 16, north Japan, February 17, Struma Valley, south Bulgaria, and February 24, south Alaska.

Double Oxy-chlorides of Rhenium

WHEREAS very little is yet known concerning the chemistry of masurium (element 43 and Mendeléeff's eka-manganese) many compounds of rhenium (element 75, dwi-manganese) have been described. The latest are some oxy- and hydroxy-chlorides obtained by Jezowska and Iodko (*Roczniki Chemji*, 19, 187; 1939) by reduction of per-rhenic acid with hydrogen iodide. These investigators state that reduction proceeds to quadrivalent rhenium at room temperature without the presence of excess of hydrochloric acid. Among the compounds isolated are ammonium, potassium and rubidium salts having the general formula $X_2[Re(OH)Cl_5]$. These hydroxy-chlorides are easily converted into oxy-chlorides of composition corresponding with the formula $X_4[Re_2OCl_{10}]$, whilst with excess of concentrated hydrochloric acid and at elevated temperatures the normal rhenichlorides, X_2ReCl_6, are formed. A quinoline oxy-chloride was prepared in addition to the alkali salts mentioned above. Since the same reactants can give rise to several different products, some difficulty was experienced in isolating these oxy- and hydroxy-salts in a pure state, a careful control of conditions being essential.

Fission of Rotating Bodies

LIEUT.-COL. K. E. EDGEWORTH has criticized (*Mon. Not. Roy. Astro. Soc.*, 99, 3; January 1939) some of Dr. R. A. Lyttleton's views (in particular those which appeared in *Mon. Not. Roy. Astro. Soc.*, 98, 8; 1938) regarding the fission of rotating bodies. Lyttleton believes that binaries did not originate by fission, as it seems probable that the smaller body would escape altogether from the larger, rotational energy being sufficient in certain conditions to drive the bodies apart from each other's influence. Edgeworth points out that such a process would involve repulsive forces for a time, such forces exceeding the force of gravity, but there is no known mechanism by which such forces could be produced. He discusses the theory that fission might lead to the production of a satellite and admits the possibility of a small portion of the detached material escaping the disintegrating effects of the Roche limit and so forming the nucleus of a satellite. The disintegrated material inside the Roche limit would gain angular momentum owing to the ellipsoidal shape of the larger mass, and for this reason would be driven outward and probably absorbed by the nucleus of the satellite, assuming that such a nucleus existed. Contrary to Lyttleton's view, Edgeworth thinks that the final stage to which a rotating body would attain would be two separate bodies revolving about each other in nearly circular orbits, but still subject to mutual interference in the form of tidal friction.

ROTHAMSTED EXPERIMENTAL STATION

ANNUAL FIELD DAY

ON June 28, the annual field day and inspection of the laboratories was held at Rothamsted, Lord Radnor, chairman of the Lawes Agricultural Trust Committee, presiding. There was a large attendance representing agriculture and the allied industries. Sir E. Kaye le Fleming, chairman of the Council of the British Medical Association, was the chief guest. His presence was a welcome sign that medical men are deeply concerned with matters of human nutrition, and recognize that a prosperous agriculture based on a fertile soil is essential for the supply of home-grown 'protective foods' on which the well-being of our town population depends. This common ground between medicine and agriculture had been thoroughly explored two months previously in a national conference organized by the British Medical Association in which nutritional experts and agricultural scientists took part (see NATURE, of May 6, p. 745); the proceedings at Rothamsted showed that both sides desire this co-operation to continue and develop. The main position, as Sir Kaye pointed out, is clear; doctors are agreed that a high proportion of the population do not enjoy a diet sufficient for the highest physical well-being, and nothing but good could come from a determined attack on this problem. From the medical side, the framer of agricultural policy needs definite information as to the kinds and qualities of food stuffs required to build up an adequate diet, and this information is apparently now available. It is for the agriculturist to show how commodities of he necessary standard may be produced with conomy of effort and the maintenance of the land.

In his survey of the activities of the Station, Sir ohn Russell mentioned that some work had already een carried out in the Dunn Nutritional Laboratories t Cambridge on certain aspects of the vitamin ontent of the produce of the Rothamsted plots. ut so far there has been no confirmation of the ew frequently expressed that the nutritive value produce grown with organic manure is superior to at grown with artificial fertilizers. The produce of e classical fields should provide excellent material settling points such as these.

An increasing amount of experimental work at thamsted is concerned with the action and value rganic manures. Studies are in progress with straw ts many forms, with turf obtained by the ploughing of grassland, with green manures, and with town se. An extensive investigation of poultry manure been completed, and work on wastes and sewage dge is in prospect. So far, yield determinations e been the chief measurements; but the much e difficult questions of quality and nutritional e can scarcely be ignored.

he tour of the farm, always an important part e proceedings, affords an unrivalled combination e oldest and the newest in field experimentation. dbalk, carrying an excellent crop of wheat this showed the striking effects of the manurial ments begun by Lawes and Gilbert ninety-six ago and continued ever since, the plots gaining rather than losing interest from the periodical bare fallows recently superimposed upon them. The field is much studied now, not simply as a demonstration of manurial principles, but as a guide to the practical problems of corn growing under semi-continuous conditions. Many wheat growers would be quite satisfied with crops as thick and healthy as Broadbalk has recently carried, for the foot-rot diseases, so troublesome when wheat is grown too frequently on the lighter soils, are seldom serious on the clay loam of the classical field. The continuous barley on the adjoining Hoosfield tells the same general story as Broadbalk, with important differences that are readily visible; the barley, for example, is more sensitive to phosphate deficiency than the wheat but less affected by potash starvation.

Passing on to the modern experiments, the visitors inspected several of the new designs set out to measure fertilizer effects on a sequence of crops. These are necessarily more complex than experiments lasting for a single year only, since special provision must be made to take account of the seasonal factor. One of the modern experiments dealing with alternative systems of cropping newly ploughed up grassland, aroused much interest. A series of excellent crops were on view on land that was in good turf so late as February of this year. Fertilizer effects were also on test, as well as several soil insecticide treatments against wireworm. In view of the official encouragement now being given to the breaking up of grassland, this type of experiment is of the greatest importance.

An indoor programme followed. Investigations in the laboratories link up with the farm work in many directions. Thus 'take-all', one of the foot-rot diseases of cereals, is intensively studied in the Plant Pathology Department, where many of the conditions of the survival of the fungus in the soil have been worked out, and control methods are being developed. In the Entomological Department a technique for measuring the wireworm population of the soil has been perfected and used to assess the value of the various soil insecticides tested in the plots. Various methods put forward for predicting the manurial requirements of soils on the basis of their chemical analyses are being examined in the Chemical Department. A wider range of soils than the Rothamsted Farm can provide is necessary for this work, and in recent years an increasing number of outside centres have been established, each providing the results of a precise and comprehensive fertilizer test and the corresponding sample of soil for laboratory examination.

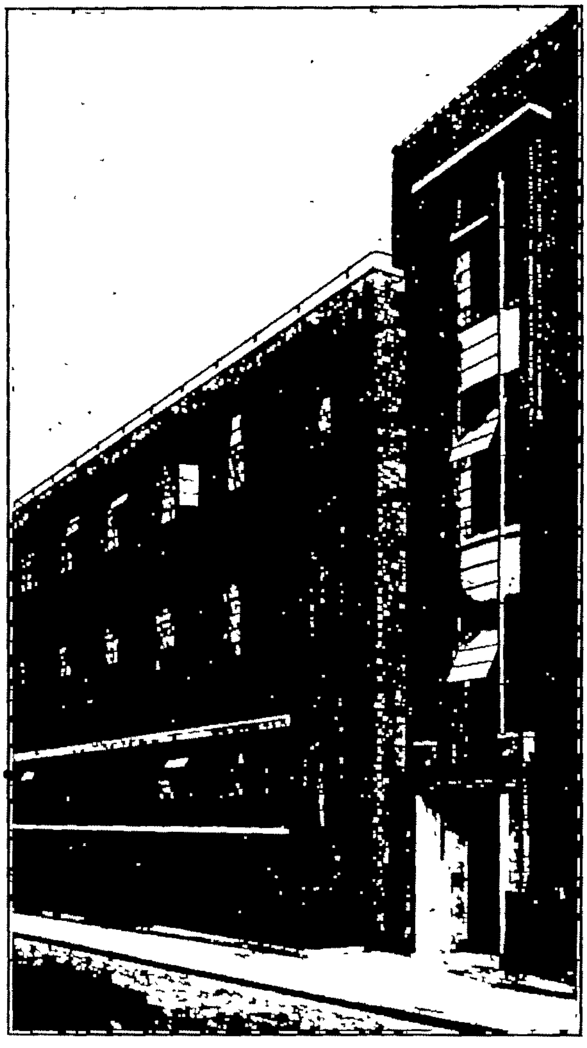
The Rothamsted Centenary is due in 1943 and the Committee proposes to celebrate it by putting the laboratories, farm buildings and other equipment into complete order for the work that awaits them. The Director announced the present position of the Appeal Fund, and said that although good progress has been made in very difficult times, £7,000 is required to complete the first part of the scheme costing £60,000.

BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION

By Dr. H. Moore, C.B.E.

SOME idea of the importance of the non-ferrous metals may be gained from the value of the world's annual production which, if gold is excluded, is not less than £250,000,000. Another illustration is provided by the dependence of the electrical industry on copper and of aircraft production on aluminium and magnesium. The many uses of lead, nickel, tin and zinc are familiar, and the application of three of these four metals as protective coatings for steel illustrates the resistance to corrosion of non-ferrous metals. The British Non-Ferrous Metals Research Association thus has a wide field for its work. It is among the larger of the research associations formed soon after the Great War as part of the Government's policy of stimulating scientific research applied to industrial progress, and about one third of the Association's annual expenditure of more than £30,000 on research and related activities is still provided by Government grant.

The Association's investigations were at first carried out at the National Physical Laboratory and at metallurgical research laboratories elsewhere, but the proportion of extra-mural work has diminished with the growth of the Association's own scientific staff, and two years ago a scheme for the erection of a modern building, near Euston Station, was adopted. The Association owns a freehold site of 13,000 square feet, of which one third is held for future extension. In the choice of location, accessibility was held to outweigh the advantage of the lower cost of suburban land, and the situation is convenient for the many members in the Midlands who use the northern London terminal railway stations. The number of member companies is not far short of three hundred and includes most of the producers and manufacturers of non-ferrous metals and their products in Great Britain, and also many large users.



New Laboratories of the British Non-Ferrous Metals Research Association

The laboratories, which accommodate a total staff of about seventy, comprise the older four-story building, formerly rented, the adjacent new block of about the same shape and size, and, in the space between, a glass-roofed melting shop. The total working floor space is about 20,000 sq. ft.

The new building, designed by Mr. J. R. Smith of Messrs. Munby and Smith, is a four-story steel-framed structure with brick panel walls. It has a 90 ft. frontage in Euston Street and is 32 ft. in width.

The extensive use of non-ferrous metals exemplifies their advantages in modern building. The heating installation, electrical conduits, hot- and cold-water supplies to laboratories, soil and waste plumbing and principal rain pipes and hoppers are all in copper; the water supplies to laboratories in *BNF* ternary lead alloy No. 2; while nickel silver, bronze and anodized aluminium are used for door furniture, water-fittings, etc.

The arrangement of service pipes and conduits has been designed with particular regard for economy in space, clean unencumbered ceiling, wall, and floor surfaces and accessibility. Each laboratory is fed from ducts running vertically, in the window piers, the full height of the building. Ample provision has been made for A.C. and D.C. electricity supply for power, furnaces and light. Heating is by low-pressure hot water on the 'invisible panel' system and is thermostatically controlled.

One main section of work deals with the influence of melting and casting conditions on the freedom of castings and ingots from cavities, caused by gas evolution or by shrinkage, and from segregation and other troubles. The Association's de-gassing process for aluminium alloys is widely used in manufacture, and the problem of soundness in castings is now being tackled for the tin bronzes and the nickel silvers. Segregation and shrinkage are being investigated in aluminium alloys in the first instance. The facilities of the melting shop providing for work on these subjects include coke fired, gas fired and electric resistance (silit rods) crucible furnaces melting 100–120 lb. copper and a high-frequency furnace. There is also a large electric resistance annealing furnace.

The mechanical testing laboratory occupies the lowest floor of the new building. The constant-temperature room (480 sq. ft.) at one end is thermostatically maintained at 20° C. ± 0·3° C. by circulation of air, heated or cooled according to the outside temperature, and is equipped for creep tests. The very complete spectrographic equipment employed in the Association's work on quantitative spectographic analysis of metals and alloys is housed in the large physics laboratory, the other equipment of which includes that designed by the Association's staff for the determination of thermal conductivity and of optical reflectivity. Good provision is made, in other rooms, for the preparation, examination and photography of metallographic specimens, for pyrometry and heat treatment, and for chemical analytical work.

The top floor of the older building is devoted to corrosion research, a subject in which the Association's work tends always to increase. Condenser tubes, on which work has proceeded for so many years, have ceased to be a corrosion problem fo ordinary conditions of service because of the genera use of tubes made of the Association's aluminium bras or other highly resistant alloys developed by maker but the more severe corrosive conditions sometime encountered—bacterial action playing a part no infrequently—are the reason for work designed t produce tubes still more resistant. Other corrosio investigations are concerned with lead, copper, zin and galvanized material, and at least five hundre corrosion tests are in progress at the present time The older building also contains the machine sho and galvanizing and welding laboratories, while one floor, occupied by the Development Department, includes an exhibition illustrating the practical results of the Association's researches.

The Association's annual lunch on June 29 was made the occasion for celebrating the completion of the new laboratories, and the large company assembled then proceeded to Euston Street where the building was formally opened by the President of the Board of Trade. Mr. Oliver Stanley also unveiled a memorial to the Association's chairman from 1920 to 1937, the late Mr. Thomas Bolton, to whose leadership the success of the Association has been due in no small measure. The memorial is a cast bronze portrait plaque, fixed on the wall of the entrance hall of the new building.

ASSOCIATION OF TECHNICAL INSTITUTIONS

AT the recent summer meeting of the Association of Technical Institutions, held at Harrogate, papers read included "The Present Position of Technical Education in the West Riding" (by Mr. A. L. Binns, director of education for the West Riding of Yorkshire), "Whither Technical Education?" (by Dr. T. J. Drakeley, principal of the Northern Polytechnic, London), and "Technical and Vocational Education in the U.S.A." (by Mr. G. A. Robinson, principal of the South-East London Technical Institute).

Mr. Binns said the organization of technical education in the West Riding was on a regional basis, he machinery for which is provided by the York-hire Council for Further Education, which is repre-entative of all the authorities for higher education n the area. The scheme, Mr. Binns pointed out, is typical English solution of a problem which might sewhere have been solved by more autocratic ethods. "It aims at combining the advantages of se local interest and initiative with those of a mmon policy over a wide area, and it hopes to cure these advantages by cordial co-operation ong free and independent statutory bodies rather an by a policy of subordination or absorption." ementary technical instruction is provided as close possible to the homes of the students, while the re advanced work is concentrated progressively centres where traffic routes converge. In connexion h the advanced work, financial arrangements ve been made which leave the students free to end the institution they prefer, whether it is hin or without the boundary of a county borough. short, the Yorkshire Council for Further Education works to harmonize the relations between the different local authorities and the industries within the region.

Dr. Drakeley referred, during his paper, to the report on Policy in Technical Education which had been published by the associations dealing with technical education and the National Society of Art Masters. He argued for certain recommendations which he hoped would promote discussion along definite lines and secure, in the words of the above report, that the latter shall produce "not only skilled scientists, technicians and designers, but also persons adaptable to continuous industrial and economic change".

The main point put forward by Dr. Drakeley was that technical education should concern itself immediately with the training of a skilled rank and file for industry and commerce. The training provided in the schools should involve a high degree of craftsmanship, together with a good educational standard. He recommended also, however, that provision should be retained for vertical advancement by the development, where necessary, of senior day technical or trade courses from the age of 16 plus to about 19 plus, such training to lead to the more responsible posts in industry. Speaking of national defence schemes, Dr. Drakeley urged that a fraction of any expenditure on Government or industrial schemes should be set apart for the purpose of training necessary personnel. He also argued that in the development of all technical courses, especially those designed for the training of skilled workers, the active co-operation of employers' and employees' organizations should be obtained.

Mr. G. A. Robinson's paper summarized the formation he had obtained during two visits to the nited States. His first visit was made as Page holar, when he was able to go to certain universities ith faculties of engineering and to examine their partments of industrial administration, in addi- on to ascertaining the progress made by summer hools (technical education) of the Oxford type. On at occasion he visited a few trade and vocational hools, but his main objectives did not lie in that ld. During his second visit, in 1938, he had three jectives, namely, to attend summer schools for cational and other teachers; to attend the Seventh International Congress on Scientific Management, and to renew the technical contacts he had made in 1936. His paper included his comments on universities and institutes, evening instruction, vocational education, industrial economics, apprenticeship, management education and production training. In his conclusion, he suggested that, in vocational education, Great Britain has much to learn from America, "especially under proposed changes in our secondary school system"; in technical education, however, he thinks that America has equally as much to learn from Great Britain in work of the national certificate type and in high-grade craft technology.

CONGRESS OF THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES, 1939

THE first Congress of the South-Eastern Union of Scientific Societies held at St. Albans in 1911 howed that the effect of Queen Victoria's raising the wn to the dignity of a city and appointing a bishop d not only resulted in the late Viscount Grimston storing the Abbey of the Benedictine monastery, ected over the Saxon shrine of the first Christian artyr, to the form it took under its abbots; but also irected attention to the excavation of the sites of he three older cities of Verulamium under the perintendence of Dr. and the late Mrs. Mortimer heeler. The second Congress, held this year, during une 6–10, marked a second stage and showed the terest and pride which the present-day citizens, ith their enlarged boundaries and modern buildings, ke in their long history. The Corporation has built fine museum specially to house the Verulamium nds which were arranged by Mr. Philip Corder, the rator, and both he and Dr. Mortimer Wheeler were n the spot to explain and interpret the finds. A isit to the excavated amphitheatre, adapted by the omans as a Greek theatre, is unique in Great ritain, and serves to emphasize the fact that it was he only town given the status of "Municipium", hus making its inhabitants citizens of Rome and erulamium the capital of England, with London erely its port twenty miles away.

The restoration of the Abbey for conversion into cathedral meant the removal of the grammar school, oused in one of the aisles of its very long nave, to site inside the old Abbey Gate, and the modern uildings with a fine school hall and lecture theatre, ogether with the Abbey Institute rooms, served well or the Congress sessions and lectures. As in 1911, he old Town Hall was made available for the recep- ion of members, and here the Mayor (Councillor T. F. Elm) and local patrons welcomed the Congress and heard the presidential address given by Mr. James G. Mann, keeper of the Wallace Collection and now Master of the Armouries at the Tower of London. His subject was "The Changing Conditions in the Study of Art and Antiquity", and dealt mostly with he growth of museums during the last century, pointing out that it was almost entirely due to the nthusiasm of amateur collectors; now there is a isk in paid officials labelling and arranging their pecimens and pictures for the education of students —even classes of school children unable to appreciate artistic treasures—and the true amateur is driven to collect unwanted 'bygones' hitherto neglected by professional curators. Mr. Mann made a plea for retaining works of art in their original setting, and for dispersing to local museums representative specimens, either permanently or by rotation in loan collections, to improve provincial taste, and specializing the general museums even in the metropolis, making some allowance for accretion.

The Archæological Section heard an address on the changing fashions in place and personal names by Mr. L. F. Salzman. The origin of many forms of place names were explained and an examination of old nominal lists, such as the poll tax required, showed that in medieval times "Mary Anne's" were rare, partly because Mary seems to have been reserved for important personages and because it was not the custom to give more than one Christian name to a girl. Although St. George has always been considered the patron saint of England, the name "George" is almost absent before the time of the Hanoverian monarch.

The address to the Botanical Section, by Mr. P. M. Hall, was devoted to a discussion of the dozen hybrid wild orchids of Great Britain. The crosses are far more common in temperate than in tropical vegetation but it often requires microscopic examination to determine the origin of a hybrid. Dr. H. G. Thornton spoke on the investigations, undertaken at Rothamsted Experimental Station, on bacteria in the soil, which are fundamental to the science of agriculture.

Mr. D. Seth-Smith, of the Zoological Gardens, addressed the Zoological Section on "Animal Behaviour". He pointed out that animals brought up in captivity, though they lose the fear of man and depend upon him for food, nevertheless retain in reared generations certain wild habits; he said that zebras are liable to panic, lions crouch on sighting a dog, deer attack familiar attendants and birds fight in nuptial display. Dr. C. B. Williams spoke of the results obtained from 800,000 insects collected in light traps of his design at Rothamsted Experimental Station in four years. The unexpected results show that the majority are Diptera and that Coleoptera rarely come to light, that at 35 feet above ground females are twice as numerous as males but not so at ground-level, that twice as many insects come to light on dark cloudy nights as in clear moonlight, and the separation of catches by hours shows the periods in which various species are active and the effect of change of temperature and barometer upon numbers captured.

Mr. C. P. Chatwin devoted his address to the Geological Section to the "Lost Atlantis", taking the view that Africa was the central land mass from which the continents divided as in Wegener's theory. In both the zoological and geological sections papers were read on modern ideas of the theory of evolution, by Mr. Ward Cutler and Dr. Dighton Thomas respectively.

A new departure at this Congress was the formation of a Section for Social Science, following the lead of the British Association, by adapting the Regional Survey Section to embrace scientific subjects not dealt with by existing sections which may be of special interest in different centres to be visited. Mr. Alexander Farquharson, honorary general secretary of the Union, explained the scheme and introduced various speakers: Miss S. Margery Fry on "Juvenile Delinquency"; Miss Hilda Jennings on "Industrial Transference"; Lord Forrester on his Welsh experiment of solving the problem of the "Older Unemployed Man", and in the public evening lecture he also took the chair for Prof. Winifred Cullis's lecture on "Biology and National Fitness".

Another evening lecture was given by Brevet-Col. W. le Hardy, who is engaged by the Corporation of St. Albans to report on the city charters, which are numerous and afford glimpses of the past history of the city and its importance for teaching the arts and crafts; but history from the charters will require supplementing by delving at the Public Records Office to trace out the activities of the abbots who ruled before the Reformation.

No less than twelve excursions were organized by a most efficient local committee convened by Miss Phyllis Gibbs as the Congress Secretary, a post her father had held in 1911. The general excursion was to Rothamsted Experimental Station and was addressed by Sir John Russell. A tour of the Lawes Trust grounds was made and in the Entomological Department an interesting experiment into the habits of bees was in progress. Bees were mark for identification by spots of cellulose paint emergence and their work in the hive watched age groups. It is here that the records collected the Insect Immigration Committee appointed by t Union are analysed, details of which appeared NATURE of January 5, 1935 (p. 9).

It is the practice of other naturalists' unions in Gre Britain to hold single day congresses at the invit tion of a local society to transact business for mutu co-operation, a practice which is now contemplat as supplementary to the five-day annual Congre of the South-Eastern Union, with the view of keepi in touch with centres too small to house represent tives and members from all the societies, whilst st keeping the representative assembly to the last da of the main Congress. This year, at the forty-fourt assembly, the only controversial matter brought u for discussion was connected with finance. As S Richard Gregory remarked to the Council, it is tradition to be proud of that the Union has been ab to maintain its activity for so long without the ai of a single paid official or any sort of endowmen and the economy of its administration is shown b a total expenditure of only £127 last year and the mainly upon printing, of which costs have more tha doubled in the last twenty years. If only a yearl income of £100 was available from an endowmen or some other outside source, the restriction o printing the transactions *in extenso* in the *South Eastern Naturalist and Antiquary* would disappea Increasing subscriptions is no solution, for it woul only mean cutting off the poorer members it is mos desired to help. With such local interest as wa displayed at St. Albans there is no fear of an actua deficit; but that cannot be expected if the nex Congress is held at Cambridge, where local support i sure to be meagre during the long vacation, howeve important the addresses may be and however muc members may enjoy a visit to a university town s suitable in all other respects.

T. D.

THE LOCUST PROBLEM IN 1937

THE latest survey on the locust problem, by Dr. B. P. Uvarov in collaboration with Miss W. Milnthorpe, has recently been published on the recommendation of the Special Committee on Locust Control appointed by the Economic Advisory Council (H.M. Stationery Office, 3*s.* net). It is gratifying to note that the international co-operation for collecting information relative to locusts continues in an efficient manner. The present survey deals with the locust problem in 1937, and it demonstrates once again the importance of keeping continuous watch over developments in the situation.

The desert locust (*Schistocerca gregaria*) did not give rise to swarms during the period of review either in South Africa or in India. On the other hand, the situation in the Sudanese-Arabian area during the winter of 1937–38 gave rise to anxiety. In the early months of 1938, it was reported as breeding in the gregarious phase in several localities along the western coast of the Red Sea. No evidence of actual swarming has been recorded, and this is evidently due to the success of the control measures that were applied. This hopeful event should well justify the establishment of proper organizations for the purpose o watching those areas known to be areas of swarn production. In this connexion it is mentioned tha preliminary arrangements for such organizations o an international basis are progressing very favourably

As regards the African migratory locust (*Locust migratoria migratorioides*), all the eastern part o Africa remained free from this insect during the firs half of the year under survey. Later in the year however, the situation changed. Swarms appeare in West Africa and spread eastwards, with the result that the Anglo-Egyptian Sudan became reinfeste by this species after an interval of two years. Thi invasion does not, however, appear to be an entirel new outbreak and its origin seems to have been in districts of Oubangui-Chari, and farther to the west, where swarm production has been noted fo the last two or three years.

The red locust (*Nomadacris septemfasciata*) has shown a slow decline in its outbreaks. While there was no marked reduction in the area under infestation, in many instances the swarms were smaller and not so dense.

CIENCE NEWS A CENTURY AGO

atistics of Births, Deaths and Marriages

ON July 8, 1839, *The Times* said: "We have eceived the first annual report of the Registrar-eneral of Births, Deaths and Marriages, in England, resented to both Houses of Parliament by command f His Majesty." From the annual abstracts up to une 30, 1838, *The Times* quoted the following gures: Total number of persons married, according o the rates of the established church 107,201; not ccording to the rites of the established church 11,481. Total of births registered 399,712; total umber of deaths registered 335,956. Discussing ne or two features of the returns *The Times* said: A very marked diversity also appears in the proortion of deaths of infants in different parts of the ountry. In the mining districts of Staffordshire and Shropshire, in Leeds and its suburbs, and in Cambridgeshire, Huntingdonshire and the lowest parts of incolnshire, the deaths of infants under one year have been more than 270 out of 1000 deaths at all ages; while in the northern counties of England, in Wiltshire, Dorsetshire and Devonshire, in Herefordshire and Monmouthshire, and in Wales, the deaths at that age, out of 1000 of all ages, scarcely exceeds 180."

Application of Photography to Astronomy

ON July 10, 1839, John Pringle Nichol (1804–59), professor of astronomy in the University of Glasgow, sent a long letter to the editor of the *Scotsman* dealing with the possibilities of applying photography to scientific observations. It had occurred to several individuals, he said, that photography could be used for recording the readings of meteorological instruments, and he proposed to erect one of the recording instruments of Mr. Jordan, of Falmouth, in the grounds of the new observatory at Glasgow. "The probable and universal application of this subject to my own especial subject are not less important than the foregoing. If, as we cannot now doubt, Daguerre's plates are so sensitive, and if as reported, he has succeeded in obtaining a *trail* from the passing light of the moon, that luminary will unquestionably record a picture of herself, capable of undergoing microscopic scrutiny upon a plate so placed as to receive her image through a large and revolving equatorial". He then went on to refer to the possibility of photographing the spots on the sun. "Obtaining the image of the sun through an adjusted equatorial on a roll of prepared paper, moving after definite intervals of time, the ever-changing disc of that luminary would infallibly write down its own history. As soon as my own equatorial is placed, I shall certainly endeavour to realise this idea when circumstances are favourable". In the following year a few "moon-pictures" one inch in diameter were obtained by means of photography by John William Draper (1811–82), professor of chemistry in the University of New York.

A History of British Zoophytes

THE *Athenæum* of July 13, 1839, contained a notice of Dr. G. Johnston's "A History of British Zoophytes". "A work has been long wanted," the *Athenæum* said, "which while it presented a sketch of the probable affinities of the groups composing the entire class, should furnish materials for a determination of the various marine and lacustrine species that inhabit our coasts or inland waters. . . . The author's own views on classification agree, in the main points, with the arrangement proposed by Milne Edwards, but the systems of Cuvier, Müller, Lamoroux, Blainville and others are placed before the reader . . . the most acceptable portion of the work will be the full and clear descriptions of species, and the numerous and beautiful engravings with which the volume is illustrated."

Dr. G. Johnston (1797–1855) was a medical man in Berwick and was the founder and first president of the Berwickshire Naturalists' Club.

UNIVERSITY EVENTS

BIRMINGHAM.—Prof. B. L. Goodlet, professor of electrical engineering in the University of Cape Town, has been appointed to the chair of electrical engineering rendered vacant by the death of Prof. W. Cramp.

The following gifts are announced: £350 per annum for seven years from Messrs. Rubery Owen, Ltd., of Darlaston, for a research fellowship in zoology; £5,000 from Mr. J. R. Hugh Sumner and £150 a year for seven years from the Birmingham Small Arms Co., Ltd., to found a research fellowship in civil engineering.

EDINBURGH.—At a graduation ceremonial on June 30 the honorary degree of Doctor of Laws was conferred on the following, among others: Mr. Harold B. Butler, warden of Nuffield College, Oxford, formerly director of the International Labour Office; Mr. Frank C. Nicholson, librarian to the University of Edinburgh, 1910–1939; Prof. G. N. Watson, professor of pure mathematics, University of Birmingham; Prof. J. C. Webster, formerly professor of obstetrics and gynæcology, Rush Medical College, University of Chicago.

The degree of Doctor of Science was conferred on the following: K. A. Chowdhury, for a thesis entitled "Growth Rings in Indian Trees"; H. P. Donald, for a thesis entitled "Studies on Growth and Variation in Large Animals"; K. Fuchs, for a thesis entitled "On Some Problems of Condensation Quantum Dynamics and the Stability of Nuclei"; F. B. Hutt, for a thesis entitled "Genetical and Physiological Studies of the Domestic Fowl".

LONDON.—The Senate has resolved that, on the occasion of the celebration of Foundation Day, 1939, titles of the degree of D.Sc. *honoris causa* be conferred on Prof. Niels Bohr and Sir Robert Robinson, and the degree of D.Sc. (Economics) *honoris causa* on Mr. R. G. Hawtrey and Mr. Simon Marks.

The title of reader in inorganic chemistry in the University has been conferred on Dr. H. J. Emeléus, in respect of the post held by him at the Imperial College of Science and Technology.

Prof. R. G. Collingwood, Waynflete professor of metaphysical philosophy in the University of Oxford, has been appointed Creighton Lecturer for the year 1939–40.

The degree of D.Sc. has been awarded to Miss Frances M. L. Sheffield (King's College); Mr. P. V. Sukhatme (University College); Mr. W. S. Stiles, an external student.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Assistant Lecturer in Geology—The Registrar, University, Leeds (July 12).

Assistant Lecturer in Zoology—The Registrar, University, Manchester (July 12).

Scientific Officer in the Air Ministry Research Pool—Under-Secretary of State, Air Ministry (S2A/B.8019), Berkeley Square House, W.1 (quoting B.214) (July 14).

Assistant Mistress to teach Biology and General Science at the County High School, Redditch—The Director of Education, County Education Office, County Buildings, Worcester (July 15).

Junior Scientific Officers in the Metrology Department—The Director, National Physical Laboratory, Teddington (July 17).

Teacher in Engineering Subjects at the Mexborough Schofield Technical Institute—The Secretary to the Managers, Education Office, Mexborough (July 17).

Superintendent of the Branch for Southern Rivers, Freshwater Biological Association, and a **Research Assistant**—The Registrar, University College, Southampton (July 18).

Lecturer in Physics and Chemistry—The Principal, Faraday House, Southampton Row, W.C.1 (July 20).

Research Fellowships in Glass Technology—The Registrar, University, Sheffield (July 21).

Assistant Officers (Civil Engineers) in the Indian Railway Service of Engineers—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 1/1A) (July 22).

Professor of Agriculture (Animal Husbandry) in the Canterbury Agricultural College, Lincoln, New Zealand—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1 (July 27)

Educational Psychologist—The Director of Education, Education Offices, Philip Lane, Tottenham, N.15 (July 31).

University Readership in Morbid Anatomy at the British Post-graduate Medical School—The Academic Registrar, University of London, Senate House, W.C.1 (September 12).

Professor of Chemistry—The Secretary, University, Aberdeen (September 16).

Two Technical Assistants in Agricultural Economics—The Adviser in Agricultural Economics, King's College, Newcastle-on-Tyne 2.

Geologist in the Geological Survey of the Anglo-Egyptian Sudan—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

Inspector of Explosives in the Stores and Ordnance Department of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

University Grants Committee. Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1937–38. Pp. 28. (London: H.M. Stationery Office.) 1s. net. [156

Department of Scientific and Industrial Research, Forest Products Research Records, No. 29. The Manufacture of Charcoal in Portable Kilns. Pp. iv+20. (London: H.M. Stationery Office.) 6d. net. [156

Department of Scientific and Industrial Research. Report of the Building Research Board, with the Report of the Director of Building Research, for the Year 1938. Pp. vi+160+22 plates. (London: H.M. Stationery Office.) 3s. 6d. net. [196

Department of Scientific and Industrial Research. Forest Products Research Records, No. 28 (Timber Mechanics Series No. 4): Strength Tests of Structural Timbers. Part 4: The Development of a Minimum Structural Grade for Redwood (*Pinus sylvestris*). By C. J. Chaplin and E. H. Nevard. Pp. iv+12+1 plate. (London: H.M. Stationery Office.) 6d. net. [206

King's College, Newcastle-upon-Tyne: Standing Committee for Research. Report, Session 1937–1938. Pp. 34. (Newcastle-upon-Tyne: King's College.) [206

Transactions of the Institution of Chemical Engineers. Vol. 16, 1938. Pp. iv+250. (London: Institution of Chemical Engineers.) [206

Lister Institute of Preventive Medicine. Report of the Governing Body, 1939. Pp. 34. (London: Lister Institute.) [206

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 10, No. 2, March. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+271–378. (London: H.M. Stationery Office.) 4s. 6d. net. [206

Seale-Hayne Agricultural College: Department of Plant Pathology. Pamphlet No. 49: Fifteenth Annual Report for the Year ending September 30th, 1938. Pp. 40. (Newton Abbot: Seale-Hayne Agricultural College.) [216

Appendices to the Report of the British Guiana Refugee Commission to the Advisory Committee on Political Refugees appointed by the President of the United States of America. (Cmd. 6029.) Pp. 106. (London: H.M. Stationery Office.) 2s. net. [216

Imperial Forestry Institute. Paper No. 17: The Influence of Vegetation on Climate in West Africa, with Particular Reference to the Protective Aspects of Forestry in the Gold Coast. By H. W. Moon. Pp. 16. (Oxford: Imperial Forestry Institute.) 1s. [236

Other Countries

Astronomischer Kalender der Wiener Universitäts-Sternwart 1939, 3 Serie, 1 Jahrgang. Pp. 124. (Wien: Carl Gerold's Sohn.) [1

Smithsonian Miscellaneous Collections. Vol. 98, No. 7: A Ne Palm from Cocos Island Collected on the Presidential Cruise 1938. By O. F. Cook. Pp. 26+26 plates. (Washington, D.C.: Smit sonian Institution.) [1

Ontario Research Foundation. Report for the Year 1938. (Session Paper No. 48, 1939.) Pp. 36. (Toronto: King's Printer.) [1

Report of the Aeronautical Research Institute, Tôkyô Imperi University. No. 174: Some Studies on Wire-Drawing. By Masaha Goto and Hiroši Tanaka. Pp. 91–128. (Tôkyô: Kôgyô Tosho Kab shiki Kaisha.) 60 sen. [1

Bericht über das Geobotanische Forschungsinstitut Rübel Zürich für das Jahr 1938. Von E. Rübel und W. Lüdi. Pp. 92+ plates. (Zürich: Buchdruckerei Berichthaus.) [1

Uganda Protectorate. Annual Report on the Geological Surve Department for the Year ended 31st December, 1938. Pp. 4 (Entebbe: Government Printer.) 2s. [15

Smithsonian Miscellaneous Collections. Vol. 98, No. 8: Flowerin Plants Collected on the Presidential Cruise of 1938. By Ellsworth I Killip. (Publication 3538.) Pp. 4. Vol. 98, No. 11: Echinoderm (other than Holothurians) Collected on the Presidential Cruise of 193 By Austin H. Clark. (Publication 3536.) Pp. 18+5 plates. Vol. 9 No. 14: Two New Gobioid Fishes Collected on the Presidential Cruis of 1938. By Isaac Ginsburg. (Publication 3539.) Pp. 6. (Washington D.C.: Smithsonian Institution.) [15

Imperial Council of Agricultural Research. Miscellaneous Bullet No. 29: Report on the Prospects of Cinchona Cultivation in India By A. Wilson, assisted by Dr. T. J. Mirchandani. Pp. vi+127. (Delhi Manager of Publications.) 2.6 rupees; 4s. [15

Society of Biological Chemists, India. Annual Review of Bio chemical and Allied Research in India. Vol. 9, 1938. Pp. 16 (Bangalore: Society of Biological Chemists.) 3 rupees; 6s. [15

Ministry of Agriculture, Egypt: Technical and Scientific Service Bulletin No. 201: Preliminary Studies on the Control of Bean Rust By Dr. A. F. El-Helaly. Pp. 20+6 plates. (Cairo: Government Press) P.T.3. [156

Proceedings of the U.S. National Museum. Vol. 86, No. 3061: A New Genus of Starfishes from the Aleutian Islands. By Austin H. Clark. Pp. 497–500+plate 57. Vol. 86, No. 3063: New Species of Moths of the Families Notodontidae and Bombycidae in the United States National Museum. By William Schaus. Pp. 543–562. (Washington, D.C.: Government Printing Office.) [196

Methallyl Chloride as a Fumigant against Insects infesting Stored Products. By Dr. C. J. Briejèr. Pp. xv+101+7 plates. (Amsterdam: N. V. de Bataafsche Petroleum Maatschappij.) [206

Spisy vydávané přírodovědeckou Fakultou, Masarykovy University. Čís. 268: Chironomidarum larvae et nymphae, I. Napsal Jan Zavřel. Pp. 10. Čís. 269: Příprava 3-6-dibrompyrokatechinu a 3-4-6 tribrompyrokatechinu, napsali J. Frejka a B. Šefránek; Soustavné vybudování atomových skupin v analytické chemii, 5, napsali J. V. Dubský a V. Černák. Pp. 20. Čís. 270: On Bicompact Spaces. By Bedřich Pospíšil. Pp. 16. Čís. 271: Soustavné vybudování atomových skupin v analytické chemii, 7. Napsal J. V. Dubský. Pp. 16. (Brno: A. Píša.) [206

Sborník vysoké školy zemědělské v Brně. C.35: Příspěvek k studiu binokulárního zorného prostoru u domácích zvířat. Napsal Dr. Antonín Píša. Pp. 67+8 plates. D. 26: Vztahy Apterygotů k vlastnostem stanoviště se zřetelem na lesní půdy. Napsal Dr. Mirko Kseneman. Pp. 56. D. 27: Tachinologický výzkum Pouzdřanských kopců. Napsal Dim. Jacentkovský. Pp. 14. (Brno: A. Píša.) [206

Science Reports of the Tôhoku Imperial University. Fourth Series (Biology), Vol. 13, No. 4: The Nervous System of Earthworm (*Pheretima communissima*) in Different Ages. By Fumiyo Ogawa. Pp. 395–488+plates 15–17. (Tokyo and Sendai: Maruzen Co., Ltd.) [206

Ministry of Public Works, Egypt: Physical Department. The Nile Basin. By Dr. H. E. Hurst and the late Dr. P. Phillips. Second Supplement to Vol. 4. Ten-Day Mean and Monthly Mean Discharges of the Nile and its Tributaries for the Years 1933–1937 and Normals for the Period 1912–1937. (Physical Department Paper No. 36.) Pp. vii+249. (Cairo: Schindler's Press.) P.T. 50; 10s. [206

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1938. Pp. 22+2 plates. (Zomba: Government Printer.) 2s. 6d. [206

Indian Forest Records (New Series). Silviculture, Vol. 3, No. 4: *Dipterocarpus* (Gurjan) Forests in India, and their Regeneration. By J. N. Sen Gupta. Pp. ix+164+20 plates. (Delhi: Manager of Publications.) 4.14 rupees; 7s. 9d. [206

Tanganyika Territory. Department of Lands and Mines, Geological Division. Short Paper No. 21. Preliminary Report on the Geology and Gold Occurrences of the Kahama Region. By D. R. Grantham and B. N. Temperley. Pp. 14. (Dar es Salaam: Government Printer.) 2s. [206

Proceedings of the Second Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India, held at Lahore from the 6th to 9th December, 1937, with Appendices. Pp. iv+365. (Delhi: Manager of Publications.) 4.2 rupees; 6s. 6d. [206

Astrographic Catalogue 1900·0. Sydney Section, Dec. −51° to −65° from Photographs taken at the Sydney Observatory, New South Wales, Australia. Vol. 13: R.A. 0^{h} to 6^{h}, Dec. −54° to −56°, Plate Centres Dec. −55°. Pp. 30. Vol. 14: R.A. 6^{h} to 12^{h}, Dec. −54° to −56°, Plate Centres Dec. −55°. Pp. 98. (Sydney: Government Printer.) [206

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 16, Part 2. Polychaetous Annelids of Porto Rico and Vicinity. By Aaron Louis Treadwell. Pp. 149–320. (New York: New York Academy of Sciences.) 2 dollars. [206

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, JULY 15, 1939 No. 3637

THE MUSEUM AND THE SCHOOL

WITH commendable restraint those responsible for the organization of the exhibition of museum publications of educational interest, which was held at University College, London, during June 20–July 15, made no attempt at exhaustive or elaborate display. It was a sampling, for which the material was derived from London and from certain museums of the United States of America. The English contributors included, in addition to the national collections, the London Museum and one of the museums of the London County Council—the Geffrye Museum. Modest as was this effort, it served the purpose, as no doubt was the intention, of provoking thought. The contrast here presented between the methods of the English and the American museums inevitably gave rise to reflection as to the purpose of these great collections of objects of natural, scientific and historic interest, of beauty and of rarity, and the nature of the function which they perform, or might perform, in the life of a community.

As Lord Bledisloe said in his address to the jubilee gathering of the Museums Association, the museum in its original conception was "a fountain of culture alike for young and old, for rich and poor, for layman and expert, adapted to the everyday intellectual and spiritual requirements of the nation as a whole". Without venturing to question the historical accuracy of this statement, we may concur in Lord Bledisloe's dictum and agree with him when he went on to point out, coupling the cinema with the museum, that "as the eye is the most efficacious channel of entry into the mind, there are no more promising educational agents or more powerful stimulants to the imagination than the museum and the cinema". But at the same time, as every educationist is aware, it must not be overlooked that visual impression, whether in adult or child, is but fleeting, unless it finds the mind of the observer already prepared to receive it, and able to link it to material which the mind has already made its own. It is by the nature and the extent of the museum's co-operation with the observer in storing up such a body of assimilated fact that the performance of its educational function must be judged.

In all the important London museums and collections, the institution of guide-lecturers, of special exhibitions, permanent or temporary, illustrating some special phase or problem, and a ready hospitality extended to school visits, have done much to make the public familiar with the character and meaning of the objects in these collections. The services of the lecturers, however, are available for comparatively few of the museum's visitors—those who have the leisure and the opportunity to attend at stated times. For the majority, or at any rate a large proportion, more intimate and more intensive study than is possible in a perambulation of the galleries, even the occasion for arousing interest and stimulating study, must depend to a great extent upon the museum publications. Within the limited space of the exhibition room at University College has been shown a selection of these publications. It was headed by some of the attractive and sometimes striking posters directing attention to the collections in the various museums, which are displayed by the London Passenger Transport Board. Each of these posters, artistic and brightly, but not garishly, coloured, is characteristic of the collection which it announces. The second, an extensive exhibit, consisted of the long range of picture post-cards and reproductions, mostly in colour, which illustrate almost every branch of science, art and history susceptible of demonstration in a museum.

Of the museum publications in book form, the more technical and advanced did not come within the scope of an exhibition intended to consider only the needs of schools, and the selection shown was confined to the simpler and more popular guides, which do, in fact, carry further the interest aroused by the collections themselves, or by the post-card series. Such a development of interest is to be noted, for example, in the Science Museum series, dealing with topics such as the development of transport, locomotion, navigation, aeronautics and the like.

Reviewing the exhibits from the English museums as a whole, and as an instrument of instruction, the more striking features are the care which has been lavished on the selection and preparation of the various series, the care in production and reproduction, and the scholarship and knowledge which have been drawn upon freely to make known to the general public the character and meaning—scientific, æsthetic or historical—of the wealth of objects displayed in London's museums. It must be apparent, however, that in so far as this material was brought together to illustrate the educational interest of museum publications, it shows strikingly little effort to make readily available for the school a vast amount of material of immense educational value. Except for the Geffrye Museum, which, with the Horniman Museum at Forest Hill, is part of London's educational organization, there is no direct orientation towards the needs of the school. It is here that the contrast with the American museum becomes marked.

Exhibits were shown from five of the larger American museums: the Metropolitan Museum of New York, Boston Museum of Fine Arts and the Brooklyn, Buffalo and Cleveland Museums. It is made abundantly evident that each of these museums regards itself, even if this be not explicitly stated in the terms of its foundation, as having a specific function in the cultural life and educational system of the region in which it stands. Normally, it has an educational division, section or committee, and an educational staff; and it undertakes organized educational work. There is a carefully prepared system of preparatory propaganda. Post-cards, memoranda, and programmes are circulated among the heads of primary, secondary and technical schools an other educational institutions. In some museum courses are specially arranged to fit in with th curricula, after consultation with the staffs c primary, secondary, and technical schools. The are given by members of the museum staff i special rooms. The museum educational sta is available for consultation by teachers an others interested in education, sometimes at small fee.

Finally, there are the museum publications usually a museum journal, which, in addition t notes on recent acquisitions, will contain articles o special groups of exhibits; or, in those museum which specialize in art, dealing with the work of a painter or sculptor, or like topic of artistic o antiquarian interest; while some museums publish a periodical devoted entirely to the interests o school children, and dealing with Nature studies, hobbies and the like. Of a more specifically educational character are sheets or cards of grouped illustrative material, with notes prepared by the museum staff. These are circulated for instructional purposes among the schools. There are also special publications, usually in pamphlet form, or guides dealing with grouped exhibits or special collections.

In general, it may be said that the material which is thus circulated among the schools or made available for their use is scarcely comparable in its printing or general technical character with the publications of English museums, nor, it may be said without offence, does it show the same standard of scholarship. At the same time, it has to be admitted that, having been prepared for a specific purpose and with the educational end in view, it is more certain to reach its mark.

It was abundantly apparent in the material shown at University College that the American museum has not shrunk from taking what it has regarded as its educational responsibility very seriously. This is due in part, of course, to the fact that, whereas the British national and other important collections, owing to their origin, have assumed the character of storehouses of national treasures, and their connexion with the advancement of knowledge has been almost entirely by way of research and not of instruction, in the United States the museums have been founded as, or have become, part of the cultural equipment of the region each serves. Most of them, too, are dependent for their current expenses, not on their ndowment or on support from public funds, but n fees and membership subscriptions; the xtent of membership is reflected by the degree in hich the activities of the museum meet the ultural needs of its area.

The English institution more nearly comparable ith the American museum is the local provincial museum, which grew out of the interests of the ocal literary, philosophical or antiquarian society. When communications were less easy and other istractions less numerous than they are now, this erved as a social and cultural focus for its neighourhood. Its educational function might well be evived, where it has lapsed, and extended.

While the very different conditions which affect ur large museums, in contrast with those affecting American museums, must be recognized, yet a omparison of the two systems of organization in Great Britain and in the United States gives rise o an uneasy feeling that the most is not made n education of the wealth of scientific and cultural material that is available in collections in Great Britain. If it be pointed out in extenuation that a remarkable range of illustrative material from which to select is available for the teacher, the reply surely must be that the teacher is not a specialist; and simple and even elementary as much of the detail in the museum guides and other publications may seem to the specialist, for the layman, however intelligent, they make stiff and uphill reading. The classes and lectures for teachers at the Horniman Museum, and the appointment of liaison officers between school and museum on the inspectorate of the London County Council, were steps in the right direction; but they do not go far enough. To be of lasting value, museum material must be brought into intimate relation with the school curriculum. Intermittent visits to general collections have little permanent instructional value. To suggest that special exhibitions should be arranged in special rooms to meet the needs of schools raises a problem with too many ramifications for discussion here. In the provincial museum, however, education might provide a channel for the further assistance from public funds for which a plea has been put forward. Such matters will no doubt come within the purview of the promised public inquiry.

FUNDAMENTAL CONCEPTS OF ELECTROMAGNETICS

Electromagnetics
A Discussion of Fundamentals. By Prof. Alfred O'Rahilly. Pp. xii + 884. (London, New York and Toronto: Longmans, Green and Co., Ltd.; Cork: Cork University Press, 1938.) 42*s*. net.

HOWEVER gratifying the remarkably rapid progress of experimental science and its practical applications during the last few decades may appear, the immense accumulation of new facts and hypotheses has tended greatly to confuse rather than to elucidate our fundamental concepts, and the edifice of science is becoming like a Tower of Babel in which hosts of skilled workers are busily engaged on their several portions but without plan or architect, and are becoming so divided by specialization as scarcely to be able to understand one another. To such an extent has this confusion grown that we seem to be reverting to pre-Newtonian scholasticism, and many modern men of science are now adopting the speculative and metaphysical modes of thought and expression against which science had to struggle for its very existence in its infancy; so that although humanity is more and more amazed at the achievements of science, it is losing confidence in it as a trustworthy interpreter of natural phenomena and as a guide to human progress.

There is therefore urgent need for a comprehensive review of our fundamental concepts, and Prof. O'Rahilly deserves our cordial thanks and admiration for the energy, skill, and courage with which he has undertaken this formidable task. Within the space available for this review, it is impossible to do more than indicate the immense field covered in this large volume, one of the most interesting and valuable features of which is the collection of quotations from the greatest authorities which reveal the large divergences of opinion which have always existed between them, even when agreement on most fundamental principles was supposed to prevail.

The majority of students, at least in Great Britain, have been brought up on the Maxwellian theory, involving the Faraday concepts of electric and magnetic fields in a medium, and are now being converted to the doctrine of relativity; but the author reminds us of the great body of theory built up by the Continental physicists, Poisson, Gauss, Ampère, Neumann, Riemann, Weber and Lorenz, and their successors, Voight, Liénard, Schwarzschild and Ritz, based on action at a distance between discrete charges and the assumption first made by Riemann in 1858 of a finite velocity of propagation approximating to that of light. He points out that not only did they arrive at results in accordance with those derived from the Maxwellian equations, but also that they were anticipatory of the modern electron theory, and therefore more in accord with recent experimental developments. The Maxwellian concept of electric displacement in space, involving a basic medium or ether, was greatly disliked by Continental physicists, and only secured their assent for a short period after Hertz's brilliant experimental verification of Maxwell's theory of electromagnetic propagation; so that the discovery of the electron and the rapid advance of corpuscular physics provided a welcome excuse for reversion to their earlier ideas.

As the author is professor of mathematical physics at University College, Cork, the volume is naturally highly mathematical; but readers with very little mathematical ability will find the discussion of various theories and the conflicting views of high authorities most interesting and thought-provoking—so much so that it may lead someone to suggest a new fundamental hypothesis which will at last satisfy not only quantitative but also intellectual needs. The very fact, as is clearly demonstrated in the volume, that widely divergent fundamental concepts may lead to almost identical formulæ which give close quantitative agreement with experimental measurements, shows that such quantitative agreement is no proof of the validity of the concepts; so that mathematical reasoning must be supplemented by physical insight.

Only two physical hypotheses at present hold the field: (1) the emission, or what the author calls the ballistic, hypothesis, which was definitely adopted by Ritz; and (2) that of a medium, adopted by Faraday and Maxwell; since the old action-at-a-distance theories and the modern doctrine of relativity have been concerned only with obtaining quantitatively accurate general formulæ, regardless of any agency by which bodies or charges act upon one another. In this the latter resemble Newton's theory of gravitation, but although Newton expressly refused to promulgate any hypothesis, he emphatically stated that the idea "that one body may act upon another at a distance through a vacuum without the mediation of anything else by and through which their action and force may be conveyed from one to another—is to me so great an absurdity that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it". This certainly expresses the feeling of every physicist who does not accept the dictum that mathematical formulæ represent the only true reality, and th belief in and search after the mediating agency bound to persist.

Prof. O'Rahilly, while accepting the validity Maxwell's equations and the existence of an ethe has definitely discarded the concepts of electric an magnetic fields, and takes his stand on the Liénard Schwarzschild force formula, which appears to b equivalent to the simple vector formula given b the present writer in NATURE of December 3, 193 except that the former contains a factor of ½ i the third term, which seems to conflict with th Neumann inductance formula, and two addition second order terms in v^2/c^2 derived from th assumption that longitudinal forces are also pro pagated with the velocity of light. This scarcel seems consistent with the deduction from th energy of a moving electric field that its inertia only of a transverse character, but the autho claims that these terms are necessary for reconcilin the formula with experiment.

In spite of his own mathematical powers, Prof O'Rahilly is far from over-estimating the value o mathematics; and his comments on some of th most elementary mathematical concepts, includin dimensions, as well as on the modern ideas o space-time, are interesting and amusing. In orde to avoid the prejudice against the concept o 'absolute' motions, he has adopted the Greek wor *schesis* for a basic framework; and he claims tha the only truly consistent relativistic theory wa the ballistic or corpuscular theory of Ritz, an that the modern doctrine of relativity is funda mentally schesic. That he is justified in thi claim seems clear from the constant recurrence o the term v^2/c^2 in the Lorentz transformatio formula (which the author points out was enun ciated by Voight in 1887) and so many relativisti formulæ, which term, like the v and v^2 in th Liénard–Schwarzschild force formula, can have n meaning unless such a framework or schesis i implicitly assumed.

Although probably every reader of this volum will find himself alternating between heart agreement and strong disagreement with Prof O'Rahilly's various criticisms and conclusions, hi wide outlook and critical survey of the variou theories entitle his views to respectful consideration. Whether they are justified or not must be left for the future to decide, but we can heartily endorse Prof. Conway's concluding remark in the foreword, that the volume "is more than a review of existing knowledge, it is a courageous attempt at reconstruction; and if we do not always agree with the writer, he certainly makes us reflect. I recommend this book to every serious student of Electromagnetics".

C. V. DRYSDALE.

CHEMICAL REACTION IN THE ELECTRIC DISCHARGE

The Electrochemistry of Gases and other Dielectrics
By Prof. G. Glockler and Prof. S. C. Lind. Pp. xiii+469. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

THE appearance of this first book on the electrochemistry of gases will be welcomed by a wide circle of physicists and chemists, who will also remember that one of the authors has written the first book on a related subject, namely, reactions initiated by α-particles. This book is the more welcome because of all the chemical writers on electrochemistry, none since Löb in 1905 appears to have found the part of the subject relating to gases of sufficient importance to devote to it more than a trivial portion of a book, despite the very extensive literature on the subject. Physicists writing on discharge phenomena, with the exception of Stark in 1902, are even more disappointing, for all the later writers have either omitted to mention the subject or dismissed it in a few lines.

The book was written at the request of the Committee of Electrical Insulation of the American National Research Council, and attempts to cover the field "considering all forms of electrical discharge and all types of reactions"; it contains, however, no more than three pages relating to industrial applications, vitamins, insulation, and lubricating oils.

There are three main sections in the book. Part 1 is entitled "Typical Reactions in Various Forms of Discharges"; its theme is illustrated in 139 pages by what the authors describe as a "quite arbitrary" selection of reactions which have been examined in one or more of the known types of discharge, including slow and fast electron beams. The last section is devoted to an account of the properties of molecular fragments as observed *outside* the discharge in which they are formed.

Part 2 deals in 190 pages with "Chemical Reactions in Electrical Discharges" and attempts to cite "most of the reactions that have been studied", which claim for the most part is well substantiated. The formidable task of arranging the very heterogeneous material from some 656 references in this section alone has been dealt with by considering the reactants in ascending order of atomic weight; in some cases, this has led to the dissemination of the information concerning the formation and decomposition of a given substance through several chapters.

Part 3 is entitled the "Physical and Theoretical Aspects of Discharge Reactions". The first three chapters deal with electron affinity, ion mobility, and a list of the ions observed in discharges. Then follow two interesting chapters on ionization produced by reaction, and on sputtering. The book closes with a chapter on the mechanism of discharge reaction.

Considered as a whole, the great value of this book derives from the fulfilment of the authors' aim to compile the vast mass of experimental data so as to facilitate the comparison of the various forms of discharge reaction, both amongst themselves, and with reaction initiated in the same systems by other agencies. This will be invaluable to all investigators of discharge phenomena, whether chemists, physicists or engineers. It should be a powerful stimulant to further exploration of the field, both experimentally and theoretically; and it may be that even the industrialist will be attracted to consider the possibilities of some of the remarkable syntheses that are described. It is, however, difficult not to feel a slight and perhaps ungracious sense of regret that, having such familiarity with this enormous collection of information, the authors have not essayed a more critical commentary on the relative value of their material.

Only fourteen pages are allotted specifically to the chapter on the mechanism of reaction, although most of the attempts to formulate a theory are mentioned either there or elsewhere in the book. The accounts of the various theories are, however, rather uneven; for example, Kirby's quantitative theory of positive column reaction is barely mentioned, whilst much of Warburg's work is given in detail. The authors themselves have chosen to discuss reaction mainly in terms of the ion cluster theory for reasons of "simplicity and personal acquaintance". The statistical approach to the quantitative theory of discharge reaction is, however, a little surprisingly dismissed without even formal statement, for the unproved and possibly irrelevant reason that it is impossible in this way to explain certain facts concerning reactions initiated along α-particle tracks.

The book is beautifully produced, readable, and illustrated with numerous clear diagrams; there are good author and subject indexes.

R. Winstanley Lunt.

GENETICS IN THE GARDEN

The Genetics of Garden Plants
By M. B. Crane and W. J. C. Lawrence. Second edition. Pp. xxi+287. (London: Macmillan and Co., Ltd., 1938.) 12*s*. 6*d*. net.

THAT a second edition of this work should have been called for within four years of the appearance of the first shows that it has met a definite need. Nor is this surprising; for the dimensions to which the study of scientific plant breeding has attained offer one of the most spectacular examples of the rapid rise of an applied science based upon a simple initial discovery.

It is not much more than thirty years ago that Biffen declared plant breeding to be a game of chance with the odds on the plant. To-day, thousands of plant breeders all over the world are in a position to define their aim and to pursue it with every prospect of success. The majority of these are, of course, dealing with farm crops of fundamental importance to mankind—with cereals, grasses, cotton and the like—crops where even a very small improvement in quality or quantity is enormously magnified by the vast acreages involved. With this aspect the authors are not concerned. They have confined themselves to the products of the flower and vegetable garden, with the inclusion of fruit trees.

A brief and clear introduction to the principles of genetics and cytology involved is followed by three interesting chapters on flowers and vegetables. Special attention has been paid to such species as have been more intensively studied—to the sweet pea, the stock, the dahlia and the primula, and among vegetables to the tomato, the potato and the garden pea. The matter is presented in a form which allows the reader to obtain an idea of the successive changes that have occurred under continuous cultivation, while at the same time he given an insight into the chemistry of flower colou and brought to realize the importance of polyploidy as a factor in connexion with 'improvement'.

A considerable part of the book is devoted t fruit trees and bush fruit, and is largely base upon the well-known experimental work carrie out at the John Innes Horticultural Institution b the senior author. The genetical analyses of th more important cultivated forms are followed b illuminating discussions on bud sports, sterility and incompatibility—topics all important for the grower of fruit. The final chapter, on the origin of new and improved varieties, should prove o deep interest alike to the student of evolution and to the practical grower. The recently discovered colchicine treatment for the induction of polyploidy is alluded to, perhaps too briefly in view of its extraordinary promise. Doubtless the authors will tell us more about it in their next edition when more data are available. It is suggested also that they might give some account of the work with X-rays and radium which is leading to the production of interesting novelties in various plants to-day.

Altogether this is a most interesting and valuable book, excellently produced and illustrated. To the practical grower its value is obvious, and nowhere else will he find so clear an exposition of the principles underlying his craft. It should make an even wider appeal to the amateur horticulturist who is not merely content to admire the beauty of the plants he grows, but wishes to learn something of their nature and of the causes that have brought them into being.

THEORIES OF VISION AND HEARING

Theories of Sensation
By Dr. A. F. Rawdon-Smith. (Cambridge Biological Studies.) Pp. xiii+137. (Cambridge: At the University Press, 1938.) 10*s*. 6*d*. net.

THIS excellent book deals with sight and hearing and does not include any reference to touch, taste and smell. Dr. Rawdon-Smith gives the reason for this in his introduction. He writes, "It would be safe to say that no theory of general sensibility has yet been proposed which is able to describe the available data. . . . We may note in the fields of olfaction and gustation not that the theoretical position is insecure, but simply that no theoretical position exists."

The four chapters on vision refer to the following subjects: Chapter i to the formation of the retinal image; Helmholtz's theory of accommodation and the pupil reflexes. Chapter ii alludes to the duplicity theory of von Kries, the Purkinje phenomenon, the photochemical properties of visual purple, dark adaptation and night-blindness. Chapter iii refers to the discrimination of intensity, the critical fusion frequency, the acuity of the eye at different nt intensities, the size of the foveal cones, vernier uity, the frequency of the impulses in the optic rve and the various theories of visual acuity. apter iv contains an account of colour vision, brightness of the spectrum, colour mixture, lour-blindness, the choice of primary colours, nultaneous and successive contrast.

Commenting on these first four chapters, apters i and ii are introductory to the ones ich follow. Chapter iii is specially good and ves a very clear picture of the rival theories of sual acuity. The position is made interesting d understandable. Chapter iv contains a good count of the theories of colour perception.

Turning now to the ear. Chapter v deals with e anatomy of the ear : the production of summa- on and difference tones, the functions of the ossi- lar muscles, the cochlea, the organ of Corti, the ode of stimulation of the hair cells. Chapter vi ntains an account of Helmholtz's resonance eory and also of the theories of Ewald and Boring, perimental deafness in animals and boiler- aker's deafness in man, the evidence of models, e evidence of the phase-change beat, the inten- iveness of the ear to the relative phases of tones, the Wever Bray phenomenon, the volley theory, the perception of pitch, the rate of conduction of the auditory nerve fibres, the cochlear response and the auditory tract potentials for a change of phase. Chapter vii deals with methods of producing changes of intensity, the sensitivity of the ear to intensity differences, the sensitivity of the cochlear response to intensity differences, and the probable way that differences of intensity are conveyed to the brain.

The reviewer's opinion on these chapters may be briefly explained as follows : Chapter v gives a good introduction to a description of the functions of the ear. Chapters vi and vii state clearly, and in a manner which is easily understood, the present position with regard to the resonance theory, the volley theory and the Wever and Bray phenomenon, and a number of other points which are very intimately connected with the physiology of hearing.

The book is an extremely successful attempt at epitomizing the very varied theories of vision and hearing, and for that reason alone should be read by all who are interested in the mechanisms of sight and sound.

H. Hartridge.

THE CULTURE OF ORGANS IN VITRO

he Culture of Organs
y Alexis Carrel and Charles A. Lindberg. Pp. ix + 222 + 38 plates. (London : Hamish Hamil- n, Ltd., 1938.) 18s.

THE Carrel-Lindberg perfusion method represents one of the most important technical dvances in biology which has been made in ecent years, so that the present volume, in which he authors describe in detail their apparatus, its ode of operation and the experimental results btained up to date, is extremely welcome.

The apparatus is designed to maintain a sterile, ulsating circulation of nutritive fluid through solated organs. It consists of two main parts : he perfusion pump, which contains the organ and erfusion fluid, and a mechanism for creating and ransmitting a pulsating gas pressure to the fluid n the pump. The mechanical details of the pparatus are complicated, but are clearly described nd profusely illustrated with good diagrams and hotographs.

Many culture media have been tried and are rouped into two main classes : natural and rtificial. The former consist of blood serum iluted with Tyrode's solution, to which may be dded such substances as Witte's peptone, insulin, aemoglobin, etc., while the latter, which vary widely in composition, contain either no serum or only a small proportion. In order to detect changes in pH during the course of the experiment, phenol red is always added to the perfusing media.

One chapter is devoted to the preparation of the tissue to be perfused. "The goal of the technique is to transplant an organ into the organ chamber without any damage to its blood vessels and without infection", a goal which demands scrupulously aseptic precautions and no small surgical skill. When the organ has been suitably prepared, it is inserted into the organ chamber and the blood vessels are connected with the perfusion pump by a system of canulæ. The entire apparatus is then placed in the incubator.

One of the major difficulties of the method is to maintain asepsis, which is rendered unusually difficult by the large volume of the tissue and perfusion fluid, by the complexity of the apparatus and by the extensive manipulation involved. Rigid aseptic and antiseptic measures are therefore necessary.

Many different organs and structures have now been successfully perfused for periods up to forty days, and a comparative study has been made of the effects of different natural and artificial media on the histology and functional activity of the organs. "Thyroid glands, ovaries, hearts, kidneys and pancreas were found to maintain or to modify *in vitro* their functional activity according to the chemical composition of the perfusing medium." For example, the addition to the Tyrode solution of only 5 per cent serum allowed parts of the thyroid to survive for several days, the addition of 10 per cent kept the gland alive and almost unchanged for more than a week, whilst 80 per cent produced hyperactivity of the organ as compared with the uncultivated control from the same animal. The thyroid was maintained in a healthy state for several weeks by transferring it every week to another pump with a fresh supply of diluted serum. The photomicrographs of sections of perfused organs present convincing evidence of the healthiness of the tissue even after prolonged cultivation.

Normal functioning of the perfused organs has also been demonstrated. Thus iodine is secreted into the perfusion fluid of the thyroid, and the secretion can be increased by adding thyrotropic hormone to the fluid. Similarly, the perfu pancreas has been shown to secrete insulin.

The number of problems to which this ingeni method can be applied is almost unlimited, a it is to be hoped that the Carrel–Lindberg techni will be introduced into many physiological a medical laboratories. The chief obstacles to more general use are its difficulty and the co plexity of the apparatus required. Dr. Ca encourages the reader by assuring him that method is not so difficult as it looks, but adm that it cannot be learned from a book; it sho be studied in a laboratory where it is be practised.

This book should be of the utmost value to beginner who, having acquired the techniq under expert guidance, is endeavouring to establ it in his own laboratory. Moreover, althou primarily a technical work, it contains matter considerable biological interest and can theref be recommended to the general scientific read

H. B. F

THE LEPCHAS OF SIKKIM

Himalayan Village: an Account of the Lepchas of Sikkim. By Geoffrey Gorer. Pp. 510+32 plates. (London: Michael Joseph, Ltd., 1938.) 25*s*. net.

MR. GORER, who had already proved his mettle as an observer in "Africa Dances", is now, as Prof. Hutton points out in his introduction to this book, a recruit to the ranks of serious anthropologists. He is fortunate in that his first essay in ethnographical study deals with a people, the Lepchas of Sikkim, whose country hitherto has been virtually closed to Europeans. In 1936 he accompanied Major C. J. Morris to Sikkim, and after two months spent at Kalumpong in study of the language, settled with him, under favour of the Maharajah and with his approval as their passport, in the village of Lingthem, which comprises a population of one hundred and seventy-six individuals. Mr. Gorer's book, and the account of the same village published recently by Major Morris, thus give from two different points of view what in sum is a comprehensive picture of a country and a culture, which though changing, up to now have been completely outside European influence and contact.

The author has treated his subject-matter from three different points of view, to each of which he devotes a section of his book. In the first he deals with the material and formalized aspects of Lepcha society—its framework; in the second he cov the mainly unformalized aspects of their life; a in the third he presents the life-history of certa individuals who, it is to be presumed, may regarded as typical.

Certain aspects of Lepcha life have impress him more strongly than others as characteristi and it is under discussion of these in his attemp at their evaluation that the author makes, apa from his purely descriptive work, his main co tribution to anthropological thought—a contrib tion which gives his book an additional claim the serious attention of the anthropologist. these characteristics one is the remarkable la of aggressiveness in the Lepcha character. H explanation which attributes this lack to th swamping of personality in the group feeling discussed by Prof. Hutton in his introduction wi some reserve, but not unsympathetically.

A further characteristic, to which the auth makes extended reference, is the obsession of th whole community by sex, a point which als impressed Major Morris. Here again Prof. Hutto has raised an interesting question by askin whether decline of population and sterility a cause, or effect, of this obsession.

Finally, there is the cynical attitude of th Lepchas to their own religious beliefs, associate with an optimism which is qualified by a complet lack of belief in their own efforts and their future

BUSH FIRES IN VICTORIA

THE drought of the early summer, which affected all south and south-eastern Australia, as followed by a heat wave in the first fortnight January which reached sufficient intensity to duce leaf litter in the forest to tinder dryness. he usual firing by cattle graziers had been in rogress for some months over all the ugh mountain grazing land which lies the north of the prime forest belt. orthern and north-western winds of eat force set in during the first week of anuary and fanned the sporadic fires into onflagrations which swept the country herever forest existed and also much of he cleared grass lands where the stock ad left enough herbage to carry a fire.

Forest losses were severe in New South Wales, and in the Australian capital erritory 3,600 acres were burnt; this epresents a quarter of its plantation area. South Australia suffered also, but proortionately less, for her plantations are ot exposed to the same external fire azard. Tasmania escaped at the time hat the fires were at their worst on the mainland, but towards the end of January and early February, serious fires broke out in that State and severe losses were sustained.

The greatest losses occurred in Victoria, where by the end of that first fortnight of January 5,038,600 acres of forest were burnt over, sixty-seven saw mills and approximately six hundred houses and cottages were destroyed and seventy-one persons lost their lives. The full extent of the loss in timber cannot be gauged, but the amount in the easily accessible areas has been assessed, and this reaches the alarming total of 2,070,000,000 superficial feet in the round. It is estimated that 916,000,000 superficial feet of this killed timber can be salvaged. The dead timber in less accessible areas of burnt ash and alpine ash forest cannot be salvaged.

Victoria's loss amounts to a national disaster, for the chairman of the Forests Commission, speaking at a representative meeting of timber men last year, stated that supplies of ash timber would last less than twenty years.

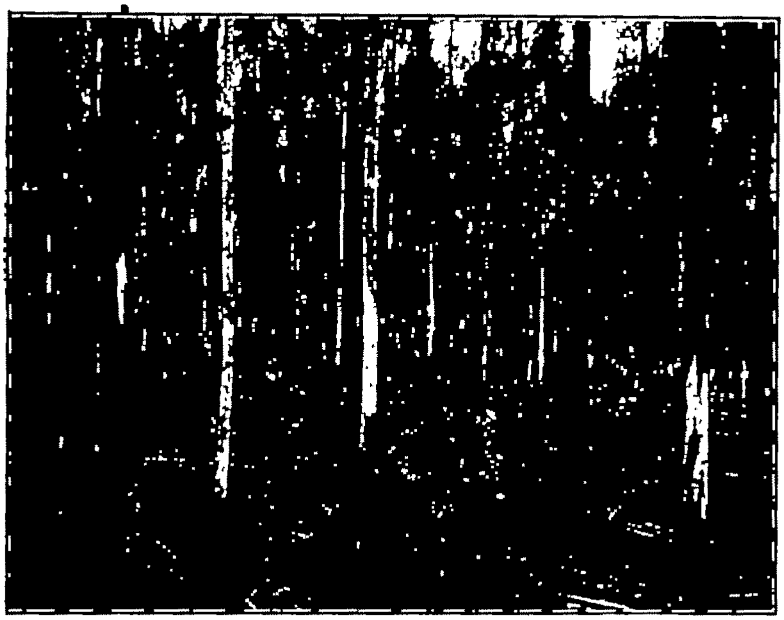
It will be seen that already the overcutting of the forests had brought the industry to the point where future supplies of logs were becoming a very serious matter, and now the greater part of the timber has been destroyed by fire. Victoria's loss is so severe that it is difficult to see how the industry can fail to sink into insignificance once the salvaged timber has been converted. Investigations are now being made to see whether it is possible to prolong the period of utilizing burnt logs. It is a question of preventing fungus attack, and is therefore a difficult matter.

[*Photo: Forests Commission*

Fig. 1.

VIRGIN MOUNTAIN ASH FOREST, CUMBERLAND VALLEY, VICTORIA.

The genus *Eucalyptus*—the gum tree—of which all the burnt forests consist, is in the majority of cases difficult to kill outright. After a very severe fire has passed through, burning all the crowns, epicormic branches spring from branch and bole and restore the leaf area, and so life is maintained and the greedy branches on the limbs grow into mature branches, new crowns are formed and the greedy branches on the boles fall off. A month after such a fire as has been experienced, the bush



[*Photo: W. Russell Grimwade*

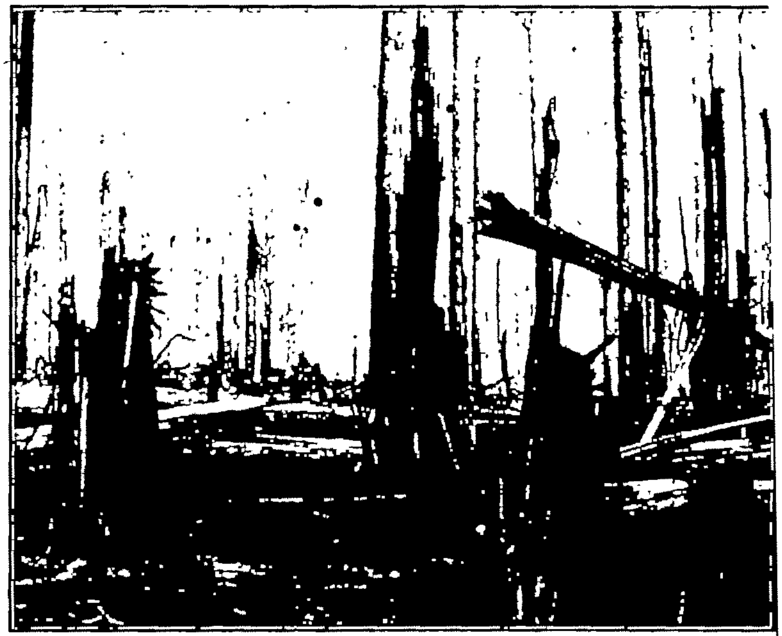
Fig. 2.

NATURAL REGENERATION OF ASH AT NOODJEE, VICTORIA, FOLLOWING THE 1926 FIRE.

is sprouting with green tufts of leaves except—and this is what makes Victoria's case so serious—the species composing the forest belonging to the ash group of gum trees. These are *Eucalyptus regnans*, mountain ash, and *Eucalyptus gigantea*, alpine ash; there are three others, but they are not of the same milling value. These ashes do not renew their leaf surface by means of epicormics and so are killed outright by any fire which attains such an intensity as to burn the crowns. A great part of the Victorian forests consists of these ashes, and the bulk of the sawn timber of that State is ash. Fig. 1 shows a type of forest of mountain ash before the fire. The trees attain heights of more than three hundred feet, and the volume per acre on first quality sites is only beaten by such forests as virgin Douglas fir. So while in the coastal regions of New South Wales great conflagrations took place at the same time as the ash forests were being destroyed in Victoria, the trees will recover, and though greatly injured and yielding as they will inferior products, will reform a forest and perpetuate it.

In the ash belts of Victoria the only hope is that sufficient seed will have been shed from the capsul on the burnt trees, some of whi will not have been consumed a would at that time of the year ripe but closed and would op after the fire had passed b Experience of past fires h shown that a very fine regener tion of ash follows an intense fir The seed falls on a good seed b and has an even chance with a weed growth that springs up i the ashes. Some of the be regeneration of mountain as has occurred in this way. Fig. Noodjee forest, shows what ma be expected twelve years after very bad fire. The big log on th ground was a tree killed in th conflagration that wiped out th forest in 1926; the seed wa shed, good rains occurred an the excellent regrowth, which th Forests Commission has carefull thinned, resulted.

All then is not lost if the trees in the forests though killed, are capable of still reproducin themselves. It means a long wait, for on presen knowledge it takes sixty to eighty years to mak a mill log. That is not all, for during this lon period there is serious danger that an uncontrollable fire will sweep the forest again. This is wha



[*Photo: Forest Commission*

Fig. 3.

WIND AND FIRE DAMAGE IN MOUNTAIN ASH STAND, TANJIL RIVER, VICTORIA, JANUARY 1939.

s occurred in many parts of Victoria, including e fine regrowth shown in the picture. What ppens then is complete destruction, for the ung trees forming the regrowth are too young bear seed and there are no old seed trees to help, d so the forest becomes bracken land, which n only be reforested by planting—a very exnsive business at Australian rates of wages.

Fig. 3 shows the effect of fire on good regrowth. e Forests Commission has been engaged in tendg those fine areas of regrowth and in protecting em from fires. Last year, some £600,000 were ent by the Commission on such work, and fires ve wiped out the greater part of the asset. uch of the money has gone into roads and perment improvements of a capital nature and their lue will remain if the forests are regrown and otected from fire.

This brings up the question: Are these fires evitable? If the answer is yes, then to spend ore money on forestry in Victoria is not justified. here is no doubt that periods of intense dryness, ccompanied by high winds, recur at comparavely short intervals. They vary in degree, but o much credence should not be given to the tatements that have been published that January 939 was the worst ever experienced since white ettlement of Victoria. Well-equipped meteorogical stations are still uncommon in the country istricts, and the evidence of old inhabitants is otoriously unreliable in all matters; degrees f heat and strength of wind are not phenomena apable of easy estimate. Probability points to ntense fire conditions having occurred many times nd likely to recur at least five times in the rotation f an ash forest.

This being so, how is it that there are any ash orests at all? The tree is killed by a severe fire nd the regrowth can scarcely escape destruction ith such a periodicity of five years. The fact hat virgin forests existed up to the recent fire n Victoria is evidence that catastrophic fires did ot occur before white settlement. The trees of he virgin forest are far older than the settlement f Australia, and apart from this evidence there re several facts which make it quite certain that he black man's fires were of small nature. The ate Sir Baldwin Spencer, discussing this matter with the writer, said that the aboriginal only burnt o provide fresh grass to attract kangaroo and wallaby and, owing to his primitive weapons, his aim was to burn very small areas which the clan ould surround when the marsupials were feeding. It is probable that no fires were lit for this purpose in the virgin ash forest because to start a fire in such forests would be difficult and the results would not be so successful for the aboriginals as in the grassed savannah forests adjoining.

It is clear that fires have increased in intensity since white men began to develop Victoria. The early history is interesting in this regard, for it shows what difficulties were encountered by the settlers who were given country to open in the ash belt. They found it most difficult to get a 'good burn' after they had felled the timber. It was only when many holes had been carved out of the forest and a very dry period occurred that a sufficient 'face' of fire was established to sweep through the green forest.

It was not until 1851 that a great conflagration was lighted, and this was so unusual and the results so devastating, that it is known to-day as "Black Thursday, the Day of Terror". Since then, fires of great intensity have occurred at intervals which have become shorter.

The great fires run as follows: 1851, 1898, 1926, 1932, 1939, and of these, the last was only the most serious because of the greater loss of life owing to the country being more opened up and, in consequence, more peopled. The evidence is quite clear that the effect of settlement has been to increase the fire hazard enormously and that forests which were once practically immune from fire became first vulnerable as the face of the conflagration increased and were finally burnt through. The opening up of virgin forest by logging operations contributed largely to the vulnerability of the forests, and the fire prevention organization of the Forests Commission, while adequate to deal with all fires that broke out within the forest reserves, found itself impotent against the raging fires which swept in from Crown lands outside.

After the disasters of 1926 and 1932, fire legislation was tightened up, and to-day the fire prevention laws of Victoria are sufficiently stringent, if enforced, to make fire setting a very risky business in any accessible part of the forests.

The education of the public has been developed to an extent which ensures that everyone is warned against the careless use of fires. The meteorological service sends out through the broadcasting network warnings when the temperature and evaporation are reaching dangerous levels. Roads, tracks and breaks have been cut through the forest and aerial patrols report the outbreak of any fire. Every year by notice in the *Victorian Government Gazette* all areas of land subject to fire hazard are proclaimed as coming under the bush fire laws. These areas cover all Victoria except the inland Mallee country. All these laws and precautions and all this propaganda did not save the position in January. The Government appointed a Royal Commission to inquire into the causes and effects of that fire and to recommend remedies; its report is not yet published so the matter is still *sub judice*. Comment must, therefore, be restricted.

It is quite clear that no internal organization within forest areas can prevent a repetition of the disaster of January 1939. The only way to prevent it is to give the Forestry Commission of Victoria, not only the legal power, but also the departmental machinery and equipment to control fires in the open Crown land leased to graziers beyond the boundaries of the forest reserves. How wide a protection belt is needed must depend on the topography. Where a range of mountains occurs in the Crown land, then it must be included if it is twenty miles away, for it has been definitely established that fires are started on plains 3,000 feet below by bark and debris blown from trees burning on a range twenty miles away. The wind reaches hurricane force, and even on the plains it reached 40–50 m.p.h. at the height of the fire on January 14. Where the forest reserve is surrounded by plain country, the protective belt may be safely made narrow. Everywhere throughout the protection belt roads must be made and look-out tow erected. Instant detection is the first step, a then immediate suppression. Wireless is a valua aid to both these services, making communicati possible between the towers, the fire suppressi gang and with headquarters. All this is going cost a great deal of money, the failure to provi which in the past is the main reason for t disaster. Conflagrations are not inevitable; t forest departments of Australia have sho this in the case of fires starting with their forests, and all that is necessary is extend the foresters' jurisdiction and operatio to cover the land held under grazing occupan outside.

The tragic loss of life has brought the questi of safety measures very much into the foregroun Dug-outs proved very valuable to forest mill-han and others during the last outbreak and ma lives were saved through them.

REACTIONS WITH MONOLAYERS AND THEIR BIOLOGICAL ANALOGIES

By PROF. ERIC K. RIDEAL, M.B.E., F.R.S., AND DR. J. H. SCHULMAN,
DEPARTMENT OF COLLOID SCIENCE, CAMBRIDGE

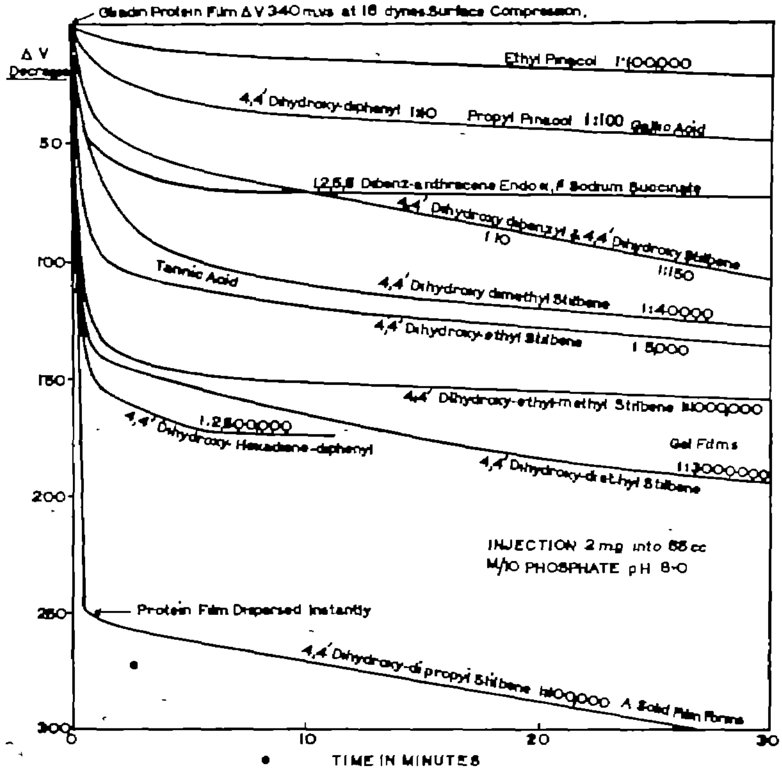
THE film technique permits us not only to examine the progress of chemical and enzyme reactions in monolayers but also to investigate mixed films, for example, lipo proteins, and the effects of injecting various reactants beneath monolayers. It has been found[1] that the reactions of monolayers of lipoids such as cholesterol with substances injected into the substrate are dependent both on the nature of the polar group and on that of the hydrocarbon 'tail' of the injected reactant. Similar conclusions can be drawn as to the extent of reaction with monolayers of proteins. The possibilities in this case are somewhat more complex, for the protein monolayer must be regarded as a triplex system, the extended polypeptide chains separating an upper hydrophobic layer from a lower hydrophilic one, the latter containing the polar groups of the side chains of the protein.

It is possible to separate the various factors which govern the adsorption by, or the penetration into, a monolayer of such a structure. These naturally include not only the usual criteria of water and oil solubility but also more specific terms, such as the interaction of polar groups and special steric configurations which permit of adlineation of specific hydrophobic portions of the molecules. We include also not only the effec produced by changing the number and spacing o polar groups in the reacting molecule, that i multiple point contact, but also the structure o the hydrophobic portions which may or may no be conducive to close packing of the reactant i a sheet below the protein monolayer.

We have examined *inter alia* a number o œstrogenic compounds[2] of which the $p.p'$-dihy droxy diphenyl hexadiene and stilbene derivative form a definite series in which the ratio of hydrophobic to hydrophilic portion could be varied These show marked differences in œstrogeni activity with a sharp maximum at $p.p'$-dihydrox diphenyl hexadiene and $p.p'$-dihydroxy diethy stilbene or dibenzyl. The œstrogenic activity fall some thirty to fifty-fold on increasing or decreasin the number of CH_2 groups in the molecule by two

In the accompanying figure are shown th extents of interaction as measured by the chang in surface potential with a gliadin monolayer o a substrate buffered at pH 8 on injection o 3 mgm./100 c.c. of reactant into the substrate The œstrogenic activities of the various compound are likewise included. It will be noted that reaction sets in rapidly, but equilibrium is only finally attained after some 15–20 minutes, and t there is a parallelism between the œstrogenic ivity and the protein adsorption except in the first d the last members—points we shall refer to later.

We observe that in apparent conformity with ube's view there is a marked increase in sorption with increase in the number of CH_2 oups in the molecule, and that this adsorption cut down by the insertion of polar groups. This fect is clearly exemplified in comparing the thyl stilbene or dibenzyl compounds with the rresponding pinacols. If, however, reactive lar groups, for example, the phenolic hydroxyl, d been inserted instead of the primary alcoholic groups in the methyl or ethyl pinacols, a marked increase rather than a decrease in adsorption would have been observed, for the following compounds react in order of increasing adsorption on both amine and protein monolayers: cresol, *gallic acid, digallic acid, purpurogallin and tannic acid.* This order is, however, reversed to give a normal Traube series when these substances are injected under a relatively non-reactive monolayer such as a long-chain acid. A wide variety of substances have been examined from this point of view, namely, their extent of interaction with protein monolayers, and it has been found that there is a direct parallelism between their extent of interaction and their lethal action on Paramecia.



We note a further biological analogy in that long-chain hydrocarbon derivatives with one reactive polar group at the chain end penetrate monolayers and biologically possess lytic activity: if a second spaced polar group be inserted the lytic and penetrating properties are lost, the substance becomes an absorbant, is packed into the double layer beneath the film, and biologically acts as an agglutinating agent.

Another significant biological similarity has been noted when we measure the extent of penetration of a series of substances *containing identical* hydrophobic 'tails', for example, a C_{16} chain, but with different head groups into a monolayer of a typical lipoid such as cholesterol. In all cases the extent of interaction, as measured by the increase in surface pressure caused by the injection of 0·33 mgm./100 c.c. under a film of cholesterol, originally extended to 40 A.^{2} per molecule, is found to be closely parallel to the hæmolytic activities and lethal activities on Paramecia of these substances.

These latter can be placed in order both of monolayer penetration and of biological activity as follows:

$$R\overset{+}{N}H_3 > RSO_4' > RSO_3' > RCOO' > R\overset{+}{N}(CH_3)_3 >$$
$$R\overset{+}{N}H(CH_3)_2 > \text{Bile acids.}$$

We may conclude that the most reactive group in the protein macromolecule is the amino group since the -NH-CO- group is poorly reactive, a point of some interest when we examine the reactions of lecithin and of cephalin. This order of head group reactivity receives confirmation when penetration into monolayers containing these head groups is examined, that is, on inverting the system. When we compare the reactivities of a series of long-chain compounds with identical head groups, it is found that biological activity and film penetration commences at about C_8 when attached to a very reactive head group and reaches a maximum value at about C_{16}. It is interesting to note that it is not necessary for all the carbon atoms to be in the form of a chain; they may be enclosed in ring systems; thus activity commences with diphenyl derivatives. Optima are found in the bile acids, stearic acid, diethyl-stilbœstrol and benzpyrene oxidation products.

We have referred to the modification which must be introduced into either the Overton Meyer or Traube concepts of biological activity, namely, lipoid solubility or capillary activity necessitated by the concept of specific head group interaction. We see that a definite limit is also set to the hydrophobic portion of the molecule, for we must take into account both the decreasing solubility in the aqueous phase causing difficulty in transport and also the ease of adlineation or packing having an optimum of C_{16}. We find that a new phenomenon, as exemplified in the figure, sets in with long chains, namely, dispersion of the monolayer, most marked in the case of 4,4′-dihydroxy dipropyl stilbene. It is possible that this phenomenon of film collapse and dispersion may be a generally important factor in setting the upper limit to the chain length or, more generally, the capillary activity of homologous series of biologically important substances, such as anæsthetics. This dispersion of protein films may have biological counterparts in adsorption on specific portions of the cell surface similar to the hæmolytic activity of long-chain compounds such as oleic acid, which readily disperses protein films. Another interesting parallelism has been observed in the surface reactivities and œstrogenic powers of two isomeric compounds (*p.p′*-dihydroxy diphenyl hexane), one being markedly differentiated from the other in both protein adsorption and in œstrogenic activity. Here models indicate that the *trans* arranged rings can pack laterally with one another in sheet form much more readily and with a greater degree of adlineation than the *cis* structure, imparting stability to the adsorption complex formed with the former substance.

In advancing these somewhat novel principles, based upon the hypothesis of a parallelism of film reactions and biological activity, it is desirable to point out exceptions. It is found, for example, that the pinacol 4,4′-dihydroxy propiophenone is a much more effective œstrogenic agent than eith its paramecidal activity or adsorption on prote monolayers would suggest. The view might advanced that on certain living tissues it can partly converted by enzymatic reaction to eith the extremely active 4,4′-dihydroxy diphenyl hex diene or to dihydrostilbœstrol. Another interestin exception is to be found in desoxycholic aci which is the only hæmolytic agent in the bile ac (c. 1 : 550) series and is likewise poorly lethal Paramecia. It is unreactive to films of protei cholesterol and glycerides, and in fact a specif interaction with fatty acids is involved, an observ tion which may be of importance in considerin the emulsifying and transporting properties of th bile acids in the intestine.

This method of attack permits us to investigat the nature of the coatings of cells of unicellula animals and plants by examining the effects lipoid or protein film penetrating or adsorbin substances on them.

Thus both red cells and Paramecium ar affected by lipoid and protein monolayer pene trating (cytolysing) or adsorbing (agglutinating agents, and we deduce that their surface structure must contain lipoproteins or consist of a lipoi protein mosaic; whereas certain other unicellula animals frequently found associated with Para mecia and, in addition, cilia of *Mytilus* are no affected by protein adsorbants or dispersants bu are readily influenced by lipoid penetrating agents and their coatings in consequence must be chiefl lipoidal in nature.

Examination of the carcinogenic hydrocarbon by the monolayer technique reveals the interestin fact that, whilst they themselves are unreactive they are readily converted into extremely reactiv water-soluble unstable photo-oxidation products These substances are not only reactive to protei monolayers like the water-soluble dibenzanthra cene endosuccinate (see graph) but are also para mecidal, a general parallelism between the bio logical activity and monolayer reaction bein maintained.

Finally, it may be suggested that the concept of specificity which we draw from the principl that both polar and non-polar interaction par ticipate in molecular adlineation in monolayers, applicable to biological reactions in general present us with a set of principles which permi of direct experimental application and theoretica attack.

---

[1] Schulman, J. H., and Rideal, E. K., *Proc. Roy. Soc.*, B, 122, 29 (1937) Schulman, J. H., and Stenhagen, E., *Proc. Roy. Soc.*, B, 126, 35 (1938). Schulman, J. H., *Trans. Farad. Soc.*, 33, 1116 (1937) Marsden, J., and Schulman, J. H., *Trans. Farad. Soc.*, 34, 74 (1938). Cockbain, E. G., and Schulman, J. H., *Trans. Farad. Soc.* 35, 716 (1939).

[2] Dodds, Lawson and Campbell, NATURE, 142, 1121 (1938). Dodd Golberg and Robinson, NATURE, 142, 34 (1938); 141, 247 (1938 Dodds and Lawson, NATURE, 139, 1068 (1937). We are indebte to Prof. Dodds and Dr. Lawson for specimens of these derivative

OBITUARIES

Dr. Edward Kidson, O.B.E.

DR. EDWARD KIDSON, director of the Meteorological Office, Wellington, New Zealand, died ddenly on June 12 at the early age of fifty-seven ars.

Dr. Kidson belonged to a well-known Nelson and ristchurch family, but was born at Bilston, affordshire, on March 12, 1882. He received his hool and university education in New Zealand, aduating at the University of New Zealand with st-class honours in physics in 1904. His first post as that of assistant observer at the Magnetic bservatory, Christchurch, which led to his joining e staff of the Department of Terrestrial Magnetism the Carnegie Institution of Washington in 1908. efore the Great War he was engaged on magnetic rveys in South America, Newfoundland and ustralia, and he spent six months as magnetic bserver on the magnetic survey ship *Carnegie* longing to the Carnegie Institution.

During 1915–1919 he was on active service in the eteorological Section of the Royal Engineers with e Salonika Force. He was mentioned in dispatches d made O.B.E. for his war service. After the War returned to the Carnegie Institution and was ven charge of its Magnetic Observatory at atheroo, Western Australia. Kidson remained at atheroo from 1919 until 1921, when he joined the eteorological Service of the Australian Commonealth as assistant director.

In 1921 Kidson returned to New Zealand on being ppointed director of the Meteorological Office, ellington. The Meteorological Service of New ealand when Kidson took charge was in a very nsatisfactory state and the total staff numbered ly five. With characteristic energy he set to work build up a service based on modern scientific lines. idson's travels had kept him in touch with meteorogical progress in America and Europe; he was a an of science and appreciated the work of the orwegian school of meteorologists. He visited ergen in 1931 and 1935 and, aided by one of Dr. jerknes's assistants, who stayed a few months in ew Zealand on his return from the Antarctic, he troduced the Norwegian ideas into the work of his rvice and in this way broke new ground in the udy of meteorology in the southern hemisphere. e was fortunate in his choice of scientific assistants, nd with their aid built up a meteorological service, onsisting of forty-five members, which compares vourably from a scientific point of view with the eteorological service of any other country.

Kidson's own scientific work, with the exception f the reports he prepared on terrestrial magnetism hile on the staff of the Carnegie Institution, was evoted almost entirely to meteorology. He wrote xtensively on the climate of New Zealand, and as interested in the investigation of the upper atmosphere. He published papers on weather forecasting and the theory of tornadoes. He was particularly interested in Antarctic meteorology; his chief published work was a thorough discussion of the meteorological records of Shackleton's first expedition (1907–9) and at the time of his death he was on the point of completing a compilation and discussion of the meteorological data obtained on Mawson's later expeditions.

Kidson's sound scientific knowledge, coupled with a wide and sane outlook on international meteorological problems, was unsurpassed in the southern hemisphere, and his early death just at the time when such qualities are especially required is a real tragedy.

G. C. SIMPSON.

Dr. C. H. Mayo

DR. C. H. MAYO, who died on May 28, was one of the greatest of contemporary American surgeons. During his active career of nearly fifty years, he was associated with his elder brother, Dr. W. J. Mayo, in founding and fostering the Clinic in Rochester, Minnesota, which bears their name. In their lifetime, this has expanded rapidly until now it is a huge centre of medical and scientific effort, an expansion the more remarkable because of the small size of the town and its distance from main roads and railways.

Dr. Mayo's scientific work cannot be considered apart from the development of the Clinic. At an early date the brothers determined to devote the profits of the enterprise to the furtherance of medical education and research, and gradually brought together a team of workers which included clinicians, experts in preclinical subjects and, notably, experts in the related sciences of biochemistry and biophysics. Thus their object has come to be the intensive study of all aspects of disease, as well as its treatment. This type of organization was an admirable background for Dr. Mayo's substantial contributions to the surgery of the thyroid gland. He was one of the earliest to operate for thyrotoxicosis, and did much to eliminate the technical difficulties associated with this procedure. Later he was able to utilize the discovery by his colleagues, H. S. Plummer and Boothby, that the administration of iodine reduced the dangers of operation, and to add and adopt further refinements in pre-operative and post-operative care, and in surgical technique. His work on transplantation of the ureters to the colon in cases of ectopia vesicæ was also outstanding, and in his hands this was a safe and satisfactory operation. He approached the problem as a biologist, and in inducing the rectum to function as a cloaca he displayed great technical ingenuity and a sturdy respect for the conservation of renal function.

Dr. Mayo was essentially a general surgeon, and his nimble mind attacked and solved many diverse problems of technique. In the operating theatre he combined wise conservatism with amazing resourcefulness, and one of his delights was to introduce and perfect operative details, many of which are in general use. His reputation was international, and this, with his personal charm, made him a welcome figure at surgical meetings the world over. Based as they were on great experience and uncommon clinical acumen, his opinions were listened to with respect, and both abroad and in the Clinic he did much to secure the free interchange of surgical ideas and ideals.

Prof. Edgar Zunz

WE regret to announce the death on June 11 after a short illness of Dr. Edgar Zunz, professor of pharmacodynamics and therapeutics in the University of Brussels and an eminent personality in the Belgian medical world. He was born at Charleroi on November 9, 1874, and received his medical education at Brussels where he qualified with distinction in July 1897. Having won a travelling scholarship, he spent some time at Heidelberg in studying organic chemistry in Gattermann's laboratory, and later at Strassburg in Hofmeister's laboratory of biochemistry and at Bern under Kronecker, the physiologist. On his return to Brussels in 1900 he was appointed assistant to Prof. Victor Jacques in the laboratory of pharmacodynamics and therapeutics. In the following year he presented a thesis to the University of Brussels on the digestion of albuminoid substances, which gained him the degree of doctor in physiological science. In 1906 he was appointed an *agrégé* in the Brussels medical faculty, and gave a course of practical demonstrations in medical chemistry. In 1909 he became lecturer to postgraduates in toxicology and in 1913 instructed students in the elements of pharmacography. During the War he did valuable work as director of the medical department including the care of the gassed at the Ocean Ambulance at La Panne. In 1919 he was appointed professor of pharmacodynamics and therapeutics in the Brussels faculty of medicine and held this post until his death.

Zunz was a remarkably fertile writer. His two chief works were his treatises on general and special pharmacodynamics published in 1930 and 1932 respectively. He also collaborated with Prof. Terroine in a work on basal metabolism (1925), and contributed articles on coagulation of the blood to Roger and Binet's text-book of physiology and on the regulation of the composition of the blood to the fourth volume of the "Encyclopédie Française". He further contributed many papers to Belgian and foreign journals on the digestion of proteins, the properties of proteoses and peptones, coagulation of the blood, secretion of adrenalin and insulin, action of the alkaloids of opium, the process of digestion, phenomena of adsorption and surface tension, and the effects of poison gases. He took an active part in the campaign against alcoholism and was president of the International Congress Against Alcoholism held at Antwerp in 1928 as well as president of the scientific committee of the World Union Agai Alcoholism.

Zunz was the recipient of many honours. In 1 he was elected a member of the Belgian Ro Academy of Medicine, of which he became presid in 1934, and in the following year was president of annual congress known as the Journées Médicales Bruxelles. He was also an Officer of the Order Leopold, Commander of the Order of the Crov Officer of the Legion of Honour, honorary doc of the University of Montpellier and correspondi member of the Royal Academy of Medicine of Ron

J. D. R

Prof. Rudolf Fick

PROF. FICK, who died on May 23 at the age seventy-three years, retired from the chair of anato in the University of Berlin in 1935. He brought do to the rising generation of German anatomists t great traditions of Gegenbaur and of Koellik Indeed Prof. Fick's first appointment was in Koellike department at Würzburg. His earliest research wo was on the ripening of the cells of reproduction, whi led to his becoming assistant to Wilhelm His Leipzig. There the nature of his inquiries took a n direction; he applied to the study of the human bo a more complete understanding of mechanics th had been done previously. The results of his studi are embodied in his "Handbuch der Anatomie u Mechanik der Gelenke" (1904–1911; 3 vols.). H fellow anatomists admired his researches more th they studied them. In all he did there are to be se care and accuracy. This is particularly true of h pioneer research into the anatomy of the orang- carried out on adult animals which died in t Zoological Gardens of Leipzig towards the end of t nineteenth century.

Prof. Fick was born in Zurich, the son of t distinguished physiologist. Although born in Swi zerland he was intensely German in feeling and aspiration. From an assistantship in Leipzig he w appointed to the German University in Prague 1905. Four years later he was invited to Innsbruc In 1917 he was called to Berlin to fill the highe post in anatomy in Germany—a prize award perhaps more because of his outstanding meri as a man than of the importance of his research in anatomy. His chief aim in life was to teach h students; he preferred to spend his energies and tim in the preparation of anatomical specimens to illu trate his lectures rather than on researches for t advancement of anatomy.

WE regret to announce the following deaths:

Mr. Henry Havelock Ellis, a pioneer in the psych logy of sex, on July 8, aged eighty years.

Prof. R. I. Meyer, editor of the latest edition "Gmelin's Handbuch der Anorganischen Chemie" known for his work on the rare earths, on June 1 aged seventy-four years.

Prof. G. E. Nichols, professor of botany an director of the Botanical Gardens at Yale University on June 20, aged fifty-seven years.

NEWS AND VIEWS

rof. F. C. Minett

FRANCIS COLIN MINETT, who has just been ap- ointed director of the Imperial Veterinary Research stitute of the Government of India, was educated King Edward's School, Bath, from 1899 until 907, and in the latter year entered the Royal eterinary College. Two years after obtaining the iploma of membership of the College, he was warded a Ministry of Agriculture research scholar- hip and studied at the Pasteur Institute in Paris nd at the Veterinary School in Alfort. On the out- reak of the Great War, he joined the R.A.V.C. and roceeded to France with the Expeditionary Force. n the following year he returned to Aldershot, here he was engaged in research and in the pre- aration of mallein for the diagnosis of glanders—at hat time a problem of urgent military importance. rom 1921 until 1924 he served in Egypt, and in the atter year resigned his commission upon receiving n appointment under the Foot-and-Mouth Disease ommittee. He was awarded the D.Sc. in veterinary cience of the University of London in 1927, and in he same year, upon the retirement of Sir John McFadyean, was appointed director of the Research nstitute in Animal Pathology at the Royal Veterinary College, and, in 1933, when the posts became amal- gamated, he was appointed professor of pathology nd director of the Research Institute.

DURING the past twelve years, Prof. Minett has contributed generously to the study of many problems associated more particularly with diseases of economic mportance among farm animals. In this connexion, special reference should be made to his work upon bovine mastitis, Johne's disease and contagious abortion of cattle, as a result of which, measures for the more effective control of these diseases have been established. Important as his researches have been, it is safe to say that one of his chief claims to recognition lies in his ability as a teacher. Indirectly, as well as by direct contact with his students and junior members of his research staff, he has advanced the study of veterinary pathology to a marked degree.

Bicentenary of Du Fay (1698–1739)

ON July 16, 1739, the death occurred of the French man of science, Charles-François de Cisternay du Fay, who though he wrote memoirs on many subjects and was superintendent of the Jardin des Plantes, is remembered to-day for his electrical experiments and observations. Born in Paris on September 14, 1698, he was an officer in the French Guards, and for a time followed a military career. Ill-health, however, led to his resignation and he then turned to literary and scientific pursuits. He was admitted to the Academy of Sciences in 1733 and contributed papers on geometry, astronomy, mechanics, chemistry and botany. He was especially interested in the electrical experiments of Stephen Gray, and suspending himself by silk cords, as described by Gray, he observed that when he was electrified, and another person came near, there issued from his body pricking shoots, making a crackling noise. The Abbé Nollet (1700–70) was associated with these experiments, which he afterwards extended. Du Fay also discovered two kinds of electricity which he named the *vitreous* and *resinous*, and he made attempts to formulate a theory of electric phenomena. A man of great industry, as superintendent of the Jardin des Plantes he did much to rescue that institution from neglect, and it was through him that Buffon became his successor.

Julius Cohnheim (1839–1884)

PROF. JULIUS COHNHEIM, the eminent experimental pathologist, was born on July 20, 1839, at Demmin in Pomerania. He studied medicine at the universities of Würzburg, Marburg, Greifswald and Berlin, where he qualified in 1861 with a thesis on suppuration in serous membranes. After acting as an assistant to Virchow in Berlin and serving as an army surgeon in the war with Austria, he was appointed professor of morbid anatomy at Kiel, where he remained until 1872. He was then transferred in a similar capacity to Breslau and finally occupied the corresponding chair at Leipzig in 1878, where he stayed until his death six years later. Cohnheim was a highly skilled technician, and made several valuable contributions to microscopical science, among which may be mentioned his methods for demonstrating the nerve endings in the cornea, the structure of striated muscle and the phenomena of inflammation. His successful inoculation in 1868 of tuberculosis in the anterior chamber of a rabbit's eye, thus proving the disease to be infectious, is an important landmark in the history of tuberculosis. His principal literary work is represented by his lectures on general pathology published in 1877–80 and translated in 1888–90 in the New Sydenham Society's publications, in which he dealt with the pathology of the circulation, nutrition, digestion, respiration, genito-urinary organs and animal heat. He also published several valuable articles on malignant growths, trichinosis and the bone marrow in anaemia. His stimulating lectures attracted a large number of students from all parts of Germany, and he had many men who later became eminent among his audience, including Heidenhain, Litten, Welch and Neisser at Breslau and Roy and Councilman at Leipzig. He died at the early age of forty-five years on August 15, 1884, from the effects of gout.

New Long-Distance Air Liner

PRELIMINARY details of a new civil transport aeroplane, the Fairey C.I., have just been made public. It is a low-wing monoplane fitted with four Bristol 'Perseus' sleeve-valve engines of 1000 h.p. each. The body is of a circular section monocoque construction, arranged to carry thirty passengers.

The undercarriage is of tricycle form so placed that the machine can land and stand with the cabin horizontal, which will increase the comfort of the passengers and facilitate loading up when on the ground. The wheels are retractable during flight. The cabin is air-tight, and conditioned air at ground-level density is maintained when flying at altitudes. The machine is fitted with an automatic pilot, relieving the pilot of most of his physical work, and making him more analogous to the captain of a ship. The whole of the mechanical detail is controlled from the flight engineer's cabin, who has actually sixty-four dials on his instrument board, dealing with matters varying from engine and flying performance down to the condition of the air in the cabin. A new feature of this machine is an auxiliary wing that can be retracted when not required. It is shaped like the more familiar trailing edge flap, and thus can be used as an air brake for reducing landing speeds as well as providing the extra surface for increasing the flying speed range. This additional surface allows for a wing loading of 25 lb. per square foot for taking off and landing, which is increased to 32 lb. per square foot while flying with it retracted. The estimated speeds of the machine are 275 m.p.h. maximum, and 220 m.p.h. cruising, and its air endurance with the full load of passengers will enable it to operate non-stop to any European capital. With a decreased pay load it will be capable of fast non-stop services on the Empire routes.

Neanderthal Man in Italy

IN more respects than one, the discovery of a skull of Neanderthal man in the Guttari cave at Monte Felice Circeo, about sixty miles south of Rome, is of unique significance for the study of the chronology and distribution of Mousterian man in Europe of the palæolithic period. Owing to conditions affecting the use of the cave by man, it is possible to fix the date of occupation within tolerably accurate limits, while the sealing of the cave in Mousterian times which brought that occupation to a close, has not only preserved the evidence of Neanderthal man and his domestic economy intact but also saved it from the superposition of the debris of subsequent intrusions—conditions unique in caves of Mousterian occupation. The skull, now the third of the type known from Italy, was found on February 25, 1939, by Dr. A. C. Blanc of the University of Pisa, who with the Abbé Breuil, discovered the second of the Italian Neanderthal skulls. Dr. Blanc had already examined thirty-one caves at Monte Circeo and found in them evidence of both the Mousterian and Aurignacian cultures, but the present find was made in a cave which had been discovered on the previous day only by its owner, S. A. Guttari.

THE skull lay on the floor of an inner chamber of the cave among stones which appear to have been laid in a circle around it, while underneath it were bones of Equus, Bos, Cervus and Sus, some of which had been intentionally flaked. The floor of the whole cave was covered with fossilized mammalian bones, antlers and skulls, including, in addition to tho mentioned, hyæna and others, while elephant bon were found in a pool. All belonged to a war climatic phase. This Neanderthal skull is the mo perfect yet known, and in size approaches that La Chapelle aux Saints. A fracture of the rig temporal region points to a violent death; and t base of the skull has been opened extensively an the greater portion of the occipital foramen d stroyed. The date of occupation is fixed by relatio to the oscillation of sea-level at somewhere betwee 130,000 and 70,000 years ago; and Sir Arthur Keit who contributed a prefatory note to an accoun with illustrations, of Dr. Blanc's discovery in th *Illustrated London News* of July 5, regards the relics of Neanderthal man as contemporary with th lowest level of the Grotte des Enfants, Mentone.

Recent Additions to the British Museum (Bloomsbury

SOME striking examples of West African art wer among the more important of the recent addition to the ethnographical collections of the Britis Museum, which were reported at the meeting of th Trustees on July 8. Of these one was a gift of th National Art Collections Fund—a cast bronze hea which was excavated at Ife, the religious centre o the Yoruba people, and is said to represent Olokun the Yoruba deity of the sea. Discovered in 1938, i is in good condition, and shows traces of red pain on the head-dress. Probably it belongs to th fifteenth or sixteenth century, though the date i uncertain. Its modelling is of a quality uniqu among the artistic productions of negro Africa, and bears comparison with the finer sculptures of civilized art. The second example of African art is a carved ivory tusk from Benin, which bears figures of fish and animals, symbolizing the king in his supernatural aspects. There is a receptacle for magical 'medicine at the larger end. No similar example is known. The gift to the Department of Manuscripts of the diaries of Robert Needham Cust, an Indian civil servant well known as an orientalist among scholars of the nineteenth century, will be welcomed by all who are interested in the history of Indian and oriental studies. The diaries were presented by his son, Mr. R. H. H. Cust.

Utilization of Coal

THE British Coal Utilization Research Association held its first annual meeting in London on June 28, when Sir Evan Williams, the president, gave an account of its first year's work, which has been largely concerned with the erection and organization of its research station in Fulham. It has been a subject of reproach that the coal industry has been largely indifferent to promoting efficiency in the utilization of coal. They now foresee, the president said, that the future will call for fuels of accurately controlled characteristics; the development of these is being investigated. The programme of research includes work on pulverized fuel firing which, it is believed, will play an increasingly important part in industry, and also on combustion in the fuel bed.

he study of producer gas is to receive greater tention in view of its present importance in heavy dustry and its potential application to mechanical ansport. Great store is laid by the coal industry n the open coal fire, and efforts are being made to inimize its admitted defects—smoke and labour. is recognized that coal-burning appliances have ffered in comparison with gas and electrical ppliances owing to the neglect of scientific principles design, and it is hoped to raise the standards of erformance and eliminate inferior and ineffective ppliances. Efforts are being made to advance the se of coal for cooking. A solid fuel cooker has been esigned for use on railways. Some of these have een installed on trains, including the *Coronation cot*. It is believed that gravity feed firing will play considerable influence on hotel and institution ookery in the future.

Collective and Economic Security

POLITICAL and Economical Planning (P E P) has ssued two broadsheets dealing with the economics of ollective security and instruments of economic ecurity. In the former, relations between economic olicy and a fresh effort to realize collective security re discussed and the necessity of military support or economic collaboration is emphasized, and the mportance of ascertaining how far geography and he balance of strategic forces would permit military ssistance if needed before inviting smaller countries nto a system of collective economic security. The maintenance of peace through collective political and conomic security involves the application of principles similar to those which would be appropriate in ime of war. The measures of self-defence now equired of a system of collective security may be lassified as those required for preserving and promoting the free exchange of goods and services between members of the system; steps needed to nsure that the advantages of participation in economic relations on those terms should no longer be available to nations which do not subscribe to the conceptions inherent in the free exchange system and which now only participate in that system to destroy; and measures for extending assistance to neutral countries to enable them with safety to enter the orbit of the free system. Civilization's resources, it is urged, should be used to maintain civilization, and the main economic implications of a policy of collective security are discussed in some detail, including the question of reciprocal aid, the utilization of limited resources, the difficulty of overvalued currencies, the possibility of organizing markets and Nazi political and economic exploitation. If civilization is to be preserved it cannot be in isolation. Its basis is international, and there is no alternative to collective measures.

THE second broadsheet, emphasizing the need for industrial reorganization, classifies the possible measures under four heads, according to their connexion with Government commercial policy, with the improvement of trading methods, with the finance of international trade and with export and import subsidies. The absence of any coherent British trade policy is criticized. The United Kingdom has a strong bargaining weapon for securing increased reciprocity in commercial relations with individual States in view of the importance to them of British import purchases, and it is suggested that 'most favoured nation' treatment might be withheld from countries which resort to unfair trade practices. Much could still be done to improve the mechanism of economic co-operation and the importance of control schemes and cartels being operated in the public interest and particularly in the interests of economics is stressed. The questions of export credits, import subsidy, and of selecting the appropriate measure for different purposes are then discussed, the final emphasis being laid on the need for more moral courage to form the nucleus of a system of collective economic security in which the benefits of free exchange would be limited to the free exchange group.

Employment in 1938

THE report of the Ministry of Labour for the year 1938 shows that on the average for the year the numbers in employment were about 120,000 less than in 1937 although higher than in any previous year except 1937, and more than 20 per cent higher than in 1924, when the series of comparable statistics was begun (Cmd. 6016. London: H.M. Stationery Office, 1939. 2*s*. net). The seasonal fluctuations were less than usual, the maximum variation in the rate of unemployment among insured persons in the general scheme being only 0·5 per cent as against variations of from 2 to 5 per cent in previous years. Seasonal improvement in the first half of the year, however, was much less marked than usual in the building and contracting industries, brick manufacture and the distributive trades, and was almost entirely offset by a decline in metal and metal goods manufacture, engineering, the textile industries, especially in the cotton industry, and the normal slackening in coal mining. In the second half of the year the seasonal decline in building and public works contracting, transport, distribution and the hotel and boarding-house service was counterbalanced by improvements in the textile industries, metal goods manufacture, and the vehicle and mining industries. The effects of the recession of 1937–38 were spread very unevenly over different areas of the country, being most marked in the north-western area, in which employment declined by 7·5 per cent, mainly through contraction in the cotton industry. Wales suffered severely with a fall of 5·4 per cent, mainly in the iron and steel and tin-plate industries. In the Midlands there was a fall of 3·4 per cent and in the south-eastern division no change.

REFERENCE is made in the report to the policy of the Ministry in regard to the admission of foreign workers. Of the 22,347 permits granted during the year, 61·7 per cent were for employment in private domestic service. The figures do not include persons admitted to the United Kingdom by the Home Office as refugees and who have been allowed to enter into employment as domestic servants in private households. The Government policy of locating new factories and other establishments required in connexion with the defence programme in areas of heavy unemployment, so far as strategic and other practical considerations allow, has led during the year to the setting up of new establishments employing many thousands of workers in the Special Areas and in other areas of heavy unemployment. With regard to juvenile employment, the report points out that the estimated number of juveniles aged 14–17 available for employment was about 159,000 less than at the end of 1937. The numbers aged 14 entering the industrial field have been decreasing since 1934, and by 1934 the decline in the birth-rate after 1920 had influenced the numbers in the whole 14–17 group. Although prospects of employment for juveniles remained fairly good in most parts of Great Britain, they were less bright than in 1937.

British Trust for Ornithology

THE fifth annual report of the British Trust for Ornithology reveals the remarkable progress made in the co-ordination of field studies in Britain in recent years, and much space is given to the results of these field investigations. They include the lapwing habitat inquiry, and that of the distribution of the corncrake, which is to be continued this year. In 1938, 1200 completed returns were received referring to the corncrake and noting its decreasing numbers, most marked in Ireland and least in Scotland; efforts are being made to get information from the Continent, where the species is also decreasing. The survey of black-headed gull colonies had 150 observers, and shows that few coastal counties have been colonized in the past twenty-five years, but there has been a marked inland spread. The sample census of heronries shows an increase of breeding stock in many places, and three heronries in England now have between 120 and 150 nests. The bridled guillemot inquiry shows that few of this variety are in the English and Welsh colonies, but the percentage increases from about lat. 56° N. The woodcock inquiry showed by ringing that occasional British woodcock accompany the winter migrants when they return to their native breeding haunts. The woodland bird inquiry gave special attention to the British sub-species of birds, which can be divided into four groups showing thirty-seven distinctive races of bird entirely confined to Britain. A new inquiry on the redshank is planned for 1939–40 and a hatching and fledging inquiry will extend nationally the work started at Whipsnade Bird Sanctuary.

Tuberculin Tests in Cattle

BOVINE tuberculosis is one of the most serious scourges that afflicts cattle in Great Britain, causing an annual loss which has been estimated to amount to £2,000,000 annually. The disease in dairy herds is also responsible for much human tuberculosis, particularly in children. The eradication of tuberculosis from herds is now receiving serious attentio The detection of tuberculous animals by means the tuberculin test is employed in all schemes f the eradication of bovine tuberculosis, but in rece years modifications in methods of preparation tuberculin and in its application have been intr duced. The need for detailed research into vario problems associated with the tuberculin test w recognized by the Joint Tuberculosis Committee the Medical Research and Agricultural Resear Councils, and work on the subject was undertak at the Institute of Animal Pathology, Cambridge, b Prof. J. B. Buxton and Mr. R. E. Glover, and t results of their investigations are published in report issued by the Agricultural Research Counc ("Tuberculin Tests in Cattle". H.M. Stationer Office. 1s. 6d. net). After dealing with the differen methods of applying the tuberculin test, sections a devoted to the value of several types of tuberculi sensitization and desensitization of tuberculous an non-tuberculous cattle to tuberculin, and the po sibility of 'doping' against the various tests. Exper ments are also described in which attempts wer made to sensitize normal cattle to tuberculin itsel and finally, the significance of reactions, resultin from infections with organisms closely allied to th bovine tubercle bacillus, is discussed.

University of London: Principal's Report

IN recent years a corporate university spirit ha made itself increasingly felt in London. Its growt has, naturally, been stimulated by the erection o the imposing block of central buildings in Bloomsbur and the grouping there in association with them o several important schools and institutes. It wi receive a further notable impulse from the openin of the new Students' Union. The Union has alread proved its value as a centre of student life, and Lor Nuffield's gift last year of £50,000, added to a gran of £25,000 from the National Fitness Council an one of £35,000 from the University Grants Committee has enabled the Court to proceed to the constructio and equipment on a generous scale of a permanen home for it. Among other interesting items of th Principal's report may be mentioned: a close association with external students through a ne system of communicating detailed examination result to all Intermediate Examination candidates and t the institutions responsible for their training; a ne Certificate in Natural History for prospective teacher of nature study in primary schools; and the establishment of an editorial board under the chairmanship of Sir Bernard Pares, who is retiring from the directorship of the School of Slavonic and East European Studies, to be responsible for the publication of the *Slavonic and East European Review*.

New Entomological Journals

THE Entomological Society of Southern Africa was founded in 1937 and the first volume of it *Journal*, dated March 30, 1939, has come to hand. It contains seven papers, covering a very wide range of subjects, including taxonomic studies on Diptera

(B. de Meillon, H. K. Munro), the biology of a nest-living Sarcophagid (A. Cuthbertson), studies of new Thysanoptera (C. Jacot-Guillarmod), descriptions of South African moths (A. J. T. Janse), the control of temperature and humidity in small cabinets (M. N. S. Immelman) and finally on the general classification of insects (J. Omer-Cooper). The journal is excellently printed and illustrated, and the first volume, including also index, obituary notices and list of members of the Society, extends to 163 pages. It is obtainable from the Honorary Secretary of the Society, P.O. Box 103, Pretoria, South Africa, and from N. V. Swets and Zeitlinger, Keizersgracht 471, Amsterdam, Holland. The price of the volume is £1 2*s.* 6*d.*

It is announced in the *Bee World* that an All-India Bee-Keepers' Association has been founded with an official organ, the *Indian Bee Journal*, the first issue of which appeared in January 1939. Owing to various causes, modern apiculture has an uphill journey in order to take its appropriate place in the scheme of Indian agriculture. The difficulties are being surmounted and the inauguration of the above Association and its *Journal* is likely to become an important factor in future progress. The address of the Association is Jeolikote, Naini Tal, U.P., India, and the annual subscription to the *Journal* is 3 rupees for one year, and proportionately less for two or more years.

Earthquakes during April 1939

According to the Central Seismological Bureau at Strasbourg there were 152 earthquakes each recorded at more than one observatory or experienced by people during the month of April. This was 52 more than during March (Nature, June 10, p. 988). The greatest number recorded on any one day was on April 6, when 14 occurred, and the least number recorded on any one day was 2 on each of April 8, 9, 28 and 30. The most important shocks during the month were probably those of April 1 (strength VIII) felt near Mostaganem in Algeria, April 18 at 6.23 G.C.T. in Chile (epicentre 27° S., 70° W. approx.), and that of April 30 felt at Guadalcanar and several other places in the Solomon Islands. The next most intense were the earthquakes of April 5 with epicentre near 20° S., 168° W., in the New Hebrides, April 21 at 4.29 G.C.T. (epicentre near Yeso), and April 23 at 16.23 G.C.T. (epicentre in the Atlantic near 1° S., 17° W.). Apart from these individual shocks there appears to have been a good deal of moderately intense seismological activity in Italy as earthquake shocks have been experienced at Livorno on more than one occasion, in the Frioul district and near Mont Amiata.

British Standards for A.R.P. Requirements

The Home Office Air Raid Precautions Department has arranged with the British Standards Institution to prepare and issued on its behalf a special A.R.P. series of British standards for air raid precautions purposes. The preparation of these standards will be under the control of a special advisory committee, and in accordance with the usual practice of the British Standards Institution will be carried out in the closest co-operation with Government departments and the industry concerned. All communications relating to this work should be addressed to the British Standards Institution, 28 Victoria Street, Westminster, S.W.1.

Research in Pathology at Leeds

The report for the years 1937 and 1938 of the Department of Pathology and Bacteriology of the University of Leeds, by Profs. Matthew Stewart and J. W. McLeod, has recently been issued. A summary of the routine examinations carried out is first given, followed by abstracts of the research work that has been done. This includes investigations on cases of silicosis and asbestosis, studies on the morbid anatomy and histology of chronic arthritis and its treatment with gold salts, and investigations on the morbid histology of diphtheria caused by the three types of the diphtheria bacillus. A report on cancer research is also contributed by Prof. R. D. Passey.

Conference on Engineering Education and Training

A Conference on Engineering Education and Training will be held at the Institution of Civil Engineers during February 6–8, 1940. Sir Clement Hindley, president-elect of the Institution, will preside over the Conference, which is being organized by a general committee representative of engineering institutions, universities, technical schools and colleges, engineering consultants, industrial organizations, Government departments and other interests. It is proposed to publish a number of papers, to be circulated in advance, which will form the basis of discussion at the technical sessions of the Conference. Inquiries should be addressed to the Secretary, Institution of Civil Engineers, Great George Street, London, S.W.1.

Two Large Sunspots

Two large groups of sunspots were conspicuous on the sun's disk during the past week. The larger of these groups, in latitude 4° south, appeared over the sun's east limb on July 3 and became a complex group with an area exceeding 1700 millionths of the sun's hemisphere. Its time of central meridian passage was July 9·3 U.T. The other group arose from a pair of tiny spots seen on July 4 in north latitude 6°. Shortly after its central meridian passage on July 8·2, it had reached an area of 1000 millionths.

British Empire Cancer Campaign

At the seventy-first quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on July 10, the following grants were approved: £400 to Mount Vernon Hospital for the employment of Prof. F. Weigert for research on a special biochemical problem; £495 to the Strangeways Research Laboratory, Cambridge, for the salary of its physicist, Dr. D. E. Lea, and £400 to Sir Robert Muir and Dr. P. R. Peacock for research to be carried out at the Glasgow Royal Cancer Hospital by Dr. Stephan Beck. This brings the total grants made to date by the Campaign for cancer research for the year 1939 to more than £49,000. The formation of a University of Cambridge Research Centre of the British Empire Cancer Campaign was approved. The initial Committee to supervise this Centre will consist of the Vice-Chancellor, Prof. H. R. Dean, Prof. J. A. Ryle, Sir Frederick Gowland Hopkins and Dr. Honor Fell, augmented later by other scientific workers at Cambridge. In future this Centre will co-ordinate all the cancer research being carried out at Cambridge and will itself initiate and direct research in the same way as the recently formed University of Oxford Research Centre of the Campaign. The Grand Council acceded to the request for affiliation from the Cancer Research Fund Committee (1934) of Northern Ireland, which now provides a link between the work of the Campaign and the cancer research being carried out at the University of Belfast and in Ulster generally. The following were elected members of Grand Council: Prof. J. A. Crowther (professor of physics in the University of Reading), Dr. H. T. Flint (director of physics at Westminster Hospital), Dr. R. W. Scarff (honorary secretary of the Scientific Committees of the Campaign) and Mr. D. G. Walker to represent the British Dental Association.

The Colonial Service: Recent Appointments

THE following appointments and promotions in the Colonial Service have recently been made: W. T. S. Brown, assistant conservator of forests, senior assistant conservator of forests, Gold Coast; F. S. Danks, assistant conservator of forests, Cyprus, assistant conservator of Forests, British Guiana; H. W. Moor, senior assistant conservator of forests, divisional conservator of forests, Gold Coast; G. M. Tolmie, assistant conservator of forests, senior assistant conservator of forests, Gold Coast; B. E. Frayling, chief inspector of mines, Tanganyika Territory, chief inspector of mines, Nigeria; J. K. Cox, inspector of plants and produce, agricultural superintendent, Gold Coast.

Announcements

DR. EMIL ABDERHALDEN, professor of physiology at Halle, and Dr. Max Planck, professor of theoretical physics at Berlin, have been elected honorary members of the Société Philomathique of Paris.

LORD HORDER has been elected president of the National Society for the Prevention of Venereal Diseases in succession to Sir Basil Peto, a founder-member and president since 1926.

AN exhibition is being arranged at the Science Museum, South Kensington, in conjunction with the Royal Photographic Society and the photographic industry to illustrate the history of photography from the time of its inception in 1839 down to the present day. The exhibition is being opened by the Marquess of Salisbury on July 20, and will be open to the public on July 22 for five weeks.

A SYMPOSIUM on "Growth and Development" to be held at North Truro, Massachusetts, during August 7–11 has been organized by the journal *Growth*. Grants towards the cost of the conference have been received from the Macy and Rockefeller Foundations. The topics for discussion, with their principal speakers, are: cell-division and differentiation (Prof. W. H. Lewis, Prof. P. W. Gregory); genes and development (Prof. Curt Stern, Dr. C. H. Waddington); chemical factors (to be announced) (Dr. J. Needham); regeneration, organization (O. E. Schotte, Prof. E. W. Sinnott); concept of organism (Dr. J. H. Woodger). Further information can be obtained from Dr. Philip White, Rockefeller Institute for Medical Research, Princeton, New Jersey.

THE People's League of Health has organized a scheme of clinical research to determine the influence of diet on expectant and nursing mothers in relation to maternal mortality and morbidity. Systematic observation and records are being collected at the ten London hospitals which are co-operating with the League in this research.

ACCORDING to the Central Dutch Office of Statistics, the average duration of life in men is at present 65·1 years and in women 66·4 years as compared with 38·4 and 40·7 during the period 1870–1879. The infant mortality, which was then as high as 22 per cent in males and 20 per cent in females, is to-day only 5 and 4 per cent respectively. During 1870–1879 only 7·6 per cent of Dutchmen reached the age of eighty years, whereas in 1931–1935 no less than 25 per cent reached that age. Holland has consequently the lowest mortality in Europe.

THE Council of the Royal Society of Arts offers a prize of £25 under the Thomas Gray Memorial Trust for an invention, publication, diagram, etc., which is considered to be an advancement in the science or practice of navigation, proposed or invented in the period January 1, 1934 to December 31, 1939. Under the same trust, a prize of £25 for an essay on "The Carriage of Dangerous Goods by Sea" is offered. Further information can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.2.

A RESEARCH scholarship of the value of £250 per annum and tenable for two years has been founded by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a Committee of the Institution of Naval Architects and it is hoped to make the first award in September 1939. Further information can be obtained from the Secretary, Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 119.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Glutamic Acid of Tumour Proteins

IN analysing tumour proteins, we[1] have isolated without exception partially racemized glutamic acid. However, Chibnall and co-workers[2] recently reported he isolation of optically pure $l(+)$-glutamic acid in our cases. These authors did not use the same method which we employed, but a different procedure which is excellent for the rapid and efficient isolation of natural glutamic acid from standard proteins.

Prof. Chibnall kindly sent us a copy of his preiminary note so that we could immediately carry out corresponding experiments.

The essential difference in the method of the British authors lies in a preliminary purification of the dicarboxylic amino-acids by precipitating them twice as the calcium salts[3] from 90 per cent alcohol. We have investigated the solubility of the calcium salts and found that the calcium-d,l-glutaminate is at least ten times as soluble as the calcium salt of the l-glutamic acid in 90 per cent alcohol. Although the pure racemic salt is relatively insoluble, the abovementioned difference can become very important through the tremendous influence of contaminating material in crude extracts, which is well known to all those who have isolated active principles from natural sources.

In our laboratory in recent months, Mr. A. M. Akkerman has investigated the 'ternary' system of d- and l-glutamic acid hydrochlorides in 20 per cent hydrochloric acid at 0° C. It was found that the d,l-hydrochloride is not a racemic compound but a racemic mixture (conglomerate); the solubility of which is exactly twice as great as that of the hydrochloride of $l(+)$-glutamic acid. Since we precipitate the crude glutamic acid by saturating the aqueous solution with hydrochloric acid at 0° C., we have also studied the solubilities in this concentration and found that, although both forms are less soluble, they showed quite the same difference in solubility.

In order to test the effects of these solubility differences upon the isolation, we have fractionated a mixture containing 75·5 per cent of pure l- and 24·5 per cent of pure d-glutamic acid according to the method of the British authors. We obtained 66 per cent of the l-glutamic acid originally present in the mixture in pure state ($[\alpha]_D = +31{\cdot}4°$).

The influence of accompanying substances is shown in the following experiment in which we used the hydrolysate from dried calf's embryo from which we had previously been able to isolate optically pure l-glutamic acid by our method. 600 mgm. of d,l-glutamic acid were added to the hydrolysate from 20 gm. of embryo tissue and the mixture fractionated according to the method of Chibnall *et al.* We obtained 1·16 gm. of pure l-glutamic acid hydrochloride ($[\alpha]_D = +31{\cdot}2°$). In a second experiment 700 mgm. of d,l-glutamic acid were added to 7·8 gm. of an alcohol precipitate which was prepared from the same embryo tissue in a previously described manner[1]. The fractionation, when done according to the method of the British authors, yielded 506 mgm. of pure l-glutamic acid hydrochloride ($[\alpha]_D = +31{\cdot}4°$).

Since the criticism might be raised that the depressions of optical rotation in our preparations of glutamic acid from tumours could be caused by analytically undetectable impurities having opposite rotation, we have attempted the isolation of the $d(-)$-glutamic acid. A resolution of the partially racemic glutamic acid by E. Fischer's[4] procedure was not practicable since benzoylation itself produces a partial racemization. We have therefore treated a partially racemic glutamic acid from Brown-Pearce tumours with fermenting yeast according to the method of F. Ehrlich[5] and were indeed able to isolate pure $d(-)$-glutamic acid ($[\alpha]_D = -31{\cdot}2°$).

In conclusion, it can be said that the method as it is employed by Chibnall *et al.*, in spite of very good yields obtained in the isolation of ***natural*** glutamic acid, appears not to be applicable for detecting the ***partial racemization*** of glutamic acid. In employing the method which we used, we recommend the inoculation with crystals of both enantiomorphs after saturation with hydrochloric acid, and further the recrystallization with the least possible loss of material. Details of our experiments will appear in the ***Zeitschrift für physiologische Chemie***.

F. KÖGL.
H. ERXLEBEN.

Organisch chemisch Laboratorium,
Rijksuniversiteit,
Utrecht.

---

[1] *Z. physiol. Chem.*, **258**, 57 (1939); *Klinische Wochenschrift*, 18, 801 (1939).

[2] NATURE, **144**, 72 (1939).

[3] Foreman, *Biochem. J.*, 8, 463 (1914).

[4] Fischer, E., *Ber. deutsche chem. Ges.*, **32**, 2464 (1899).

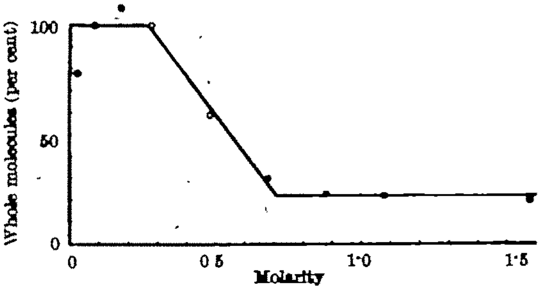
[5] *Biochem. Z.*, **63**, 379 (1914).

Dissociation of the Hæmocyanin Molecule

SEVERAL proteins are dissociated by a change of the hydrogen ion concentration, by adding amino compounds or salts to the solution [1, 2, 3, 4] and by exposure to various kinds of radiation[5].

The hæmocyanin molecule of *Helix pomatia* (molecular weight 6,700,000) may, upon a change of pH, dissociate into halves, eighths and sixteenths[6]. The reaction is reversible: the dissociation fragments recombine, if we bring the solution back to the original pH[6]. Certain amino compounds may also cause dissociation[1].

By means of the ultracentrifuge[1,2] we have investigated the influence of different types of salts and of a few non-electrolytes in acetate (pH 5·2) and in phosphate (pH 6·0) buffers of molarity 0·08. Well-defined sub-multiples ($\frac{1}{2}$, $\frac{1}{8}$, and $\frac{1}{16}$ of the original molecule) are obtained. The dissociation effect increases with the valence of the ions. The 1–1 valent sodium and ammonium chlorides both have the same effect: no dissociation occurs in 0·2 molar solutions, while in 1·0 molar 78 per cent of the hæmocyanin is dissociated into half-molecules. Nearly



the same effect is obtained for the 1–2 and 2–1 valent sodium sulphate and calcium chloride in 0·2 molar solutions (32 and 27 per cent, respectively), but the dissociation is different in 1·0 molar solutions, where sodium sulphate gives only half-molecules and calcium chloride eighths and sixteenths.

The dissociation effect of sodium chloride has been studied for a series of concentrations in acetate (pH 5·2) and in phosphate (pH 6·0) buffers of molarity 0·08, but in neither case were smaller components than half molecules obtained. In Fig. 1 the amount of whole molecules is plotted against the molarity of the electrolytes including acetate buffers. The dissociation reaction starts at the molarity 0·3 and ceases at 0·7, corresponding to a concentration of 22 per cent of whole molecules, after which concentration no more dissociation occurs. The same limiting value (22 per cent) is obtained with phosphate buffers of pH 6·0. When we use sodium chloride as dissociation agent, it is of interest to note that the reaction stops before all the whole molecules are dissociated (see graph). In solutions of molarity below 0·3 we have always got whole molecules.

The dissociation effect is smaller for non-electrolytes. The solutions investigated had a molarity of 1·0 in non-electrolytes, 0·2 in sodium chloride and 0·08 in phosphate buffer (pH 6·0). Glucose dissociated 64 per cent of hæmocyanin into half molecules, glycerine only 32 per cent. Urea (very often used as a dissociation agent for proteins) causes a dissociation of 58 per cent which is of the same order of magnitude as that for glucose; in the case of urea, however, 25 per cent of the dissociation fragments are non-uniform low-molecular compounds.

Reversibility has been observed in all cases where the dissociation had given only half molecules. The reaction is not completely reversible when the fragments obtained by the dissociation are smaller than half molecules.

It is shown from this and earlier investigations that dissociation of the hæmocyanin molecule is produced by a great variety of substances, and it follows that the effect is a general rather than a specific reaction associated with a special type of compound. Certain molecules or groups may have a stronger effect than others, but all types, whether ions or uncharged molecules, influence the dissociation of hæmocyanin.

SVEN BROHULT.
STIG CLAESSON.

Institute of Physical Chemistry,
University, Uppsala. June 2.

---

[1] Svedberg, T., NATURE, 139, 1051 (1937).

[2] Svedberg, T., and Pedersen, K. O., "The Ultracentrifuge" (Oxford: in the press).

[3] Pedersen, K. O., C.R. Trav. Lab. Carlsberg, Sér. Chim., 22, 427 (1938). Steinhardt, J., J. Biol. Chem., 123, 543 (1938). Lundgren, H. P., NATURE, 143, 896 (1939). Andersson, K. J. I. (cf. ref. 2).

[4] Pedersen, K. O., (cf. Jersild, M., and Pedersen, K. O., Acta Pathol. et Microbiol. Sca., 15, 426 (1938).

[5] Svedberg, T., and Brohult, S., NATURE, 141, 830 (1938); 143, 938 (1939). Brohult, S., NATURE, 140, 805 (1937).

[6] Eriksson-Quensel, I.-B., and Svedberg, T., Biol. Bull., 71, 498 (1936).

Elimination of Administered Chloral Hydra
the Urine as a Test for Liver Functio

WHILE engaged in studying certain phase
toxicity of chloral hydrate to the organism,
made some observations regarding its urinary
tion in normal and liver-damaged dogs which p
to offer a great deal of information regarding
the most important functions of the liver,
its function of detoxication.

Chloral hydrate was one of the first hypnoti
to be used in therapeutics, and its action and
fate in the body have been worked out fairl
factorily. It is now generally agreed that ch
not broken down in the body but is redu
an alcohol which is conjugated with glucuro
and is excreted as the innocuous compou
chlorethylglucuronic acid (urochloralic or chl
acid). This method of excretion as urochlora
accounts for nearly the whole of the chlo
ministered, though some authorities think
small part of chloral may be excreted unchang
at most, minimal traces as inorganic chloric
chloroform[1]. The reaction is represented as f

$$CCl_3.CHO \rightarrow CCl_3.CH_2OH + CHO.(CHOH)_4.COOH \rightarrow CCl_3.CH$$
$$CO(CHO$$

Chloral Trichlorethyl alcohol Glucuronic acid Urochlor

The liver has long been recognized as ar
which plays an important part in the pro
conjugation with glucuronic acid. Recent res
by Hemingway *et al.*[2] on liver-kidney-lung-
limb perfusion experiments have proved
doubt that this conjugation always takes p
the liver and nowhere else. Under normal con
therefore, that is, when the liver is func
properly, any chloral that presents itself to t
cells will be almost completely coupled with glu
acid, an apparently unlimited supply of w
obtainable in the body from the metabolism o
hydrates or the glucogenetic amino-acids. If, h
the liver cells are damaged, due to the chronic i
of carbon tetrachloride for example, it is p
that this normal mechanism of conjugation
disturbed, the liver cells failing to mobilize glu
acid to the same extent as under ordinary con
If the administered chloral is not complete
satisfactorily conjugated, free chloral may m
appearance in the urine.

Working on this hypothesis, we have est
free chloral in 24-hour urine samples of
and liver-damaged animals after administra
200 mgm. per kilo. of chloral hydrate to do
in metabolism cages on a standard diet.
damage was brought about by the administra
1·5 c.c. per kilo. body weight of carbon tetra
on alternate days (every third day whenever S
intervened) for eighteen weeks according
method of Lamson and Wing[3]. The presence
chloral in the urine was estimated by the me
Friedman and Calderone[4] with the modificati
animal charcoal (1 gm. per 10 c.c. urine) w
ployed to decolorize completely the urine
starting the experiments. This treatment p
the masking of the final pink colour of the r
by the yellow pigment of urine. The resul
typical set of experiments are given in the fo
table.

It will be seen that, at least under the
mental conditions in our series, dogs with
damaged livers fail to conjugate chloral hydra

	Dog No.	Weight kgm.	Total excretion of free chloral hydrate in 24 hour urine after the administration of 200 mgm./kgm. of the drug. Figures given in milligrams				
			Days				
			1	2	3	4	5
Normal	4 5	5·5 4·7	*Nil Nil	Nil Nil	Nil Nil	.. ..	. ..
Liver Damaged	1 2	6·3 6·1	20 15	15 18	12 10	20 10	40 50

* 'Nil' indicates that either there is no free chloral hydrate in the urine or quantities less than 1 in 40,000 (0·025 mgm./c.c.) are present.

that degree of completeness characteristic of normal animals, thereby allowing significantly measurable quantities of free chloral to appear in the urine.

Although our series of experiments is small, we feel that this measure of chloral elimination after the administration of a known dose of chloral may be a valuable adjunct to the other methods of diagnosis of liver function, and an extended trial seems justifiable.

We are grateful to Colonel R. N. Chopra for giving us facilities and help in carrying out this investigation.

B. MUKERJI.

Biochemical Standardization Laboratory,
Government of India.

R. GHOSH.

All India Institute of Hygiene
and Public Health,
Calcutta, India.
May 26.

---

[1] Sollmann, "A Manual of Pharmacology", 727 (1936).

[2] Hemingway, A., Pryde, J., Williams, R. T., *Biochem. J.*, 28, 136 (1934).

[3] Lamson, P. D., and Wing, *J. Pharm. Exp. Ther.*, 29, 191 (1926).

[4] Friedman, M. M., and Calderone, F. A., *J. Lab. and Clin. Med.*, 19, 1332 (1934).

Nature of the Growth-accelerating Substance of Animal Tissue Cells

EVER since a technique for cultivating tissue cells *in vitro* has been developed, the isolation of the growth-promoting substances in the embryo extracts has been an important subject of research. Several important facts have been discovered during the attempts to isolate the growth-promoting substance of the chick-embryo juice tested on cultures of tissue cells of fowls. These investigations led in some respects to erroneous results, for example, the statement of the extreme lability of the active principles.

Experiments have long since indicated that the growth-promoting substances are unspecific as regards the animal species. New facts obtained lately are in favour of the assumption that one substance only is responsible for the activity.

In using beef embryo extract a most active growth-promoting fraction was obtained by isolating the nucleoproteins by using the method of Hammarsten[1]. When these nucleoproteins are dissolved in water by careful addition of sodium hydroxide and added to the culture medium of tissue cells a pronounced growth-acceleration takes place. With these substances, strains of tissue cells can be maintained for long periods of time. The ratio of phosphorus to nitrogen in the active fraction is about 12 per cent, much lower than that found by Hammarsten for the nucleoproteins of the pancreas, namely, 33 per cent. The nucleic acids found in the active nucleo-proteins belong to the thymonucleic acid type as well as the ribose nucleic acid type. The growth-promoting activity seems in the meantime to follow the fractions containing the ribose nucleotides. After reprecipitations of the nucleoproteins with glacial acetic acid in excess, the precipitate is most active and contains a relatively great amount of the ribose nucleotides and very little thymonucleic acid, whereas the non-precipitated substances remaining in solution contain relatively much thymonucleic acid and less ribose nucleic acid. These facts seem to agree very well with the statements of Jorpes[2], Levene and Jorpes[3] and lately of Caspersson[4] that the ribose nucleic acid was found in actively growing animal cells and thymonucleic acid in the resting cells.

The growth-promoting activity of the substance is destroyed after digestion with trypsin for a short length of time. Likewise the activity disappears after boiling for a few minutes. This indicates that the protein forms an important part of the active compound. Experiments have further shown that the active compound can be restored after coupling of two inactive components, the one thermo-resistant, the other thermo-labile—more likely the latter is the protein component. The active principle is probably of high molecular order since they are rather easily precipitated in the ultracentrifuge.

ALBERT FISCHER.

Biological Institute of the
Carlsberg Foundation,
Copenhagen.
June 9.

---

[1] *Zeit. physiol. Chem.*, 109, 141 (1920).

[2] *Acta med. scandinavica*, 68, 503 (1928).

[3] *J. Biol. Chem.*, 88, 289 (1930).

[4] NATURE, 143, 602 (1939).

The Last Thousand Feet on Everest: Possible Bacterial Factor

PROF. YANDELL HENDERSON, in his article in NATURE of June 3, p. 921, emphasizes some of the difficulties facing the members of the expeditions to Mount Everest. The main handicap is the small amount of oxygen which can be breathed in per minute from such rarified air as exists at 29,000 ft. Prof. Henderson refers to my experiments on animals, which show clearly that mammals cannot be fully acclimatized to live under an oxygen pressure below 10 per cent of an atmosphere such as exists above 20,000 ft. These results have been confirmed by attempts of South American sulphur miners to establish permanent villages near this level. The highest permanent village is at 17,500 ft.[1].

The experiments with animals show also that even resting animals, which are not specially exercised or exposed to special muscular effort, cannot tolerate for an indefinite period the degree of oxygen-want in the tissues such as is suffered in an atmosphere containing less than 10 per cent of oxygen. From the symptoms in man and postmortem findings in animals, it may be concluded that all systems and organs are adversely affected by such severe anoxia and naturally the most important are the vital organs, namely, the cardio-respiratory system and the brain. Any attempt to assign supreme importance to any one organ is not likely to be successful, although the postmortem evidence indicates heart failure as the immediate cause of death. It seems that much more information regarding changes in the human organism at the last thousand feet might be obtained from clinical wards with patients suffering from severe oxygen-want.

Much has been written on various aspects of the physiological problems of high altitude, but above 20,000 ft. the problem enters the realms of pathology and clinical medicine. The physiology at the lower altitudes may therefore be of little help in elucidation of what is taking place in the human organism at excessive altitudes. Certain systems and organs have been very fully studied at the lower altitudes, and this tends to magnify their importance. However, one system, namely, the alimentary canal, has perhaps not received the attention it deserves.

In the course of some feeding experiments with white rats, evidence has been obtained that, under very low oxygen pressure, toxic substances accumulate in the gut. The toxic substances come from the food and from the tissues, but are probably oxidized under normal oxygen pressure and rendered harmless. Certain articles of diet, particularly certain proteins, seem to be most potent in producing these effects. By excluding these proteins from the diet, the resistance of the rats may be definitely increased. These adverse proteins include casein, egg albumin, meat and fish. Various other proteins have been investigated and zein, one of the proteins of maize, gives the best resistance, but a diet of whole maize alone is of no protective value. Adding zein to a maize diet improves the result, so that the zein appears to contain some favourable factor.

Certain amino-acids of the proteins have been tested separately, and adverse effects are obtained with histidine, cystine and arginine. Under bacterial action, histidine gives rise to histamine, which may cause collapse and shock. Collapse is a symptom also of severe anoxia. It is possible also that poisonous compounds of guanidine may arise from arginine. Resistance to oxygen-want is increased also in rats fed on diets containing adsorbents, such as charcoal, fibre or paper pulp, and kaolin. These may act by removal of toxic products from the contents of the alimentary canal. The most favourable foods for increasing protection against oxygen-want include carrots (the most protective), parsnips, beetroot, apples and bananas, all of which have a low protein content and also contain some fibre. As stated above, zein is the best of the proteins, with gelatin second, but not nearly so good. Starch, glucose, fat, vitamins and salts seem to be inactive—that is, they do not affect the result one way or the other, and therefore may be used in addition to the above more favourable articles of diet.

Undoubtedly, bacteria are responsible mainly for the adverse effects with most of the protein foods. Cats cannot tolerate the conditions at 14,000 ft., and this may be due to their protein diet. The variation in resistance observed in man may be due in part to variation in protein content of diet and to variation in bacterial flora in the intestine. The full details of the above experiments are being published elsewhere.

J. ARGYLL CAMPBELL.

National Institute for Medical Research,
Hampstead, London, N.W.3.
June 5.

---

[1] McFarland, *J. Comp. Psychol.*, **24**, 189 (1937).

Open Type Oxygen Apparatus

IT is suggested in NATURE of June 10 (p.
the weight of this apparatus may possibl
further reduced "by mechanical improv
valves and cylinders"; and as weight red
so important, the question is worth conside
first Vibrac (not Vibrax, as on p. 961) bo
made were used for the 33lb., 1,600 li
apparatus. The weight of steel was thus
almost exactly from 4¼ to 3¼ times the
oxygen, the former figure applying to the
1922, apparatus. Subtracting 19 lb., give
Peter Lloyd's article as charged bottle weig
latest 1,000 litre apparatus, from the total
25 lb., we get 6 lb. as the rough weight o
of the gear. This compares with 8 lb. in 1
the flow meter was not omitted.

Further weight reduction by mechanical
ment seems doubtful, and the only ho
metallurgists to produce a steel justifying
stress higher than 27 tons/sq. in. That is
when Vibrac bottles are charged at We
120 atm., and the pressure is raised to
owing to a shade temperature of 113° F., t
for deck cargo on the route of transit.

P. J. H.

4 Deans' Yard,
London, S.W.1.
June 14.

An Experimental Attack on some Proble Physiological Genetics

SINCE 1937, experimental work with *D*
melanogaster on two problems of physiologica
has been in progress in this laboratory.

(1) *Experiments on the development of th*
aristapedia (ss^a) *which transforms the bris*
antenna (*arista*) *into a tarsus*. In ss^a-flies
tion of the antennal disk starts two days ea
in normal flies[1]. Goldschmidt[2] therefore assu
at 2½ days of larval age an evocator which d
leg segmentation is present in the germ, and
in the proper stage of development will rea
stimulus by tarsus formation. In normal
undeveloped antennal disk will not reac
evocator. In ss^a-larvæ, however, the differ
of the antennal disk is speeded up and the
disk will react simultaneously with the le
starting tarsus segmentation.

If this explanation is correct, a compou
with different leg mutants should show th
effect on the legs also, on the antenna of
mutants influencing the arista should show
on ss^a. Confirmatory results were obtained
tests. Compounds of ss^a with *dachs* and
thickoid, mutants which influence the lengt
thickness of the legs respectively, showed
effects on the tarsus-like part of the anten
A compound of ss^a with aristaless, a mutant
the arista and influencing the scutellar bristle
no effect on the antennæ of ss^a, but its us
on the bristles could be observed. Transpl
of antennal disks were performed between
of ss^a and normal at different stages of l
from 2½ days to pupation. ss^a-Disks transpla
normal larvæ always developed into leg-li
tures; normal antennal disks transplan
ss^a-larvæ developed into normal antennæ wi
The negative results of these transplantatio
ments can probably be explained by the

s* is determined at a very early larval stage (2¼ days) prior to which successful transplantation is extremely difficult.

(2) *Experiments on the development of mutant wing characters.* With the help of an electrically heated needle, small defects were made during the developing young pupal wings. No significant effect could be detected on the degree of notched if *vg^no*-pupæ were operated on. However, a significant effect on the venation could be observed. If the defect was made on the basis of the wing at a pupal age of 12–18 hours, the distal cross-vein was mostly missing or reduced in the hatching flies. Pupal wings from *plexus* (*px*) and *net* stocks, mutants which show extra venation, were operated at the basis at the pupal age of 12–24 hours, and the hatching flies showed reduction in extra venation and the distal cross-vein. It was possible to get operated wings without any extra venation in *px* and *net* flies, while the other wing as unoperated control showed the *px* and *net* type clearly. Identical results were obtained after the defect was made by a cold needle.

Developmental studies indicated that the formation of the distal cross-vein and the extra venation takes place after the rest of the venation has been formed at 18–24 hours of pupal age. By operation at the pupal age of 12–24 hours, a general process of formation of veins is probably inhibited. The exact location of the defect does not seem to influence the degree and place of reduction of venation so long as the defect is placed in the proximal third of the pupal wing. Defects placed in the distal part of the wing result in destruction of distal parts without effect on the venation. Operations after 24 hours of pupal age result in local destruction of the tissue. Extreme changes in the shape of the wings were sometimes observed after operation. A detailed analysis of these studies will be published elsewhere.

A great part of these studies has been suggested by Dr. R. Goldschmidt. His advice and help are gratefully acknowledged.

WERNER BRAUN.

Department of Zoology,
University of California,
Berkeley, Calif.
April 5.

[1] Balkaschina, E. I., *Arch. Entwicklungsmech.*, 115, 448–463 (1929).

[2] Goldschmidt, R., "Physiological Genetics" (New York: McGraw-Hill Book Co., 1938.)

Energy of High-Velocity Neutrons by the Photographic Method

FOR many years it has been known that after the development of certain types of photographic plates, the tracks of any heavy ionizing particles which have passed through the emulsion are represented by a succession of developed grains. Several investigators have examined the question of the precision with which the length of the track can be taken as a measure of the energy of the particle. Opinion on the question has been divided[1,2,3], and the method has not come into general use for nuclear problems though several investigators are using it for work on the cosmic rays. If the method could be made precise, it would have great advantages over expansion chamber technique in dealing with certain types of nuclear problem. Recently, having made experiments with Dr. Heitler on the heavy particles in the cosmic radiation by this method, we decided to re-examine the question of its precision in detail. In view of the importance of developing more powerful methods of measuring neutron and gamma-ray energies, the results seem to us to suggest that the method merits the serious consideration of those engaged in nuclear research.

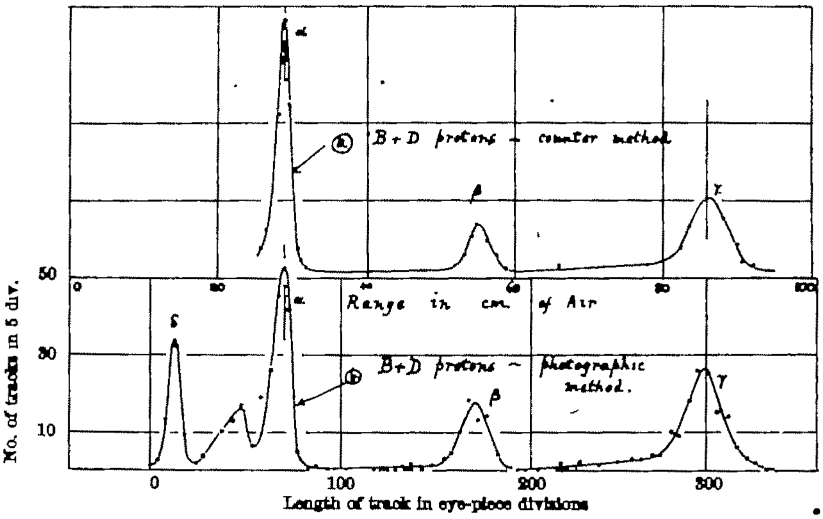


Fig. 1.

Curve (*a*), B + D protons by counter method. Curve (*b*), B + D protons by photographic method. Peak δ due to D + D protons.

We first passed protons from boron under deuteron bombardment, through a mica window and tangentially into an Ilford 'half-tone' plate, measured the length of the 'tracks' and drew the appropriate range-frequency curve. The corresponding curve obtained by counting methods[4] is shown in curve (*a*), Fig. 1, and our results in curve (*b*), the two scales having been chosen to make peaks 'α' and 'γ' coincide. It will be seen that the resolving power of the photographic method is comparable with that of the counting experiments for protons in this range of energy. The results shown in Fig. 1 enable us to calculate the stopping power of the emulsion and hence the range of particles in peak δ. This turns out to be 14·8 cm. of air and is evidently due to particles from the D + D reaction.

We next passed neutrons, from various light elements bombarded with deuterons, tangentially through similar plates and measured the lengths of the 'tracks' of the directly knocked on protons. We could thus determine the neutron energies in a way analogous to that employed by Bonner and Brubaker[5,6] using the expansion chamber technique. Our results for B + D neutrons and for Be + D neutrons are shown in Figs. 2 and 3, together with the results obtained with the expansion chamber. It will be seen that the photographic method has a resolving power considerably higher than that achieved with the expansion chamber.

We would direct particular attention to the great saving in labour which the photographic method

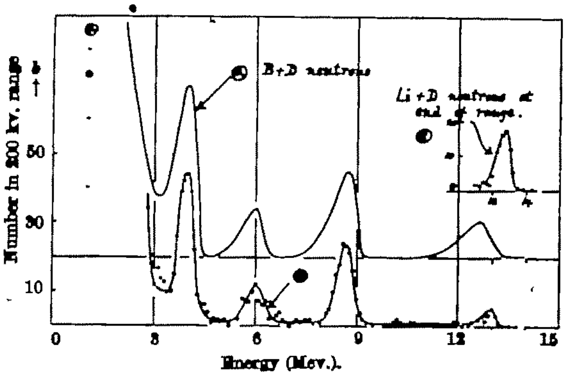


Fig. 2.

CURVE (a), B + D NEUTRONS BY EXPANSION CHAMBER METHOD. 1,000 TRACKS FROM 11,000 STEREOSCOPIC PAIRS.

CURVE (b), B + D NEUTRONS BY PHOTOGRAPHIC METHOD. 4 HR. EXPOSURE.

CURVE (c), END POINT OF ENERGY SPECTRUM OF NEUTRONS FROM LI + D BY PHOTOGRAPHIC METHOD.

affords. For the analysis of the energies of the neutrons from the Li + D reaction by the expansion chamber method, 20,000 stereoscopic pairs of photographs were taken from which 1,600 tracks were suitable for measurement. We have measured the energy distribution of these neutrons by the photographic method. The 3,000 tracks for the analysis are all contained in three square centimetres of an Ilford half-tone plate obtained in a single exposure of a few minutes.

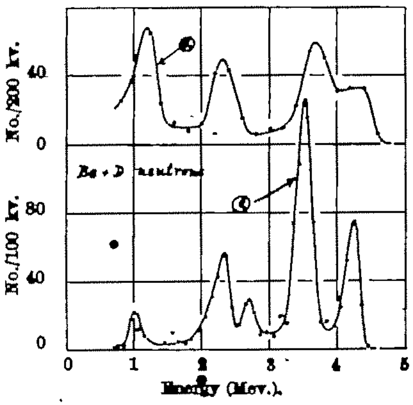


Fig. 3.

CURVE (d), BE + D NEUTRONS BY EXPANSION CHAMBER METHOD. 580 TRACKS FROM 3500 STEREOSCOPIC PAIRS.

CURVE (e), BE + D NEUTRONS BY PHOTOGRAPHIC METHOD. 20 MIN. EXPOSURE. 960 TRACKS. INTENSITY OF 1 MEV. PEAK LOW IN COMPARISON WITH OTHERS DUE TO IGNORING SHORTER TRACKS.

For experiments with neutrons the photographic method has the following important advantages: (a) It is equivalent to a continuously sensitive high-pressure expansion chamber. (b) It involves a minimum of material and does not give rise to disturbing scattered neutrons. (c) The photographic plate is small and can be placed very near the neutron source, with a corresponding gain in intensity. Many quantitative experiments with neutrons become possible, because of these advantages, which could not be seriously considered with the expansion chamber technique.

A complete description of the experiments in which we have examined the energies of the neutrons from all the light elements under deuteron bombardment and a discussion of further applications of the method will be published shortly.

C. F. POWELL.
G. E. F. FERTEL.

H. H. Wills Physical Laboratory,
University of Bristol.
June 3.

---

[1] Taylor and Dabholkar, *Proc. Phys. Soc.*, 48, 285 (1936).

[2] Blau, *J. Phys.*, vii, 5, 61 (1934).

[3] Livingston and Bethe, *Rev. of Mod. Phys.*, 245 (July 1937).

[4] Cockcroft and Lewis, *Proc. Roy. Soc.*, A, 154, 251 (1936).

[5] Bonner and Brubaker, *Phys. Rev.*, 47, 910 (1935).

[6] Bonner and Brubaker, *Phys. Rev.*, 50, 308 (1936).

Directional Distribution of the Hard and Soft Component of Cosmic Radiation

WITH a two-fold coincidence apparatus we have determined the intensity distribution of cosmic radiation in the north-south and east-west planes. The measurements were made in all four directions with zenith angles (δ) varied by 5° steps from the vertical to the horizontal. Every position was measured once with no absorber and a second time with 36 cm. lead between the counters. From the results it is possible to determine independently the directional distribution of the hard and of the soft component:

$$\text{Hard component: } R(\delta) \times 10^4 = 2 + 59 \cos^2\delta \quad (1)$$

$$\text{Soft component: } R(\delta) \times 10^4 = 3 + 27 \cos^{2\cdot5}\delta \quad (2)$$

The intensities are given in coincidences per cm^2/sec./unit solid angle. The following interpretation of these results seems to us justified.

The intensity of the hard component can be resolved into the intensity of two factors. The first represents the meson intensity, giving rise to a variation corresponding to $\cos^2\delta$. Assuming that the majority of the mesons are created at a height equivalent to about 8 cm. mercury pressure, below the top of the atmosphere, further that the number of the mesons created there with energies greater than E is given by

$$N = \text{constant}/E^\gamma, \quad (3)$$

with[1] $\gamma = 1\cdot8$, and that the meson intensity decreases chiefly through spontaneous decay, thus it will be a function only of the distance between the place where they have been created and the observer:

$$J = \text{const.} \int_{E_1}^{\infty} \frac{e^{-lE_0/\tau cE}}{E^{\gamma+1}}\, dE \sim \frac{\text{const.}}{l^\gamma}\,; \quad (4)$$

where τ is the life-time of the meson at rest ($\sim 10^{-6}$ sec.), E_0 is the energy of the meson at rest ($\sim 8 \times 10^7$ ev.), c is the velocity of the light, E_1 is the energy necessary to travel through the atmosphere ($\sim 2 \times 10^9/\cos\delta$ ev.), l is the distance of the observer from the place where the mesons were created.

A pressure of 8 cm. mercury in a vertical direction corresponds to a height of about 16 km. For more inclined directions we must take into consideration that a meson created at 8 cm. mercury below the top of the atmosphere will be in this inclined direction at a greater height from the observer at sea-level even when measured vertically. Thus for the distance measured in the inclined direction we obtain:

$$l = \frac{1}{\cos\delta}\left(16,000 + 14,620 \log \frac{1}{\cos\delta}\right) \approx \frac{\text{const.}}{\cos^{1\cdot3}\delta} \qquad (5)$$

(For greater elevations such as 11 km. use the barometric formula: $\Delta h = 14,620 \; (\log p_1 - \log p_2)$ metres.)

From (4) it follows that the intensity varies inversely as $l^{1\cdot8}$; together with (5) we may compute that the intensity must vary according to $\cos^{2\cdot3}\delta$; the experimental result being a $\cos^{2}\delta$ variation.

The second part of the intensity of the hard component consists of heavy particles created by neutrinos in multiple showers, the neutrinos themselves being a product of the meson decay[2]. It is, however, not quite excluded that neutrinos with magnetic moment are able to produce a coincidence with the help of two soft secondary electrons[3]. It can easily be seen that this part of the intensity should be invariant for every direction, since (1) the meson intensity can be taken as uniformly distributed over all directions at the place of origin; (2) the majority of the mesons are already disintegrated before they reach the apparatus, thus the number of the neutrinos will only slightly increase in more inclined directions through the number of those produced in further decay; and (3), on the other hand, the decrease in the number of the neutrinos in the inclined direction will also be negligible on account of their small absorption. This constituent of the intensity corresponds to the first term on the right hand side of (1).

In the case of the soft component, we can again distinguish two parts, the first consisting of electrons produced at the disintegration of the mesons, or cascade electrons created by them. This part of the intensity should vary according to the meson intensity, that is, with $\cos^{2\cdot3}\delta$; but we must also take into account that the probability with which the decay occurs in the region surrounding the apparatus is inversely proportional to the energy of the meson. Thus the intensity will be expressed now by

$$J = \text{const.} \int_{E_1}^{\infty} \frac{e^{-lE_0/\tau c E}}{E^{\gamma+1}} \frac{1}{E}\, dE \sim \frac{\text{const.}}{l^{\gamma+1}}\,; \qquad (6)$$

and we get finally from considerations analogous to those above that this part of the soft component should vary as $\cos^{3\cdot4}\delta$. The experimental results are in good agreement with a variation corresponding to $\cos^{3\cdot3}\delta$, the second term on the right hand side of (2).

The second constituent of the soft component furnishes again a constant intensity. It consists of electrons created by neutrinos. The same considerations as above hold also in this case; thus this part, corresponding to the first term in (2), should be invariant for all directions. We believe we have found here an explanation why the relative intensity of the soft component increases again not only for more inclined directions but also at very great depths[4].

So far as the reliability of the measurements permit, we are able to estimate the amounts of the different kinds of radiation observable at sea-level from the vertical direction. 65 per cent of the radiation consists of mesons, 30 per cent of electrons produced in meson decay or cascades initiated by them, 5 per cent of electrons and heavy ionizing particles created by neutrinos.

We wish to express our gratitude to the Hungarian Council for Natural Science, and the Hungarian Academy of Science for financial support.

J. Barnóthy.
M. Forró.

Institute for Experimental Physics,
University, Budapest.
May 27.

---

[1] Euler, H., and Heisenberg, W., *Erg. d. exakt. Naturwiss.*, 17, 33 (1938).

[2] Yukawa, H., *Proc. Phys. Math. Soc. Jap.*, 19, 712 (1937).

[3] Bethe, H., *Proc. Camb. Phil. Soc.*, 31, 108 (1935).

[4] Barnóthy, J., and Forró, M., *Phys. Rev.*, 55, 870 (1939). On 1,000 m. water-equivalent depth, about 60 per cent of the radiation consists of soft particles.

Effect of an Electric Field on the Viscosity of Liquids

Prof. E. N. da C. Andrade and C. Dodd have described[1] their investigations of the effect of an electric field on the viscosity of a number of organic liquids. They state that they found an increase of viscosity of up to 60 per cent in polar liquids, while non-polar liquids showed no increased viscosity.

We would point out that work of a similar kind was performed by us in 1935[2].

We succeeded in showing that the increase of viscosity, which in some cases was more than 100 per cent, is due to the passage of the electric current through the liquid. Increased viscosity was also observed in non-polar liquids (benzene, hexane, carbon tetrachloride) when the latter had been artificially contaminated by the addition to the pure preparations of a few drops of the same liquid saturated with hydrochloric acid vapour, or of a few drops of acetone. In our opinion, this seeming increase of viscosity in a liquid under the action of an electric field is a purely hydrodynamic phenomenon due to the convection of a non-homogeneous liquid placed in an electric field.

S. Sossinski.

Physical Institute,
Leningrad State University.

---

[1] Nature, 143, 26 (1939).

[2] *Acta Physicochimica U.R.S.S.*, 5, 691 (1936).

We are sorry that the interesting paper of Sokolow and Sossinski, referred to in the above letter, escaped our notice, and we are very glad that our attention has now been directed to it. We agree that in it the authors clearly established a large effect of electric field on the apparent viscosity of polar liquids, and that the effect is accompanied by the passage of an electric current, both of which facts are among our observations. We think, however, that the method which Sokolow and Sossinski used, namely, a capillary of square cross-section, with the field applied to two opposite sides, is less precise than our disposition: we used a capillary of rectangular cross-section, with side ratio 1 to 50, and the potential applied to the long sides. In our case the field is uniform; in the other case, owing to differences of dielectric constant between liquid and glass, it is far from being homogeneous, which may be one of the causes of certain discrepancies which we have noted.

Owing to the fact that the upper limit of the fields used by Sokolow and Sossinski was 17 kv./cm., while our fields went up to 40 kv./cm., the Russian workers were unable to observe the saturation effect, namely, that the viscosity-increase becomes constant at high fields, which was one of the most striking of our results. This saturation is not accompanied by a saturation of current, which shows that the close relation between current and viscosity-increase suggested by Sokolow and Sossinski is unlikely to be correct. Their comparatively small number of frequencies and small range of frequency in the case of alternating potential, namely, the two frequencies 50 and 1,000 cycles/sec., as against our range of 0 to 10,000 cycles/sec., with determinations throughout the ranges, prevented them obtaining our effects in this part of the work. They have not calculated the effect which a low-frequency alternating current should have if at each stage static equilibrium existed between field and viscosity increase. If allowance for the variation of potential is made, we find that for 50 cycles/sec. the effect is the same as at a steady potential.

We believe that their explanation, that the effect is due to hydrodynamic convection, is not tenable in view of our results. It will not explain either the saturation at large fields or the lack of parallelism between current and viscosity increase. The conditions of Hofmann's experiments, on which Sokolow and Sossinski base their argument, are so different from those of our experiment that we do not think they are applicable. The explanation is also not in accordance with later experiments of ours which were not referred to in our letter in NATURE. In these we have carried out experiments with three different gaps, namely, 0·2 mm., 0·22 mm. and 0·28 mm., and have found that the effect at constant field, in terms of volts per cm. of gap, diminishes as the gap increases. This is one of the facts that led us to attribute the effect to the building up of comparatively rigid ionic layers on the opposite walls of the channel, layers which reach a limiting thickness at high fields. Assuming a constant thickness at saturation, we are able to explain quantitatively the influence of gap width on the effect.

E. N. DA C. ANDRADE.
C. DODD.

Physics Laboratory,
University College,
London.

A New Model of the Point Charge Electron and of Other Elementary Particles

WE wish to introduce a point charge electron which conserves a number of properties of the Lorentz electron and which can be taken over into quantum theory without any difficulties.

The Lorentz model of the electron (a charge e spread over a region of space of the order of a certain fundamental length l) is a satisfactory description of classical optics of wave-lengths $\lambda > l$. If $\nu^{-1} = \lambda \precsim l$, this theory contains the classical analogue of 'showers'. This can be seen from the equation of movement of the co-ordinates $q_a(t)$ of the centre of the electron. If the electric field is decomposed in an external field E'_a ($\alpha = 1,2,3,$) and the retarded field of the charge density $e\rho(x_a - q_a)$, this equation takes the form (if $\dot{q}_a = 0$*):

$$e^2(2l)^{-1}\ddot{q}_a + e^2\sum_{3}^{\infty} a_n l^{n-2}((\ddot{q})^{n-1}\ddot{q}_i + \;.\;\;.\;\;.\;) = (2/3)e^2\dddot{q}_a + \int dx^3 \rho E'_a \quad . \;\; . \;\; . \quad (1)$$

The term proportional to l^{n-2} superimposes on the periodic movement of frequency ν an additional
oscillation with the frequency ν/n. The
interpretation of the emitted radiation is the
effect and the simultaneous emission of n q
energy $h\nu/n$.

$e^2(2l)^{-1}$ is the mass due to the energy of the
and the (non-electrical) cohesive forces in the
We use the four-vector of the electrodynamic
A_i to describe the electric, and a real ar
potential ψ to describe the cohesive forces. $e\rho$
$e\rho_4 = i\rho$ and $e\rho_\psi = e\sqrt{1 - \dot{q}^2}.\rho$ are the fo
of charge density and a real and scalar densi
produce the fields A_i and ψ.

Let $L(A_i)$ be the Lagrangian of electrom
and $L(\psi)$ that of the ψ-field. The field equa
the equation of movement for $q_a(t)$ follow
variation principle based upon the Lagrange f

$$L = L(A_i) + L(\psi) + \rho_i A_i + \rho_\psi \psi \quad . \;\; .$$

This theory has the remarkable property
total energy of a charge at rest tends to
the charge distribution tends to a point
$\rho(x_a) \rightarrow \delta(x_a)$. l signifies now the *fundament*
introduced by the Yukawa field (and *not* th
of the charge distribution). The equation
ment has been derived elsewhere[1]. In the
a point charge, equation (1) of the Lorentz
results. Therefore our point electron cons
properties of the Lorentz electron includ
'shower terms'. If $\nu > l^{-1}$, ψ-waves are emi
quanta of which are neutral particles of $2h/$
electron masses.

Because of the point character of the
quantization presents no formal difficulties.
not contain any non-classical (spin) terms
classical formulæ remain valid. The electr
finite self energy $H_0 = e^2(2l)^{-1}$.

If the spin terms of the form $el\gamma_i\gamma_k\delta A_i/\delta$
we have to add a pseudoscalar potential ψ_{1}
leads to terms $el\gamma_i\gamma_k\gamma_r\delta\psi_{ikr}/\delta x_r$) in order to
finite self-energy. Analogous consideratio
for the heavy particles the L of which
isotope spin' terms and the complex meson
In order to arrive at finite self-energies, the
of Kemmer[2] can be applied. Due to the c
tions[3] arising from the non-commutability
terms, H_0 will be a complicated function o
It is hoped that this function converges
certain values of H_0 and so explains the
masses of the elementary particles actually

E. C. G. STUECKE

Institut de Physique,
Université, Genève.
June 21.

---

* The velocity of light is put equal to 1. a_n are numerical constants.

[1] Stueckelberg, *C.R. Acad. Sci.*, in the press.

[2] Kemmer, *Proc. Roy. Soc.*, **166**, 127 (1938).

[3] Stueckelberg, NATURE, **143**, 560. (1939).

Toxicity of *Salvia reflexa*

MINT weed (*Salvia reflexa*) has been show
responsible for heavy losses of stock in Que
Chemical investigation of the plant failed t
strate the presence of any of the poisonous
commonly found in plants. Following on
of Rimington[2] with *Tribulus*, we were led t
gate the nitrate and nitrite content of *S. re*
the possibility that methæmoglobinæmia
nitrite poisoning would follow the ingestio
plant. The dried plant was found to cont

per cent of nitrate calculated as potassium nitrate, nd an enzyme is present in the plant capable of educing nitrate to nitrite, apparently through oxidaion of glucose.

Two pounds of the dried plant mixed with water, llowed to stand for twenty hours and fed to a sheep, roduced fatal methæmoglobinæmia, the oxygenarrying capacity of the blood being reduced in five ours to approximately 30 per cent of the normal.

Furthermore, the higher nitrate content of the lant[3] is of itself capable of being toxic without the ntervention of the reducing enzyme and was shown n subsequent experiments. We suggest that *Salvia eflexa* may be typical of a group of plants which nder appropriate conditions can accumulate nitrogen s nitrate very rapidly and thus at times be poisonous o stock.

A full account of this work will shortly be published n the *Australian Veterinary Journal*.

C. H. WILLIAMS.
H. J. G. HINES.

niversity of Queensland,
Brisbane.
May 29.

Commonwealth Council for Scientific and Industrial Research. Pamphlet No. 49. Melbourne (1935).

Rimington, C., *South African J. Sci.*, 30, 472 (1933).

Cf. Seekles, L., and Sjollema, B., *Arch. wiss. prakt. Tierheilkunde*, 65, 331 (1932).

Salaries of Scientific Workers

IN NATURE of July 1 there appears an advertisement asking for applications for a post under the Ministry of Agriculture and Fisheries, which requires a botanist with an honours degree and at least two years experience of research in systematic botany. The starting salary offered is £155 per annum. We would like to point out that this salary is not only incommensurate with the training required, but is also far below the normal salaries obtaining in Government departments for men of science holding equivalent qualifications.

In the same issue of NATURE there is an advertisement under the name of University College, Southampton, requiring the services of a research assistant of graduate standing who will receive free board and residence and a remuneration of £50 per annum. We also wish to direct attention to the salary offered, £250 a year, in the same advertisement for the post of superintendent of the Branch for Southern Rivers, Freshwater Biological Association.

REINET FREMLIN.
(Secretary.)

Association of Scientific Workers,
30 Bedford Row,
London, W.C.1.
July 4.

Points from Foregoing Letters

F. Kögl and H. Erxleben state that the method used by Chibnall *et al.*, although very suitable for the isolation of natural glutamic acid, appears not to be applicable for detecting the partial racemization of glutamic acid in hydrolysates from tumour proteins. The presence of racemic glutamic acid in tumour proteins was shown by the isolation of the *d*-form.

S. Brohult and S. Claesson have investigated the influence of different types of salts and of some nonelectrolytes on the dissociation of the hæmocyanin molecule. The dissociation reaction, usually reversible, seems to be of a general type, as it is caused by ions as well as by uncharged molecules.

B. Mukerji and R. Ghose suggest a new method for measuring liver function. Under ordinary conditions, no free chloral appears in the urine of dogs given this substance. When the liver is damaged by the chronic administration of carbon tetrachloride for 18 weeks, appearance of free chloral in significant amounts following the administration of the drug was observed in the urine.

Albert Fischer states that the growth-promoting principle of embryo extract is found in the fraction of nucleoproteins isolated by the method of Hammarsten. The ratio of phosphorus to nitrogen is rather low. The active fraction contains ribose nucleotides and very little thymonucleic acid. The activity is destroyed after digestion with trypsin and after boiling for a few minutes. Restoration has been possible after coupling of two inactive components. Precipitation in the ultracentrifuge indicates that the active principle is of high molecular order.

Evidence has been obtained with white rats by J. Argyll Campbell that under very low oxygen pressure toxic substances accumulate in the intestine. Certain proteins, for example, casein, egg albumin, meat and fish, in the diet give adverse effects. Certain amino acids, for example, histidine, arginine and cystine, also give adverse effects. Bacteria are held responsible for the toxic substances.

Werner Braun reports on some experimental work in physiological genetics. Using the fruit fly as material, he records experiments on the development of the mutant responsible for the transformation of the bristle on the antenna into a tarsus, and on the development of mutant wing characters.

C. F. Powell and G. E. F. Fertel have developed a technique for the determination of the energy of protons and neutrons by measurement of tracks made by these particles on special photographic plates. For many investigations the method has great advantages over the expansion chamber technique.

J. Barnóthy and M. Forró find that the results obtained by measuring the directional distribution of the soft and hard component of cosmic radiation can be explained by assuming that the radiation at sea-level consists of 65 per cent mesons, 30 per cent electrons produced in meson decay, and 5 per cent of electrons or heavy ionizing particles created by neutrinos, this part of the intensity being invariant for all directions.

S. Sossinski points out that he and Sokolow published in 1936 work in which they showed that an electric field has a great effect on the viscosity of polar liquids, a fact to which attention was recently directed by Andrade and Dodd, and suggests a hydrodynamic explanation. E. N. da C. Andrade and C. Dodd, in reply, regret that they overlooked the paper in question, and point out that their work goes much beyond that of Sokolow and Sossinski. They suggest that the effect is due to the building up of comparatively rigid ionic layers on the opposite walls of the channel.

E. C. G. Stueckelberg derives an expression for a point charge electron which can be taken over into quantum theory.

RESEARCH ITEMS

Biology of Cerambycid Beetles

C. F. C. Beeson and B. M. Bhatia have published an article "On the Biology of the Cerambycidæ". in which they present data collected during twenty-four years on the food plants, distribution, life-cycle and other biological features of 350 species of this family of beetles from India, Burma and Ceylon (*Ind. Forest Rec.*, Ser. Entom., 5, No. 1 ; 1939). The total number of species of Cerambycidæ, or longicorn beetles, known to occur in the Indian region is 1182. It appears that the sal (*Shorea robusta*) is the tree which supports the largest number of species, some 37 different Cerambycidæ being known from it. The beetle *Stromatium barbatum* is recorded to have no fewer than 311 different food plants, which indicates a very unusual range of polyphagy. The food plants of at least 250 species of these insects have not been previously published, and a total number of 568 species of Indian trees, shrubs and woody climbers is now known to be attacked by one or more kinds of Cerambycids. *Hoplocerambyx spinicornis* is potentially the most injurious forest insect in India. This is partially due to its liability to cause bad epidemics among the sal forests. Even a small outbreak of this insect, affecting eight square miles of forest in the United Provinces, resulted in 45,000 trees being killed, representing nearly a million cubic feet of timber. The most serious epidemic was estimated to have attacked about seven million trees before it was checked. The new data given for the biology, etc., of this species are more complete than for any other : for many of the species little more than the host tree and the locality are at present available. It is mentioned that sun-loving or diurnally active species may frequent the foliage and flowers of trees without any of them breeding as larvæ in the wood or feeding as adult beetles on the foliage or other parts of such trees.

Ring Spot Disease of Lettuce

THE fungus ***Marssoniana Panattoniana*** in epidemic form rapidly destroys lettuce seedlings and may also destroy older plants. Even a mild attack causes browning and perforation of the leaves which give rise to the name 'ring spot'. The disease is an important one in England, and has at various times caused considerable damage in Europe and America. Winter lettuce is the crop most affected, the disease being rare on plants grown under glass or planted out in spring. Experiments carried out over three years by Greta B. Stevenson at the Biological Field Station of the Imperial College (*J. Pom. and Hort. Sci.*, 17, 27 ; 1939) have shown that the disease is readily transmitted by seed. Diseased plants gave apparently good seed which, however, under suitable conditions produced a heavily infected crop. On the other hand, sprayed and segregated mother plants gave seed which produced healthy plants where commercial seed gave valueless crops. The disease may also be contracted from the remains of a previous infected crop, though such remains normally lose their infectivity after about eight months. A similar fungus was found on a common weed (*Crepis capillaris* Wallr.) growing
near diseased plants, and it is believed that tl
be a source of infection. Sixteen commercial v
of lettuce were all found to be equally suscep
ring spot. Reduction of the disease was affe
spraying the seedlings with Bordeaux r
(3 : 6 : 50) and by treatment of the seed
filtered 10-per cent solution of bleaching powd

Chemistry and Genetics

IN a paper given before a joint meeting of a
of American Societies (*Amer. J. Bot.*, 26 ;
A. E. Blakeslee points out the growing import
chemistry in genetics and other branches of l
The paper is concerned mainly with the
achieved by treatment of plants by solutions
chicine, a toxic substance which has proved r
ably effective in inducing polyploidy. It is
nized that polyploidy following hybridizati
been a feature in the evolution of some speci
the use of colchicine provides a means whereb
allotetrapoids (multiple diploids) may be pr
at will from sterile hybrids. This fact alone
great possibilities in plant breeding. Other
bilities are also outlined in a survey of induced
tions of chromosome number in *Datura*. Refer
also made to the little explored field of chemi
relation to genetical characters. It is describ
two externally similar types of *Rudbeckia*
readily distinguished by their colour reactio
caustic potash or caustic soda. It is quite p
that in other cases also simple reactions mi
employed to distinguish between similar homo
and heterozygous types, thus enabling much ec
in breeding experiments. Some problems of cy
and propagation which might have light throw
them by such methods are discussed at the
the address.

Chromosome Numbers for the British Flora

THE *New Phytologist*, 38, No. 1, May 193
tains under the heading of "The Merton Cata
a first attempt to provide chromosome numb
the species of the British flora, compiled by Par
Maude of the John Innes Horticultural Insti
Merton. Such a list is, of course, incomplete
present time, but that it can be attempted
that cytologists have been much more thoro
their attack on the native flora than is ge
realized, and the list, with its numerous gap
stimulus to further work and gives invaluable
tions where such work is particularly needed
list reveals that of 526 British genera of flo
plants, 444 have been examined, and of 2,256
in the London Catalogue, numbers can be su
for some 1,300. Authorities are cited in eac
usually the latest reference being cited, but, at
the preference is for a more important refere
to a more accessible (European) paper. This cat
will be invaluable to both systematist and cyt
It is published under the auspices of the Asso
for the Study of Systematics in Relation to G
Biology.

Chromosomes of the Sawflies

THE characteristic diploid chromosome number in the Tenthredinidæ, the sawflies, is sixteen, although in Claudius and a few other species allied to this genus the number is twelve. A. D. Peacock and Ann R. Sanderson have investigated the cytology of another sawfly, *Thrinax macula* Kl. (*Trans. Roy. Soc. Edin.*, 1939), in which the diploid number is fourteen as found in the blastoderm, follicle cells, oogonia, oocytes and polar nuclei. This species is a female-producing parthenogenetic one in which, however, rare males sometimes make their appearance. Some of the latter were fortunately found and they appear to be haploid with a chromosome number of seven. During the maturation of the egg only one non-reductional division takes place in which there is neither synaptic pairing nor tetrad formation. The diploid number is presumably maintained in this species by the omission of synapsis, as is probably the case in the majority of parthenogenic animals in general. It is to be noted, however, that two maturation divisions do occur in some female-producing parthenogenetic sawflies. During spermatogenesis the first maturation division is abortive and the second is equational, as is commonly found in the Hymenoptera.

Chromosome Rearrangements in Drosophila

B. P. Kaufmann (*Genetics*, **23**, 154; 1938; **24**, 101; 1939) and B. P. Kaufmann and Ruth C. Bate (*Proc. Nat. Acad. Sci.*, **24**, 368–371) have analysed some chromosomal abnormalities in the progeny of X-rayed *Drosophila melanogaster*. One individual showed a duplication *abcdgfeefgh* in the nature of a 'reversed repeat'. This is shown to have arisen from the breakage and reunion of two sister chromatids derived from one paternal chromosome. Complex configurations were found. One configuration involved ten breaks and attachments, of which five were in one chromosome arm. Another showed that both chromatids of the duplicated section had been broken at two similar loci accompanied by a third break in each of the chromatids which had occurred at different loci.

Position Effect

HAIRY wing (*Hw*), a well-known and much used dominant character near the distal end of the *X*-chromosome of *Drosophila melanogaster*, has been shown by M. Demerec and M. E. Hoover (*Genetics*, **24**, 68, 271–277; 1939) to be due to a duplication of a single band of a salivary gland chromosome. This band is known to be associated with achæte (*ac*), which reduces the dorso-central bristles. Further, as in Sturtevant's Bar case, it is shown that when two bands are represented on one chromosome they have a greater effect than if they were distributed between two chromosomes. Unfortunately, no case of crossing-over between the two bands has yet been observed. This may probably be due to the fact that crossing-over is normally low in the region *y–ac* where *Hw* is placed.

Heterosis

L. C. LUCKWILL (*J. Genet.*, **37**, 421–439) has investigated the stage in the life-cycle of hybrid tomatoes at which heterosis is manifested. There was little correlation between heterosis in the seed and in the mature plant. In some hybrids heterosis was present in the shoot primordium on the 16th day and persisted until the 145th day, while in other hybrids heterosis arose subsequent to the 16th day. The author considers that in intraspecific hybrids heterosis may be dependent on complementary size determining genes as visualized by Jones. For interspecific hybrids, however, he produces evidence to support East's hypothesis.

Structure of South-east England

DEFINING South-east England as the region lying south and east of the main chalk escarpment between Dorset and The Wash, S. W. Wooldridge and D. L. Linton have written a closely reasoned monograph on the development of its structure and relief ("Structure, Surface and Drainage in South-East England". Institute of British Geographers Publication No. 10. 1939. 12*s*. 6*d*.). The broad lines of the structure of this area are well known, but the two authors have added much detail and traced in lucid fashion the genetic development. They begin with the early Palæozoic floor. Particular interest is attached to the concealed junction of the Armorican and Caledonian structures which runs beneath the Lower Thames Valley. Southwards the cover rocks show competent folding and northwards only gentle flexuring. After the emergence of the chalk floor, a full cycle of erosion ran its course and the greater part of the area lost its upper divisions of the chalk. The mid-Tertiary flexures south of the Thames and the mid-Tertiary foldings and the subsequent production of the late Miocene and early Pliocene peneplain are then traced. The invasion of the Pliocene sea and the emergence of the Pliocene sea-floor followed, and the lower Thames is shown to have had a course well north of its present channel. Then came the effects of the Chiltern and eastern ice sheets and the general subsequent uplift of the area. The monograph is well illustrated by maps and diagrams.

Range of Possible Existence of Stoneley Waves

THIS problem has been studied by K. Sezawa and K. Kanai (*Bull. Earthquake Res. Inst.*, Tokyo Imp. Univ., **17**, Part 1, 1–8; March 1939). First they obtained the velocity equation for waves of this type which are particular forms of Rayleigh waves, and from this equation calculated the velocity of transmission in the critical conditions of the equation which allow waves of this type to exist. From tables and graphs in two limiting cases of Poisson's ratio, it is seen that Stoneley waves exist within a narrow range of μ'/μ for every ratio of ρ'/ρ. The authors point out that this feature is remarkable, particularly when the ratio of ρ'/ρ is nearly unity, at which condition Stoneley waves could not exist unless Wiechert's condition, $\rho'/\rho = \mu'/\mu$, be almost satisfied. On the other hand, when the ratio of ρ'/ρ is relatively small, say less than $0{\cdot}5$, or relatively large, say greater than 2, the range of μ'/μ in which Stoneley waves exist is relatively wide, Wiechert's condition being then rather unimportant. The greater the ratio ρ'/ρ, the greater the ratio μ'/μ for the real existence of the waves. The velocity of transmission of the waves is independent of the wave-length, that is, they are not dispersive. It is likely that in between the critical values the velocity of transmission is less than either one of the velocities of distortional waves in both media. The waves are found not to exist for the range $0{\cdot}563 > \mu'/\mu > 0{\cdot}4927$, the corresponding velocities of transmission ranging between $\sqrt{\mu/\rho}$ and $0{\cdot}9926\sqrt{\mu/\rho}$, where ρ, ρ', are the densities and μ, μ', the elastic constants of the adjacent media.

Structure of Vitamin B_6

VITAMIN B_6 is that factor of the vitamin B complex which prevents or cures an acrodynia-like dermatitis in young rats. If factor 2 is added to the usual thiamin and riboflavin supplement, vitamin B_6 not only produces a cure of the dermatitis but also a stimulation of growth. It has also been found that a severe microcytic hypochromic anæmia developed in puppies when the rat antidermatitis factor (vitamin B_6) was apparently the only missing component of the diet, and the anæmia was cured by the addition of this factor to the diet. The constitution of vitamin B_6 has now been established by a group of workers in the research laboratory of Merck and Co., Inc. (*J. Amer. Chem. Soc.*, 61, 1237–1247; 1939), whose results confirm those obtained by Kuhn and co-workers published this year. The vitamin was isolated from rice bran as the hydrochloride $C_8H_{12}O_3NCl$ of a base $C_8H_{11}O_3N$ (m.p. 160°). The methyl ester of vitamin B_6 was oxidized to a lactone and a dibasic acid. The acid was shown to be 2-methyl-3-methoxypyridine-4, 5-dicarboxylic acid and vitamin B_6 to be 2-methyl-3-hydroxy-4, 5-(hydroxymethyl)-pyridine. The 3-cyano-4-ethoxymethyl-6-methyl-2-pyridone was made from ethoxyacetylacetone and cyanoacetamide. This 2-pyridone derivative was used for the synthesis of the lactone of 2-methyl-3-methoxy-4-hydroxymethyl-5-carboxypyridine and the 2-methyl-3-methoxy-4, 5-pyridine dicarboxylic acid. This lactone and this acid were found to be identical with the lactone and dibasic acid obtained by the oxidation of the methyl ether of vitamin B_6, and the latter was thus proved to be 2-methyl-3-hydroxy-4,5-di-(hydroxymethyl)-pyridine. A complete synthesis of vitamin B_6 from ethoxyacetylacetone and cyanoacetamide was accomplished. The synthetic vitamin B_6 hydrochloride was shown to be identical with the natural product. A single dose of 100 gamma of the synthetic vitamin B_6 hydrochloride gave a curative effect which paralleled that of the natural vitamin B_6.

Metabolism of Chloronaphthalenes

R. V. Cleary, J. Maier and G. H. Hitchings (*J. Biol. Chem.*, 127, 403; 1939) have studied the metabolism of a mixture of polychloronaphthalenes. The substance was found to be absorbed completely when given in olive oil solution to albino rats in doses up to 15 mgm. per day. No significant storage of the material could be detected in lung, liver, skin or kidney, nor was any significant amount excreted in the urine. Both the rat and dog apparently were able to remove and excrete the chloride promptly. A rise in the urinary ethereal sulphate fraction, but no significant change in the neutral sulphate excreted, was noted following chloronaphthalene feeding in the dog.

Testing of Electric Fuses

IT is of considerable importance to know the time necessary for the melting of fuses upon the occurrence of an electric short circuit. This time must be short enough to prevent damage to the apparatus or to the lines in series with the fuse, before the fuse has melted. It is particularly important in the cases of
branches of a network, which is protec
fuse, when each branch contains an
These fuses protect the main fuse, so tha
of one of them does not disturb the o
In a paper in the *Philips Technical Re*
by J. A. M. van Liempt and J. A. de V
method is described of testing fuses
ray oscillograph. The melting time of
on the short-circuit current. If this tim
short to allow the dissipation of th
neglected, then the short-circuit curr
times the limiting current, that is,
current the fuses can carry for un
G. C. Meyer found in 1906 that the melt
be expressed by a formula. He foun
fuses were initially at room temperat
time multiplied by the square of th
current equals a constant for a given n
is called the relative inertia constant.
this constant, for example, may be 1,
and 40 for lead. By recording the c
moment of the melting of the fuse as
the time until it melts with the aid of
oscillograph, the short-circuit current
can be determined from the same osci
authors also show how the measuremen
with alternating current. In this case i
as for the calibration of the time no se
gram is necessary, the time-scale b
immediately from the oscillogram for t
of the current.

Supernovæ

H. ZANSTRA (*Occasional Notes, M*
Astro. Soc., No. 4, March 1939) has d
main characteristics of these objects.
extra-galactic novæ have a brightness e
100 million suns, a remarkable contrast t
nova, which has a brightness about o
of this. In 1934 Baade and Zwicky s
these extremely bright objects were
novæ, but presented a class by themsel
of supernovæ. In the *Contributions fr*
Wilson Observatory (Nos. 600, 601 and
a comprehensive study of all these su
1885 to 1938, and in these Baade de
photographic brightness at maximum
Zwicky with their light curves, and Mi
their spectra. It is remarkable that
photographic magnitudes of the super
spiral nebula in which it appears are ne
on the average about − 14·2. The ori
cataclysm, producing a brightness of
presents a problem on which it is possibl
and which will probably exercise the
theorists for some time. A supernov
something entirely different from an
outburst on a large scale, although th
similarity in the spectra. Certain diff
ever, exist, and Minkowski, who has
bright bands in the later stages of th
has not been able to identify them wit
belonging to known atoms or ions. T
of the spectrum is peculiar, and it is
that the conditions under which matt
in supernovæ are most abnormal. Zw
Palomar Observatory is undertaking
survey with an instrument of large fie
the autumn of 1936 has discovered seve
It is hoped that sufficient material will
able for a study of these very interesti

CYTOGAMY: A NEW SEXUAL PROCESS IN JOINED PAIRS OF PARAMECIUM CAUDATUM

By Dr. Ralph Wichterman, Temple University, Philadelphia

TWO sexual processes have been described for Paramecium in which three micronuclear (pre-mic) divisions lead to synkaryon formation. One ocess, called conjugation (cross-fertilization), may defined as the temporary union of two individuals volving three micronuclear divisions, *nuclear exange* and the establishment of a new synkaryon each conjugant.

The second process, called autogamy (self-fertilizaon) was described by Diller[1] for *Paramecium aurelia* occurring in *single* animals only. Here three icronuclear divisions lead to the formation of metic nuclei which fuse and form a synkaryon in e single animal.

I have observed a third sexual process in joined aramecia which appears to be intermediate to true onjugation on one hand and autogamy on the her. It resembles conjugation since two animals in together along their oral surfaces as in conjugaon, but there is *no nuclear exchange* between e members. Instead, the three micronuclear ivisions lead to the formation of the gametic nuclei, ut a synkaryon is established in the *same individual* s in autogamy. I am therefore proposing a new erm, *cytogamy*, for this phenomenon as distinct from utogamy in single individuals and true conjugation nvolving a nuclear transfer in joined pairs.

A new method of studying *living* joined *Paramecium udatum* with a view of obtaining a better undertanding of the problem of sexuality and nuclear ehaviour was begun two years ago. By using recently developed precision micro-compression hamber, it is possible to observe in the living conition the behaviour of nuclear phenomena over a airly long period of time. In addition, accurate ime relationships can be determined during the nion. In this preliminary note, the method and bservations may be stated briefly as follows:

With a micro-pipette, a single pair of recently oined paramecia is removed from a pedigree ulture, placed in a small drop of culture fluid on he circular glass slide of the micro-compressor and tudied at approximately 26° C. Extremely fine djustments to within a few microns make it possible o prevent gradually the joined paramecia from piralling between the two pieces of glass. When he joined animals move slowly, detailed observations may be made. In this manner, the divisions of the micronuclei and their behaviour have been seen and photographed on 35 mm. and 16 mm. motion picture film. The behaviour of the micronuclei in cytogamy closely parallels the described accounts of conjugation up to the stage of pronuclear exchange.

Cytogamous paramecia, which are considerably smaller than typical vegetative ones, are very insecurely attached to each other at their anterior ends at the beginning of the process. They can be separated very easily in the first hour or two of union. After they have been joined firmly, there is a progressive dedifferentiation of the ingestatory structures which appear to pass into a sol state. The micronucleus of each cytogamont leaves its place near the macronucleus and then gradually increases in size. This enlargement takes approximately 4–5½ hours, while the subsequent anaphase and telophase stages require only about 18 minutes.

The 'crescent' prophase stage and long anaphasic telophasic separation spindle, so characteristic in accounts of conjugation, is shown clearly. The swollen part at the centre of the separation spindle is passed into the cytoplasm (micronuclear chromatin extrusion) where active cyclosis moves this fragment about until it ultimately degenerates. Each product of the first micronuclear division enters into the second where again two long spindles in each individual are visible. This second division requires 50 minutes for completion from the time the first division products are formed. The anaphase and telophase stages take place still more rapidly, requiring only nine of the fifty minutes.

Micronuclear products, even while dividing, are moved about in the streaming protoplasm. Degeneration of three of the four products of the second division is observed. The remaining product enters into the third pregamic division, resulting in the formation of two pronuclei in each individual. The pronuclei of each single individual of the joined pair are seen to fuse and form a synkaryon in the *same individual*. No evidence has been obtained to indicate a transfer of pronuclei as is supposed to occur in conjugation.

To simulate normal conditions, the cytogamous paramecia are allowed to spiral freely except during those stages when critical observations are made. In fact, the joined paramecia may be removed from the small drop of culture fluid in the chamber and placed in a larger volume until a further observation is to be made, at which time they may be replaced in the chamber. On the other hand, the entire process may be observed in the micro-compression chamber. Since practically all the other stages of micronuclear behaviour can be verified with stained slides of joined paramecia, it seems very unlikely that the stage of nuclear transfer would be the only one affected by the relatively slight amount of compression to which they are subjected at certain times.

One is struck by the non-synchronous character of the nuclear activity in the individual members of a pair; that is, one member may show a nuclear stage definitely more advanced than that of its mate. This condition is seen occasionally. Recently Penn[2], using stained slides, also observed this phenomenon in a reinvestigation of the cytology of conjugation in *P. caudatum*. Although he believed he was studying conjugation, it appears very likely from his account and photographs that cytogamous individuals were seen instead. In such joined individuals, where the micronuclear divisions are out of phase with each other, the conclusion that there is a simultaneous pronuclear transfer which characterizes conjugation seems irrational.

After the individuals of a pair separate along their margins, a thin, clear, highly elastic strand holds the organisms* together. This strand, which finally breaks, consists of the fused and stretched apices of the paroral cones. Joined individuals may remain together for about 13¼ hours at 26° C.

Diller writes, "Whenever conjugation is found in a culture, autogamy is likely to be taking place simultaneously; and conversely, when no conjugation is occurring in a culture, autogamy is unlikely to be seen". He says further that autogamous animals were "sticky" and more likely to stick to the wall of the pipette during transfers. It is very reasonable to suppose that Diller may have been observing pairs of individuals undergoing cytogamy instead of pairs undergoing conjugation as he believed.

Before this present work was undertaken, I was impressed by not being able to find clear and convincing cases of nuclear exchange after studying many slides of fixed and stained 'conjugating' paramecia from different sources. I believe now that I may have been studying cytogamous individuals and not true conjugants. The fact that a dividing third pregamic or maturation spindle presses against the contiguous membranes of joined paramecia is not evidence enough to enable one to infer pronuclear exchange, even though the membranes may appear to be stretched. It may indicate, however, that in a cytogamont, the membrane in this reg paroral cone is very elastic.

In all my pedigree cultures, individ joining in cytogamy are never strongly a each other as is so strikingly demon Sonneborn's[3] sex reaction of paramecia. gamous union, they become rather f insecurely joined in the beginning of th mass pedigree cultures left standing in the for approximately seven days after usually demonstrate this type of union wit cytogamy. Perhaps cytogamy takes plac strains of *Paramecium* and true conjug when diverse strains are present.

Finally, my observations[4,5] have led me the work of others where a transfer of p *presumed* to occur in "conjugation". Th may be raised as to how often joined c individuals in a culture of Paramecium (or ciliates) have been mistaken for true conj investigators.

[1] Diller, W. F., *J. Morph.*, 60, 11–67 (1936).

[2] Penn, A. B. K., *Arch. Protistenk.*, 89, 45–54 (1937).

[3] Sonneborn, T. M., *Proc. Nat. Acad. Sci.*, 23, 378–385

[4] Wichterman, R., *Biol. Bull.*, 73, 396–397 (1937).

[5] Wichterman, R., *Biol. Bull.*, 75, 376–377 (1938).

THE MUSEUMS ASSOCIATION

JUBILEE CONFERENCE AT CHELTENHAM

AT its annual conference held at Cheltenham in the week commencing July 2, the Museums Association celebrated the fiftieth anniversary of its foundation. In his presidential address, the Right Hon. Viscount Bledisloe appropriately dealt with the state of museums fifty years ago and with the progress that has been effected in the intervening years. Speaking of the needs of the future, he suggested that at least one open-air folk museum might be established in England, for example, in the Forest of Dean. He also directed attention to the lack of any English museum illustrating agriculture.

In addition to a gracious message from its patroness, Her Majesty Queen Mary, the Association received many messages of greeting and congratulation from kindred societies, including the International Museums Office, the American Association of Museums, and the Internationaler Museenverband.

On behalf of the Standing Commission on Museums, Sir Albert Seward read an address prepared by Sir Evan Charteris; and an address from Mr. Arundell Esdaile, president of the Library Association, was also read.

Conveying the congratulations of the Royal Society of Arts, Lord Amulree, its chairman of Council, delivered an address on the museum as an aid to the encouragement of arts, manufactures, and commerce, in which he put forward the attitude of the Royal Society of Arts to the question of museums. He recalled that the Society held in 1760 the first important exhibition of contemporary art in England, and in the following year what was probably the first industrial exhibition in the world. The latter exhibition gave rise to "the Society's Repository or Model Room", which could be claimed a industrial museum. The part played by t in the establishment of the Science Muse Kensington, and its subsequent activiti field were also discussed.

Prof. Anders Bugge conveyed greeting Norwegian Association of Museums, and Chubb and Mr. A. R. Penfold those of African and Australian and New Zealand As

Sir Robert Witt, chairman of the Nat Collections Fund, gave an account of the r that organization to the work of museum galleries.

One of the most important features of ference was an address by the Right Hon. I Warr, president of the Board of Edu "Museums and Education", in which he the great value of local museums in te right use of leisure, and in assisting develop the practical and realistic side of sc The Board of Education is prepared applications for grants from local educatic ties for museum activities specially arrang benefit of school children. Museums dese for all the trouble they are taking in helpi to-day, and encouragement towards st activities in the future.

An address which was received by all with the very greatest enthusiasm was tha His Excellency Don Salvador de Madariaga of the International Museums Office, on and World Peace". To visit an art museu a Velasquez, a Watteau, or a Constable is ciate the true character and inner thoug anish, French, and English nations. Art museums of great importance in educating the emotions d in promoting a feeling of human unity. Their licy might be to bring out that power of man over tter which is opposed both to the exploitation of verty and to the use of power over other men.

Speaking on "The Function of Natural History seums", Dr. W. E. Swinton, of the British seum (Natural History), referred to the great ilities for education in museums, but made a plea r the education of the adult as well as the child. great deal of the so-called educational work done museums is not related to their true function and uld equally well be carried out by other institutions. e great value of natural history museums is to ing the visitor back to the basis of things. Dr. inton made a plea for simpler series of exhibits th fewer specimens (and preferably some that uld be handled), and with clear explanatory labels.

A private meeting of the Association discussed air id precautions in museums, and it is understood at the recent Government handbook on this bject received some criticism.

Among the other discussions held during the onference was one initiated by Dr John Rothenein, director of the Tate Gallery, entitled "Towards Policy for Art Galleries", and a long discussion on r. S. F. Markham's "Report to the Carnegie rustees on the Museums of the British Isles".

In the course of various excursions, the long barrows of Belas Knap and Notgrove were inspected, as were the Roman Villa at Chedworth and the new Corinium Museum at Cirencester; also the Saxon Church at Deerhurst and Tewkesbury Abbey. Gloucester Cathedral and the Gloucester Museums were also visited. Garden parties were given by Viscount Bledisloe at Lydney Park and by Mr. Robert Holland-Martin at Overbury Court.

The Conference Exhibition was one of the largest ever held. As well as various trade stands, it included a collection of photographs by the Royal Institute of British Architects to illustrate contemporary museum architecture; examples of Cotswold crafts; an extensive display of material from the Leicester City and County Schools Loan Department of the Leicester Museum; two new loan cases prepared by the Victoria and Albert Museum and three by the Yorkshire Federation; and an exhibit by the Reading Museum of modern methods of casting.

At the annual meeting of the Association, honorary membership was conferred upon the Right Hon. the Earl of Harewood, M. E. Foundoukidis, Dr. E. E. Lowe, Mr. T. Sheppard, and Mr. William Wyndham, and the first diplomas under the Association's training and examination scheme were presented.

The next conference of the Association will be held at the Liverpool Public Museums in July 1940.

ASSOCIATION OF SHORT-CIRCUIT TESTING AUTHORITIES

DURING the last ten years, owing to the increase in the size of electrical power generating tations and of the machines they employ, together rith the greatly increased voltages used for distribuion, very difficult problems in switchgear technique nd design have come to the front, which make it ecessary to make a practical test of modern circuitreakers of an unprecedented size. During an ccidental short circuit, enormous currents may be enerated, and if the circuit be not broken by suitble switchgear, great damage may be done to very xpensive cables and generators. After intensive esearch, switchgear manufacturers realized that they nust provide themselves with testing facilities on a very much larger scale than was hitherto in existence, n order that the apparatus manufactured should meet the new conditions satisfactorily, performing its functions, to the specified ratings, to the satisfaction both of user and manufacturer alike. The design of circuit-breakers has now become a specialized science.

The manufacturers have therefore erected high-power testing stations, fully provided with the most up-to-date equipment for the testing of circuit-breakers, fuses, reactors, transformers, etc. Without these facilities, manufacturers would have found it practically impossible to comply with the demands imposed upon them by the rapidly changing conditions in the supply industry. The owners of these high-power short-circuit testing stations soon realized that their separate endeavours would be of much greater benefit to the industry if the results of their experience and research in this highly specialized field could be pooled, and this resulted in the formation of the Association of Short-circuit Testing Authorities (ASTA). It is a company limited by guarantee and not having a share capital. In order to comply with the Board of Trade requirements, the articles of association provide (*a*) that the income and property of the Association shall be applied solely to the promotion of its objects as specified in a published memorandum, and (*b*) that no addition to the regulations contained in the articles of association can be made without the permission of the Board of Trade.

We have received from the head office of the ASTA, 36 Kingsway, London, W.C.2, an interesting illustrated publication giving general information on the short-circuit testing and certification of electrical apparatus. The names of eight of the largest electrical companies in England, which form this Association, are given. Prior to the formation of ASTA, individual owners of short-circuit testing plants had tested and certified the products of some manufacturers who had no testing facilities of their own. Other manufacturers held the view that there should be a national testing plant under the control of the National Physical Laboratory and a suggestion to this effect was made to the Home Office. The Department of Scientific and Industrial Research was asked to consider this suggestion, and, in reply to a questionnaire issued by the Department, the owners of short-circuit testing stations directed attention to the following points:

(1) That there are in existence or under construction short-circuit testing plants of a greater capacity than exist in any other country in which switchgear is being manufactured.

(2) That most of the manufacturers who have no testing plants would be satisfied if they could obtain

testing facilities for circuit-breakers of a maximum capacity of 250 million volt-amperes with a voltage limit of 11 kilovolts.

(3) That if the existing testing stations could place the necessary facilities at the disposal of the D.S.I.R., this seemed to be the most economical method of meeting the situation.

The Department saw the advantage from the national point of view of utilizing the existing facilities, and it has now been agreed that the ASTA will collectively place at the disposal of the D.S.I.R. facilities equivalent to one 'test bay' a year for testing circuit-breakers up to the agreed limits of capacity and voltage, and, further, that the D.S.I.R. will appoint a resident officer at any test plant where testing is being carried out, with a view to certification of the results by the National Physical Laboratory. These arrangements will enable the N.P.L. on request to undertake, supervise and certify the results of tests of switchgear manufactured by n members of ASTA. Manufacturers wishing to ha short-circuit tests carried out by the Association w. a view of obtaining a certificate from the N.P. should apply in the first instance to the director of t National Physical Laboratory, Teddington, Middles

The testing stations are at Hebburn-on-Ty Trafford Park (Manchester), Stafford, and Witt Birmingham. The generators are of unusual desig capable of short-time rated outputs in excess of t normal outputs of the largest power stations, a mechanically constructed to withstand the stres resulting from repeated short circuits. The priva of all tests is rigidly ensured, but a reasonable numb of persons nominated by a client are welcome witness them. Members of the Association do considerable amount of research work, not only f manufacturers, but also in the general interests the electrical industry.

'TIME-OF-DAY' ELECTRIC TARIFFS

During the last few years, electrical engineers have given much study to the development of tariffs for electric power which will benefit both consumer and producer and lead to an increased demand for their product. Dr. Hopkinson pointed out fifty years ago that a steady load could be generated much more cheaply than a variable load, although their total loads for a given time were the same. This follows because with a steady load you require less machines in reserve than you do when there are peaks in the load for which much reserve plant is required which is only used for a comparatively short time. The total annual costs of a supply station depend on the running costs and the overhead costs, the former usually being only about one eighth of the latter. Hence any saving in the capital costs of the reserve plant enables appreciable savings to be divided between producer and consumer and would probably attract new consumers. One way of securing a uniform load is by means of a 'time-of-day' tariff. The rate at which the meter registers could be controlled by a ripple current superimposed on the supply current. The ideal case of continuous variation would be difficult, but if the rate at which the meter registers was changed at the supply station two or three times a day, the consumers being notified of the times of these changes, most of them would naturally be careful to keep down their consumption during the times when the meter was registering a high charge. This would increase the 'diversity' of the load and make it more uniform, thus lowering the station cost.

At first sight, this seems unpractical and far-fetched, but as several European cities use a 'time-of-day' tariff the discussion of one of these methods given in a paper by D. J. Bolton of the Regent Street Polytechnic, to the Institution of Electrical Engineers, on May 10, entitled "Superimposed Control Applications with Special References to Tariffs and Load Levelling", is worth studying.

The following are the details of the tariff of a Paris company. Consumers are divided into groups according to the 'size' of their installation. The size is defined by the maximum power consumption and depends on the number of rooms. The charge is 2 kw per day for a one-room apartment, 3 kw. per day fo two to four rooms, 4 kw. for five to six rooms, et Consumers whose power demand is less or equal t this amount are supplied through a single dial mete and are charged at the following rate. If the fir 'block' of the amount is charged at 3*d*. a unit, th second block will be charged at 1½*d*. per unit, an the remainder at 0·54*d*. per unit. The size of th first block is dependent on the number of rooms, an the second block size is always half the first bloc size. Large consumers can have supplies on a two part tariff consisting of a small fixed charge to cove lighting consumption and a running charge varyin with the time of the day. The fixed charge depend on the number of rooms and ranges from 11*s*. to £2 year for a one to six room flat. In addition to thi fixed charge, all the energy passes through a specia meter having three registrations. These are put int operation at appropriate times of the day by mean of timed relays on a centralized control system.

A Paris company was started in 1924 at a special rate for off-peak consumption but was changed into the three-rate tariff system outlined above. This tariff is little used in the purely domestic field, but there is a definite and growing utilization of it in the commercial field for large-scale cooking, oven heating and thermal storage. There would probably soon be a growing demand for it for domestic purposes, if the cost of the special metering required were reduced. This Paris company's charges for the peak period are 2·5*d*. per unit. This period lasts from 3 until 6 p.m. during the winter months. For the 'day' period, which lasts from 7 until 11 a.m. and 2 until 3 p.m. in the winter months and from 2 until 6 p.m. in summer, the price is 1·3*d*. per unit, and for the night period and all other times it is 0·53*d*. per unit.

Mr. Bolton concludes that the function of a 'time-of-day' tariff in Great Britain, both in the commercial and domestic field, would be to develop new loads not yet reached. It should supplement rather than supplant existing methods of charge.

CIENCE NEWS A CENTURY AGO

ying the Keel of the *Great Britain*

On July 19, 1839, the keel of the *Great Britain* was d in a dock at Bristol. This marked the beginning the construction of by far the largest iron ship of time. Like the *Great Western*, she was built for Great Western Steamship Co., for work on the lantic. Her construction was due to the collaboran of Isambard Kingdom Brunel, Thomas Richard ppy, William Patterson and Captain Christopher xton, R.N. At first it was intended to build the p of wood, but the unusual size led to the adoption iron. The largest iron vessels afloat were only of out 700 tons, but when completed the *Great itain* had a displacement of 3,618 tons. She was 9 ft. long between perpendiculars, 50½ ft. wide and ½ ft. deep. Her flat keel was made of wrought iron tes ¾ in. thick and 20 in. wide, welded into lengths 50–60 ft. Her stern and stem frame were both ought iron forgings. The ship had five watertight lkheads. Before the ship was commenced, Claxton d Patterson made a careful study of iron for shipilding. They found that iron afforded greater rength, buoyancy and capacity, and that iron ams 2½ in. thick would have the strength of oden beams 2 ft. thick. The *Great Britain* was t only the largest iron ship, but the largest wrought n structure for any purpose.

-discovery of the Aurora Islands

The *Athenæum*, in its accounts of the papers read the Royal Geographical Society on June 24, 1839, cluded references to the voyages of the *Medina* d *Mary* belonging to Mr. Burrows of New York, no on a recent expedition had re-discovered the rora Islands, which lie half way between the lkland Islands and South Georgia. In its issue of ly 20, 1839, the journal said: "A letter from our nited States Correspondent gives us some parulars of this expedition which are romantic enough deserve to be recorded. It appears that some four ars since a neighbour and friend of Mr. Burrows, a pt. Johnson, after consulting with and communiting to him his views and intentions, sailed from ew York to the Antarctic Seas. Letters were ceived from Johnson when in a high latitude, and ill sailing south, since which no information has en received either from or of him. These circumances weighed upon the mind of Burrows, who inking there was a possibility of rescuing his iend, resolved to follow the example of Capt. Back, d to proceed in search of him. Two small vessels ere accordingly fitted out for the expedition. The ccess in the principal object has been small, though the hazards run were great and the labour ost oppressive." When beyond the Falklands icergs were met with. "Subsequently Mr. Burrows, hen exploring in his boat, was wrecked on an eberg, but he was rescued by another boat driven y accident to the spot, where for three days he and is crew had been without food. For six months he ersevered, but without discovering any positive idence of the fate of his friend. He found, indeed, ear traces of eight different wrecks, a house conructed from the wrecked vessels and fitted up as a inter residence; several graves were near it, and ne body not interred. What a history 'in little' is ere in this last fact."

A Uranian Society

In July 1839, a preliminary meeting was held in the Meteorological Society's rooms, Bartlett's Buildings, Holborn, for the purpose of founding a society for the advancement of astronomical science. The society was to be called "The Uranian Society". According to the *Mechanic and Chemist*, Mr. W. H. White, F.R.S., the senior secretary of the Astronomical Society, presided at the meeting. Various resolutions were passed relating to membership, subscriptions, committee and officers, and it was agreed "that the anniversary of this society be held on the 22nd of March, that being the birthday of the immortal Laplace".

Sepulchral Urn

The *Gentleman's Magazine* for July 1839 contains the following information: "A curious discovery has recently been made on the ridge of hill which divides the Vale of Ovoca from the Vale of Redcross near Kilbride, County of Wicklow. The ridge of the hill affords many remains of remote antiquity, some are blocks of stone 15 ft. in length, laid parallel to each other, resembling burying places made for men of gigantic stature. A farmer was raising stones in a wild and solitary part of the mountains to fill up gaps; about two feet below the surface he turned up a flag, under which was a stone coffin, containing an urn in an inverted position, under which were two small bones laid parallel to each other. The coffin, consisting of six flags, was eighteen inches long, the sides were seven inches high, and ten broad, put together with neatness, the corners rectangular and the sides perpendicular; the inside perfectly clean and free from dust or mould. The urn was four inches deep, swelling in the middle, and contracting at both ends."

UNIVERSITY EVENTS

ABERDEEN.—At the graduation ceremony held on July 6, the honorary degree of LL.D. was conferred on Prof. C. L. Burt, professor of psychology in the University of London, and on Prof. A. Low, professor of anatomy in the University of Aberdeen from 1925 until 1938.

The degree of D.Sc. was conferred on Dr. J. Farquharson, for a thesis entitled "Magnetism and Polymerisation"; L. C. Snook, for a thesis entitled "The Effect of Diet on Ketonemia and Pregnancy Disease in Breeding Ewes"; and on H. Waring, for a thesis entitled "The Relation of the Pituitary Gland to the Chromatic Function of Fishes" (*in absentia*).

ST. ANDREWS.—The degree of M.A. *ad eundem gradum* has been conferred on Dr. E. Finlay Freundlich, Napier lecturer in astronomy. The degree of D.Sc. has been awarded to Dr. J. D. Robertson for a thesis entitled "The Nature and Movements of Interstitial Fluids and Aqueous Humour".

Dr. F. L. Arnot, whose work on ionization in gases has been approved for the degree of Sc.D. by the University of Cambridge, has resigned his post as lecturer in natural philosophy in the United College, having been appointed to a lectureship in his old University of Sydney, New South Wales.

APPOINTMENTS VACANT

Applications are invited for the following appointments, on or before the dates mentioned:

Graduate Lecturer in Engineering at Lincoln Technical College—Director of Education, City Education Office, Lindum Road, Lincoln (July 19).

Lecturer in Chemistry (Organic) at King's College, Newcastle-upon-Tyne—Registrar (July 19).

Teacher of Mining Subjects at Leigh Municipal College—Director of Education, Education Department, Town Hall, Leigh, Lancs (July 20).

Dietitian at the Middlesex Hospital, W.1—Secretary-Superintendent (July 22).

Assistant Technical Advisers in the Engineering Branch of the Air Raid Precautions Department—Establishment Officer, Home Office, Whitehall, S.W.1 (quoting Technical Adviser) (July 22).

Lecturer in Mechanical Engineering—Secretary, Robert Gordon's Technical College, Aberdeen (July 22).

Assistant III (Engineer) at the Fuel Research Station, East Greenwich—Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (quoting J. 29/9) (July 24)

Head of the Chemistry Department in the Municipal Technical College, Bolton—Director of Education, Education Offices, Nelson Square, Bolton (July 24).

Assistant Lecturer in Electrical Engineering at York Technical Institute—Secretary for Education, Education Offices, York (July 24).

Two Assistant Marketing Officers—Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (July 24).

Lecturer in Physiology—Secretary, King's College, Strand, W.C.2 (July 25).

Assistant Master to teach Physics—Headmaster, Royal Naval College, Dartmouth (July 25).

Lecturer in Metallurgy and Chemistry in the Technical College, Coventry—Director of Education, Council House, Coventry (July 26).

Chemists and Assistants III in the Royal Ordnance Factories—Under-Secretary of State (C 5), War Office, S.W.1 (quoting Appts. 156) (July 27).

Cartographers (Unestablished) in the Hydrographic Department of the Admiralty—Secretary, Civil Service Commission, Burlington Gardens, W.1 (July 27).

Lecturer in Engineering at the Cape Technical College, Cape Town—J. A. Ewing and Co. (London), Ltd., 73–74 Chiswell Street, E.C.1 (July 28).

Public Analyst and Government Bacteriologist in the Isle of Man—Government Secretary, Government Office, Isle of Man (August 1).

Temporary Assistants Grade III (Male) in the Meteorological Office—Under-Secretary of State, S.2.B. (Met.), Air Ministry, Adastral House, Kingsway, W.C.2 (August 14).

Principal Agricultural Officer in the Federated Shan States, Burma—High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 5/153B) (August 14).

Assistant Lecturer in Engineering—Registrar, University, Manchester 13 (August 14).

Lecturer in Natural Philosophy in the United College, St. Andrews—Secretary, University, St. Andrews (August 15).

Senior Lecturer in Bantu Studies at Rhodes University College, Grahamstown—Secretary, Office of the High Commissioner for South Africa, Trafalgar Square, W.C.2 (August 17).

Assistant Mistress to teach Physics—Principal, Ladies' College, Cheltenham.

Assistant Engineer for the Drainage and Irrigation Department, Malaya—Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/5765).

Mechanical and Automobile Engineers in the Royal Army Ordnance Corps—Under-Secretary of State (A.G. 9), War Office, S.W.1.

Technical Officers and Assistants II and III at various Royal Air Force Stations—Under-Secretary of State, Air Ministry (S 2. A/B. 8019), Berkeley Square House, Berkeley Square, W 1.

Civilian Education Officers, Grade III, in the Royal Air Force Educational Service—Under-Secretary of State, Air Ministry (E.S.1) (E. and M.), Adastral House, Kingsway, W.C 2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Hull Museum Publications. No. 202: The Old Dutch Whalers. By Thomas Sheppard. Pp. 20. No. 203: Viking and other Relics at Crayke, Yorkshire. By Thomas Sheppard. Pp. 12+6 plates. No. 204: Prehistoric East Yorkshire, Early Valentines, and Record of Additions. Edited by Thomas Sheppard. Pp. 42. (Hull Hull Museum.) [266

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1938 Pp. iv+549+5 plates. (London: H.M. Stationery Office.) 12s. 6d. net. [276

North of Scotland College of Agriculture. Guide to Experin and Demonstration Plots at Craibstone, 1939. Pp. xii+65. (Aberd North of Scotland College of Agriculture.)

Other Countries

Proceedings of the U.S. National Museum. Vol. 86, No. 3 Species of the Foraminiferal Family Camerinidae in the Tertiary Cretaceous of Mexico. By R. Wright Barker. Pp. 305–330+p 11–22. (Washington, D.C.: Government Printing Office.)

The South African Journal of Science. Vol. 35: Being the Re of the South African Association for the Advancement of Sci 1938, Pietermaritzburg. Pp. xx+514. (Johannesburg: South Afr Association for the Advancement of Science.) 30s. net.

Institut de France. Académie des Sciences Annuaire pour 1 Pp. 196. Index biographique des Membres et Correspondant l'Académie des Sciences de 1666 à 1939. Pp. x+478. (Paris: Inst de France.

Comité National français de Géodésie et Géophysique. Explora gravimétrique de l'extrême-orient. Par le R. P. Pierre Lejay. 76. Exploration gravimétrique des états du levant sous man français. Par le R. P. Pierre Lejay. Pp. 54. (Paris: Comité Nati français de Géodésie et Géophysique.) [

Geological Survey of British Guiana. Bulletin No. 10: Rep on the Aranka Goldfield, Cuyuni River. By Dr. D. A. Bryn Dav Pp. iii+25+3 plates. (Georgetown: Government Printers.) cents. [

Newfoundland Government: Department of Natural Resour Research Bulletin No. 6: The Occurrence and Biological Feature Haddock in the Newfoundland Area. By Dr. Harold Thomps Pp 32. (St. John's: Department of Natural Resources.) cents. [

Spectrochimica Acta: ein Forschungsarchiv. Band 1, Heft 1. 92. (Berlin: Julius Springer.) 8.60 gold marks [

Memoirs of the Faculty of Science and Agriculture, Taiho Imperial University. Vol. 21, No. 8 (Mathematics No. 36). Beitr zur Geometrie der Kreise und Kugeln (29), von Sôzi Matumu Über Flächen und Kurven (20), von Sôzi Matumura. Pp. 253–3 (Taihoku: Taihoku Imperial University) [

Report of the First Scientific Expedition to Manchoukuo, under Leadership of Shigeyasu Tokunaga, June–October 1933. Section Division 1, Part 1: Trematode Parasites of Jehol; Chaetopoda Jehol; Hirudinea of Jehol; Mollusca of Jehol and District No of It. Pp. 345+45 plates. Section 5, Division 1, Parts 5, 7, 9, 11, 1 Insects of Jehol (1, 3, 5, 7, 9). Pp. 361+49 plates. (Tokyo: Was University.) [

Smithsonian Miscellaneous Collections. Vol. 98, No. 13: Polychaetous Annelids Collected on the Presidential Cruise of 19 By Olga Hartman. (Publication 3538.) Pp 22. Vol. 98, No. A New Dicrocoeliid Trematode Collected on the Presidential Cr of 1938. By Allen McIntosh (Publication 3541.) Pp. 4. (Washingt D.C.: Government Printing Office.) [

Report for the Year 1938 of His Majesty's Astronomer at the C of Good Hope to the Secretary of the Admiralty. Pp. 17. (Cape Good Hope: Royal Observatory.) [

Spektral-Durchmusterung von Milchstrassenfeldern. Von A. Wachmann. Teil 1. Pp. ii 38+68. Viertes Bergedorfer Sternverzeich 1950·0. Von F. Dolberg und J. Larink. Pp. 22. Astronomische Abha lungen, Band 5, Nr. 1: Untersuchungen über Gesetzmässigkeiten Lichtwechsels der RR. Lyrae-Sterne. Von Elisabeth Kleissen. Pp. Jahresbericht der Hamburger Sternwarte in Bergedorf für das J 1938. Erstattet von dem direktor, Dr. R. Schorr. Pp. 24+4 plat (Bergedorf: Hamburger Sternwarte.) [

Commonwealth of Australia: Council for Scientific and Industr Research. Bulletin No. 125: A Soil Survey of part of the Ker Irrigation District, Victoria. By J. G. Baldwin, G. H. Burvill a J. R. Freedman. Pp. 44. (Melbourne: Government Printer.) [2

Annuario della Società Reale di Napoli. Anno 17 (29 ottobre 193 28 ottobre 1939). Pp. 120. (Napoli: Società Reale.) [2

Smithsonian Miscellaneous Collections. Vol. 98, No. 6: Decap and other Crustacea Collected on the Presidential Cruise of 1938 (w Introduction and Station Data). By Waldo L. Schmitt. (Publicat 3531.) Pp. 30+3 plates. Vol. 98, No. 10: Mollusks Collected on t Presidential Cruise of 1938. By Paul Bartsch and Harald Alf Rehder. (Publication 3535.) Pp. 18+5 plates. Vol. 98, No. 12: New Holothurian of the Genus Thyone Collected on the President Cruise of 1938. By Elisabeth Deichmann. (Publication 3537.) Pp. (Washington, D.C.: Smithsonian Institution.) [2

Catalogues, etc.

Meteorological Instruments. (Catalogue No. 633.) Pp. 13 (London: C. F. Casella and Co., Ltd.)

Musik: Praktisch, Historisch, Theoretisch Teil 4 Royer-Zwickauer Gesangbuch, Nachtrag. (Antiquariats-Katalog Nr. 5 Pp. 337–448. (Leipzig: Karl Max Poppe.)

Water Heater Thermostat. (Leaflet No. 152–2.) Pp. 2. The Summe stat Control for Cooker Hotplates and Radiant Boiling Rings. (Leaf No. 153–1.) Pp. 4. (London: Sunvic Controls, Ltd.)

Cambridge Automatic Regulators. (Folder No. 68.) Pp. 6. (Lo don: Cambridge Instrument Co., Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 3, No. 21, Jun Pp. 52–64. (London: Wild-Barfield Electric Furnaces, Ltd.)

The Nivoc Supplement. No. 8, Series E, June. Pp. 12. (Londo W. and J. George, Ltd.)

The Askania Review. No. 8, June. Pp. 40. (Berlin-Friedena Askania-Werke A.G.)

Editorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 144 SATURDAY, JULY 22, 1939 No. 3638

SCHOOL BIOLOGY AND CITIZENSHIP

IN Great Britain and in other countries the present century, and particularly the last twenty years, have seen great efforts made to improve the school curriculum. It is true that these efforts have been largely experimental, and it cannot be said that they have produced that balanced course which would meet with general, even if not universal, approval. That is partly due to the difficulty of viewing with detachment the traditional courses through which we ourselves have passed, and partly to the endeavour to create new courses by interpolation of new subjects without due regard to the unity of the educational scheme as a whole.

Yet behind these efforts there are apparent ideals which in the end may greatly modify education in schools of all degrees. One affects the pupil as an individual, for the clear trend of modern education is to lay more stress upon the personality, which must be developed through its own response and through the encouragement of initiative. The biological truth that it is not so much the impression from without, but the response of the organism from within which counts in development, appears to be a sound foundation for educational method.

The second ideal has been forced to the front by the antagonisms which have become so insistent within the nations themselves, and it affects the pupil not as an individual but as a member of society. It asks for knowledgeable citizens, able to see and think for themselves, to balance opposing points of view and to make their own decisions, self-confident enough in their own judgment to be independent. It implies that the schools must plan their courses deliberately to contribute to the foundation of sound citizenship.

These thoughts were evidently in the minds of speakers taking part in the educational discussions which had a prominent place in the Ninth Imperial Social Hygiene Congress held in London last week. There the emphasis was laid upon the subject of biology, and while this is but one of the arts and sciences which must contribute to the development of youth, it embraces interests and methods which offer advantages of their own. Particularly it presents an easy and natural gradient to human affairs, from the discussion of the common properties of all living things and their inter-relations to the dependence of man upon common plants and animals, and so to his general relation to his environment. But part of the environment of man is man himself, and so a logical scheme of biological studies must in the end include not only aspects of human physiology but also a wider human biology, objective studies of human populations, human relationships, racial significances or perhaps insignificances, and the like.

A new and forcible argument for the universal teaching of biology in schools was advanced by Prof. James Ritchie in an address upon the "Supply and Training of Teachers in Biology". Sir Richard Gregory and others have in the pages of NATURE and elsewhere directed attention to the difficulties which have arisen between the nations because of the inordinate progress of scientific knowledge and invention in recent years, and the failure of mankind to assimilate these advances and weld them into a social and moral unity. Prof. Ritchie suggested that the failure is partly due to the exclusiveness of science, and that the remedy lies in the creation of a national appreciation of the social and moral implications of scientific knowledge. So soon as biological knowledge, and that embraces knowledge of human relations, becomes a common heritage of every child in the country, the nation would be conditioned for that blending of knowledge and moral sense which has lagged behind in this age of scientific progress.

If that prognosis be accurate, the introduction of biological teaching into all schools, under graded schemes covering the school life of a pupil, becomes a matter of national importance. Distinct progress has been made in Great Britain since the Zoology Organization Committee of the British Association reported in 1921 that "it is a common fact that in England alone, among civilized countries, a boy and girl can reach the age of 18 or 19 years and leave school without having received any school instruction in animal physiology or the natural history of animals". At that time, many lands abroad had already established graded courses in biology which were shared in, not by a few scholars passing on to a specialized course in science in the universities, but by all pupils without exception. Some of the lee-way has been made up in Great Britain, particularly in England and Wales, though Scotland still seems to lag behind; but much has to be done before biology can be looked upon as a school subject universally adopted.

Yet if the subject holds in its interests and content the values that have been claimed for it, its introduction and prosecution in the proper spirit in schools is a matter of national import, which may have beneficial repercussions towards the amelioration of social relations within the nation and between nations. Several speakers in the course of the discussions at the Social Hy Congress pointed out that upon the univer lies a heavy responsibility in this respect, they undertake the training of the majority men and women who as teachers are to b the disseminators of biological knowledge thr out the nation; and it was suggested that, a few exceptions, they have failed to live their responsibilities. University courses, pa larly in zoology, are not adapted to giv student who is to become a teacher that co with animals in their relations to environ and to each other which must form a ground in school teaching.

Furthermore, the universities have u sciously done an ill-turn to the service of bi as a national asset by favouring research a expense of school teaching; the best me usually guided into the paths of scientific in gation, and second raters are often looked up good enough for the services of scientific educ and the investigations it so badly needs. there is any situation that requires re-examin in the nations to-day, it is the chasm bet scientific progress and the knowledge and spi use that progress solely for the benefit of man No certain method of bridging this gap is evi But any reasonable suggestion is worthy of and if, as has been suggested, the national tea of biology is likely to create a scientific attitu mind such that appreciation of the social moral implications of science becomes s nature, then the best men and women are no good for a task upon which may depend ultimate progress of humanity.

ANALYTICAL ASTROPHYSICS

An Introduction to the Study of Stellar Structure

By S. Chandrasekhar. (Astrophysical Monographs sponsored by *The Astrophysical Journal.*) Pp. ix+509. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 50*s*. net.

EDDINGTON'S "Internal Constitution of the Stars" was published in 1926 and gives what now ranks as a classical account of his own researches and of the general state of the theory at that time. Since then, a tremendous am of work has appeared. Much of it has to do the construction of stellar models with diff equations of state applying in different Other parts deal with the effects of va chemical composition, with pulsation and tida rotational distortion of stars, and with the p relations between the interior and the atmos of a star. The striking feature of all this w that so much can be done without assuming particular mechanism of stellar energy-gener Only such very comprehensive assumption ade about the distribution and behaviour of the nergy sources that we may expect future knowdge of their mechanism to lead mainly to ore detailed results within the framework of the xisting general theory.

The work does actually appear at the present ime to be entering upon the new phase in which nown physical laws of energy generation will be mployed. For nearly ten years, it has been enerally believed that the main source of stellar nergy is nuclear transmutation. But only in the ast year or two have sufficient laboratory data n nuclear reactions accumulated to facilitate he quantitative study of its mode of operation; nd only this year has Bethe been able to give the first general survey of the possibilities which is fairly free from hypothetical steps. Incidentally, it is also likely that the theoretical etails of the absorption of radiation in stars soon acquire a more trustworthy physical basis.

The time is therefore opportune for the publication of an authoritative survey of the general theory of stellar structure. Indeed, there seems to be a demand for two rather different expositions, designed for readers with different requirements. Astrophysicists in general would doubtless welcome, before the subject fully enters its new phase, an expert summary of the main results achieved since the appearance of the "Internal Constitution of the Stars". This is not the book which has been written by Dr. Chandrasekhar. But such a book would apparently be more in keeping with the avowed aims of the present series of monographs, and one hopes that the editors may yet supply this need. On the other hand, the developments which we anticipate during the next few years will almost certainly engage the attention of research workers whose training has been in pure physics. They will require an accessible and authoritative account of the astrophysical setting of their work, and they will find their need to a very great extent met by Dr. Chandrasekhar's book.

The scope of this book is deliberately restricted to the most fundamental aspects of the theory. It constitutes in fact a courageous attempt to reduce a branch of astrophysics to analytical or 'rational' form after the manner of classical mathematical physics. The spirit which inspires it is revealed in the author's remark that "the logical rigor and beauty of Carathéodory's theory [of thermodynamics] may be regarded as an example of the standard of perfection which should be demanded eventually of any physical theory, including the theory of stellar structure". So it is not surprising to find the first 'astrophysical' chapter headed "Integral Theorems on the Equilibrium of a Star" and giving a series of elegant inequalities involving the central and mean values of the temperature, pressure, and density in stellar configurations about which the fewest possible assumptions are made. The next astrophysical chapter is on gaseous stars and may roughly be described as an up-to-date version of the theory initiated by Eddington. This is followed by a full account of the bearing of the chemical composition of stars on the general theory, discovered by Eddington and Strömgren, and of its application by the latter to the interpretation of the Hertzsprung-Russell diagram, and describes methods which are certain to play an essential part in future developments. The next chapter regards the subject from a fresh point of view; the outer envelope of a star may be studied under simplified assumptions, and Dr. Chandrasekhar shows how this study leads to significant conclusions about the central condensation of stars and also yields partially independent checks on the preceding work. Subsequent chapters deal with theoretical stellar models in which various general assumptions are made concerning energy generation, or in which the matter may be wholly or partially degenerate, and describe the application of the latter to the theory of white dwarf stars. The closing chapter forms an introduction to the theory of energy generation by nuclear transmutation, in which no attempt is made to maintain the rigorous treatment hitherto employed. Many of the methods and results in these chapters are new, as are many of the extremely useful tables which give both astrophysical results and auxiliary computational material.

These chapters occupy, however, barely half the book. Others are devoted to physical principles, general thermodynamics, radiation theory, and quantum statistics. While each is a masterly account of the topic reviewed, it is probably true that the bulk of the material contained in them is nowadays part of the general equipment of the type of reader most likely to benefit by the rest of the book. There is also a chapter of a hundred pages on "Polytropic and Isothermal Gas Spheres" which is effectively a pure mathematical tract on Emden's differential equation, and might preferably have appeared separately in that form.

The material is throughout presented with enviable crispness and clarity of expression. The work will undoubtedly become an indispensable handbook for future researchers in this field. Nevertheless, one is compelled to think that they would find its size, and incidentally its price, more acceptable had the non-astrophysical portions been drastically reduced.

W. H. McCrea.

THE FUNCTION OF EDUCATION IN DEMOCRACY

Educating for Democracy
Planned and edited by J. I. Cohen and R. M. W. Travers. Pp. xxx+458. (London: Macmillan and Co., Ltd., 1939.) 10s. 6d. net.

THE challenge to democracy at the present time derives part of its strength from the way in which education has been made to serve the purposes of the Fascist State. Those who believe in democracy have, however, been slow to realize that education for democracy is something quite different from education for Fascism, though an admirable pamphlet on "Bias in Education" issued last year by the Association for Education in Citizenship indicates that the danger of the tendency for education to become little more than a means of adjusting the individual to certain restraints on his or her liberty is already realized in some quarters. The present book is an admirable attempt to state the function of education in English democracy, and the participation of twenty-three authors has in no way prevented the presentation of a consistent and convincing exposition of the possibilities of deliberately planning our educational system to serve the purposes of democracy on a factual rather than a political basis.

The several essays vary considerably in scale and scope. Together they give a very comprehensive picture of the possibilities and they are characterized by a remarkable unity of thought. Scientific workers will welcome the expression given to the importance of bringing our education into vital relations with the deeper and more significant movements in our national life, of which probably the most significant is the modern transformation of industry under the influe science. Sir Percy Nunn emphasizes the i ance of the general outlook of the school a spirit which dominates its activities, and of greater stress to-day on the intrinsic va man's creative powers. It should be an es function of the school to awaken and devel special gifts and talents which in time will the community with their fruits.

A dominant theme in this symposium necessity of considering the school as an or the community and not a self-contained Scientific workers will find in the volume nc a lucid statement of the functions and contri of education from the nursery school to tl versity, but also stimulating and suggestive ments on important problems such as the fur of the universities and of the technical oc freedom of teaching and limitation of entry universities, recruitment for the professior elimination of bias in adult education, the of science in modern education, the significa the social sciences, the opportunities in ind psychology and vocational guidance and sel Sir Philip Hartog contributes a discussion place of examinations in the social syster Prof. K. Mannheim an analysis of the socio approach to education and the function of analysis in helping the individual to ma adjustments.

Few will put down this book without convinced that democracy can only f meet the challenge of Fascism to-day n inherent weakness but by sheer neglect possibilities that lie in its hand.

R

BEDFORD COLLEGE, LONDON

A History of Bedford College for Women, 1849-1937
By Dr. Margaret J. Tuke. Pp. xvi+364+12 plates. (London, New York and Toronto: Oxford University Press, 1939.) 10s. 6d. net.

THERE were several reasons why the history of Bedford College should be written, and every reason why Dame Margaret Tuke, who took the chief responsibility for guiding its destinies during a period of twenty-three years, should have written it. Her story necessarily includes a great deal of detail which is meant for the information of past and present members of the College with an admirable sense of proportion, sh the story so as to bring out, not only th which the College has played in the advan of the higher education of women, but al striking and often amusing changes in the background and setting of the College, duri long stretch of years since 1849, the date foundation.

Opened in that year at a house in B Square, London, the College was at first reall other than a school for young ladies of the pla period. Gradually it began to assume som ore nearly approaching the status of a college, d in 1874 moved to more suitable and dignified emises in York Place, Portman Square. Four ars later, the University of London, then an amining body, threw open its doors to women ndidates, and Bedford College, as it was and is ill called, naturally availed itself of the opporunity thus provided. Good work continued to done in adverse circumstances, the buildings ing crowded and ill-adapted for their purpose. here were, we are told, no proper lecture theatres, ere was only an apology for a laboratory situated a basement, and adjoining a small gymnasium hich was the sole provision for physical exercise. here was not adequate room for meals, and the brary was rudimentary.

These details are worth recalling, because a omparison with the fine buildings occupied by he College in Regent's Park since 1913 suggests a ngularly apt illustration of the enormous strides ade by the cause of women's education; and edford College enjoys the distinction of having, o to speak, seen the whole thing through. It ecame a school of the University in 1900, and as granted a Royal Charter in 1907. Naturally, here had existed during the more strenuous period desire to become affiliated to one of the great nd long established colleges, especially as the expenses of adequate equipment for work on the science side would thus have been avoided or minimized. But the party which believed in a great and complete university institution, run by women for women, prevailed, with the results which we now see.

From the first, the services of men were sought and obtained for help which men can generally best give. In their time, for example, the names of F. W. Newman, Mark Pattison, Erasmus Darwin and Arthur Acland were associated with the College, which is under a lasting obligation to the last-mentioned for his work in setting the finances of the College in good order.

But having said so much for the men who have been associated with the College, we must end by saying that had it not been for certain outstanding women there could have been no Bedford College as we know it. Mrs. Reid, the founder and benefactor, "Eleanor Smith of Oxford" (sister of H. J. Smith, the distinguished mathematician), Miss E. Penrose, the lady on whom the title of principal of the College was first conferred, Miss Hurlbatt who succeeded her and carried on until the appointment, in 1906, of Miss Tuke, in whose time the mighty changes indicated above have mostly taken place—these are the persons who really made Bedford College what it is.

NEURO-PHYSIOLOGY

Physiology of the Nervous System
By Prof. J. F. Fulton. (Oxford Medical Publications.) Pp. xv + 675. (London, New York and Toronto: Oxford University Press, 1938.) 25*s*. net.

IN recent years, considerable attention has been paid to neuro-physiology, and marked advances have taken place in our knowledge of the subject. As so few monographs have been available, Prof. J. F. Fulton's book "Physiology of the Nervous System", which he describes as an exposition of the experimental approach to the subject, is of special interest.

In this monograph, Prof. Fulton has emphasized two concepts. The first is the evolutionary principle of levels of function which implies that headward segments of the brain have become dominant over caudal, and that when higher parts are removed many activities of lower segments are, after a time, released. The second relates to the extensive interaction normally occurring between somatic and autonomic reflexes.

The historical notes which are placed at the head of each chapter are of interest, and the author may be congratulated on the manner in which he has drawn the threads together. In some instances, the account demonstrates how the subject came to be developed. For example, it is pointed out in reference to postural reflexes that "Sherrington had been using the decerebrate preparation to study individual reflexes and the underlying mechanism of reflex transmission within the nervous system. After Magnus had left Liverpool, Sherrington and Magnus independently noted the effects of rotation of the head on the posture of a decerebrate cat. When Sherrington learned that Magnus had seen the reaction, he urged him to pursue it and stated that the observation would be his to elucidate." That Magnus carried out these observations with great success is now a matter of history.

Prof. Fulton has succeeded in giving an admirable account of the functions of the central nervous system in relation to somatic reflexes. It is regrettable, however, that the author has not been able to pause and give more attention to the question of chemical transmission of the nerve impulse at the synapse. It must be pointed out that those originally responsible for the hypothesis have never applied it to the central nervous system. The experiments which are quoted as conclusive evidence against chemical transmission in the sympathetic ganglion, namely, that the liberation of acetylcholine has no relation to discharge of impulses, have been repeated since the publication of this book, and have not been confirmed.

It is scarcely possible, in view of the evidence in support of chemical transmission in the ganglion, to dismiss the hypothesis with the statement "that the humoral concept of central transmission has served its purpose". It may be recalled that only a few years ago the postulates of Keith Lucas, which are now stated to harmonize in a striking manner with the new concept, were also supposed to have served their purpose.

The treatment of the autonomic nervous system is open to criticism. Important investigations have been omitted and the chapter as a whole lacks balance and body. It is difficult to understand why Prof. Fulton has attempted a new definition of the autonomic nervous system. Langley's original definition of the autonomic system, "The nerve cells and nerve fibres, by means of which efferent impulses pass to tissues other than mult nuclear striated muscle", was clear and sati factory. It should be emphasized that refle responses involving involuntary tissues may elicited in response to stimulation of a somatic a visceral afferent nerve. Furthermore, somat reflexes may be obtained on stimulation of viscer afferent nerves. It is not necessary to extend th concept of the autonomic system to include viscer afferent fibres.

An excellent account is given of the recent wor on the cortex, and Prof. Fulton is undoubtedl right in emphasizing "the co-existence of autonom and of somatic representation which makes possib simultaneous and appropriate adjustments in th outflow of both autonomic and somatic systems"

There is no doubt that Prof. Fulton ha succeeded in carrying out a difficult task wit distinction. He has given an excellent summar of the experimental investigations carried out i recent years, and his book will undoubtedl stimulate further work. The bibliography is remarkable achievement: it includes 136 references to anatomical and physiological paper This section of the book will be of great value t senior students and research workers. The mono graph is an important contribution to the subject

NITROGEN FIXATION AND NUTRITION

Cattle Fodder and Human Nutrition

With Special Reference to Biological Nitrogen Fixation. By Prof. Artturi I. Virtanen. Pp. vi+108+8 plates. (Cambridge: At the University Press, 1938.) 7*s.* 6*d.* net.

THE process of nitrogen fixation is at once one of the most intriguing and elusive of the unsolved problems of microbiology. It is apparently brought about only by the living cells of certain bacteria and algæ, and the immediate products of nitrogen fixation are in consequence mixed with those of protein degradation whose presence is inevitable in an active cell. This fact has made it very difficult to determine which nitrogen compounds, found in the cells or in their surroundings, are to be regarded as the early products of fixation.

The important contributions that Prof. Virtanen has made to the theory of nitrogen fixation arose from his discovery that the nodules of certain legumes often secrete combined nitrogen into the root surroundings, and that this nitrogen is almost all in the form of *l*-aspartic acid and to a smaller extent of β-alanine. He argues that the products of protein degradation should consist of a variety of amino-acids and consequently cannot accoun for the aspartic acid, which he claims is a primary product of nitrogen fixation. It may be said here that, while this contention is very reasonable, i has not been proved that the products of fixatio have remained unaltered in passing from the bacteria, through the nodule tissue, to the exterior. Prof. Virtanen supposes the bacteria to produce hydroxylamine, which is not detected since it reacts at once with oxalacetic acid (found in pea sap) to form an oxime which is then reduced to aspartic acid. In support of his theory, Virtanen has been able to obtain a fixation of nitrogen by crushed nodules supplied with oxalacetic acid. But we are still in complete ignorance as to how the nitrogen is caused to combine, or as to whether hydroxylamine is in fact the first-formed product.

The nature of the process by which nitrogen compounds are secreted from legume nodules is in itself a remarkably interesting problem. Prof. Virtanen seems to have established the existence of such a process and of the uptake of the secreted compounds by other plants if grown in association with a legume. But attempts to confirm his results have sometimes succeeded and sometimes not, and

feels that there are factors controlling the
retion process that have not yet been detected.
he book under review comprises four lectures
en in England during the autumn of 1937. In
first two of these the author gives an excellent
l very clear exposition of his experiments on
secretion of nitrogen compounds by legumes
l of his resulting theory of nitrogen fixation.
third lecture deals with the supposed lack of
amins in the diet of the Finns. The conclusions
be drawn from the analyses quoted depend on
minimal requirements of average human
ngs for each vitamin, a point concerning which authorities are not well agreed. The fourth lecture describes the now well-known A.I.V. process of ensilage, which was developed by the author, who urges that with its help, protein-rich legume fodder can be preserved with its content of vitamins for winter feed, thus improving the vitamin content of winter milk, to the great benefit of the populace.

The book concludes with a general survey in which the reader is very nearly convinced that the work on investigating nodule secretions on one hand, and the development of the A.I.V. silage process on the other, formed in themselves an example of "associated growth". H. G. T.

A STUDY OF DEWPONDS

wponds in Fable and Fact
Alfred J. Pugsley. Pp. x + 62 + 8 plates.
ndon: *Country Life*, Ltd., 1939.) 3*s*. 6*d*. net.

R. PUGSLEY describes his little book as
"mainly another nail in the coffin of an
eady dead idea". He goes on to say, however, that
e body won't lie down", which is true enough.
The originator of the belief that certain upland
nds are maintained in times of drought by
ect condensation from the atmosphere appears
have been Gilbert White of Selborne. Letter
XIX in "The Natural History of Selborne" sets
t the theory in detail. This simple and, at first
ht, attractive idea gained ready acceptance. It
been demolished scientifically on various
asions; but the writings of the demolishers
ve never enjoyed a publicity comparable with
writings of Gilbert White. Mr. Pugsley's book
ntains an adequate summary of the literature,
d like other competent investigators he has
ched the conclusion that the behaviour of the
called dewponds is accounted for by the
dinary agencies of rainfall and evaporation.
describing the 'dew' pond idea as "one of the
ggest pseudo-scientific swindles that has ever
en foisted on unthinking readers of popular
riodicals by writers who have not troubled to
amine the facts themselves", he can scarcely be
cused of over-emphasis.

The word 'dewpond' is, it appears, of relatively
ent origin, the earliest reference to the term
ing in a pamphlet by Rev. H. P. Slade published
1877. The title-page of Slade's pamphlet,
produced by Mr. Pugsley, might lead one to
ppose that it was a blatant and valueless exsition of the old dewpond hypothesis. It was,
the contrary, a very thorough study of the
ctors involved in the maintenance of a pond
the north-east Berkshire Downs, based on accurate observations of rainfall, water-level and consumption by animals. As Slade's work is now almost forgotten, it is of interest to recall that it was noticed and warmly praised by G. J. Symons in his "British Rainfall". Mr. Pugsley also pays tribute to the work of E. A. Martin, who seems to have been the first to demonstrate the fact that the surface temperature of the water in a so-called dewpond scarcely ever falls below the dew-point of the air above it.

Although, in face of the evidence summarized so clearly by the author, the traditional ideas about dewponds must be thrown overboard, there is no doubt at all that they served, and continue to serve, a most useful purpose in areas where surface water supplies are difficult to get. Their construction calls for great skill acquired by long experience, for it must be remembered that the materials naturally available in these areas do not readily lend themselves to durable water-tight construction, and the power to retain water indefinitely is the essence of the contract. It is a mistake to suppose, however, that there is anything secret or mysterious about the mode of construction. Mr. Pugsley details quite a number of methods. Another myth exploded in the book is that many of the ponds date from neolithic times. He points out that the cleaning process which must be carried out at fairly frequent intervals necessarily involves the removal of some of the puddled material from the bottom of the pond. He estimates, therefore, that such a pond would not last more than 100–150 years, unless entirely remade.

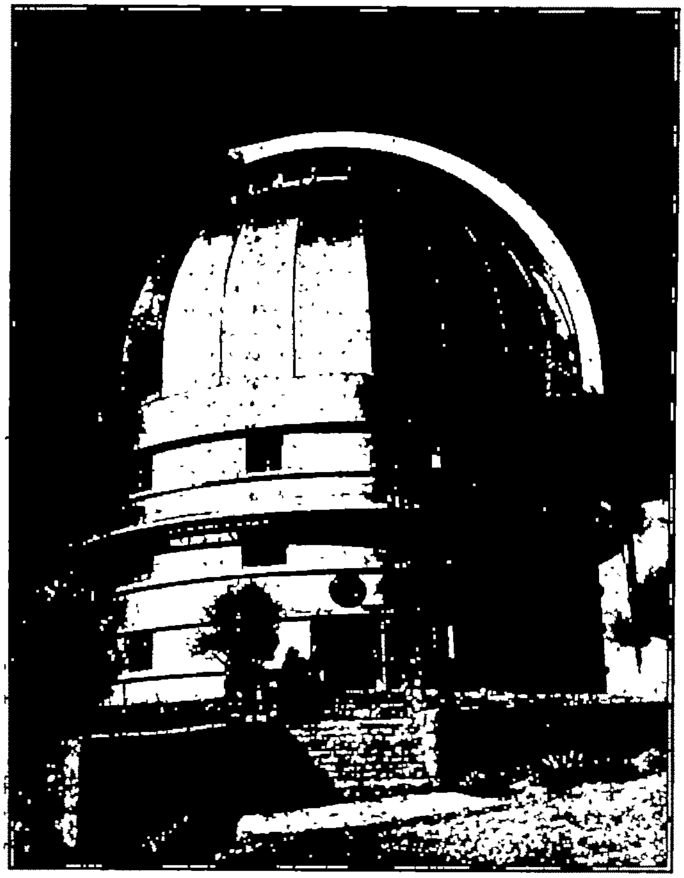
The book contains some pleasing photographs of typical dewponds and it may be cordially recommended to those who desire, at trifling cost to themselves, to have at hand a means of clarifying the ideas of their unscientific friends on the subject of dewponds. E. G. B.

THE McDONALD OBSERVATORY, FORT DAVIS

By Prof. Otto Struve

ON May 5, the president-elect of the University of Texas, Dr. H. P. Rainey, formally dedicated the McDonald Observatory and declared it open for research "as an enduring symbol of the insatiable desire of man to discover the secrets of the universe and as a symbol of the freedom of man's mind to explore the boundless areas of truth without any restrictions whatsoever".

The new observatory is located in the Davis Mountains of western Texas, at an altitude of 6,825 ft. above sea-level. The principal instrument is an 82-inch reflector completely designed and built by the Warner and Swasey Company of Cleveland, Ohio. The disk for the mirror—of Pyrex glass—was cast by the Corning Glass Works on December 31, 1933, and was ground and figured by Mr. C. A. R. Lundin, optical expert of the Warner and Swasey Company. Dr. J. S. Plaskett, director emeritus of the Dominion Astrophysical Observatory at Victoria, B.C., acted as scientific consultant for the Company and performed the laborious optical tests in the shop, before the mirror was installed in its cell on Mount Locke. The following is quoted from Dr. Plaskett's address given at the dedication:



[Photo by Paralto Studio, Austin, Texas.

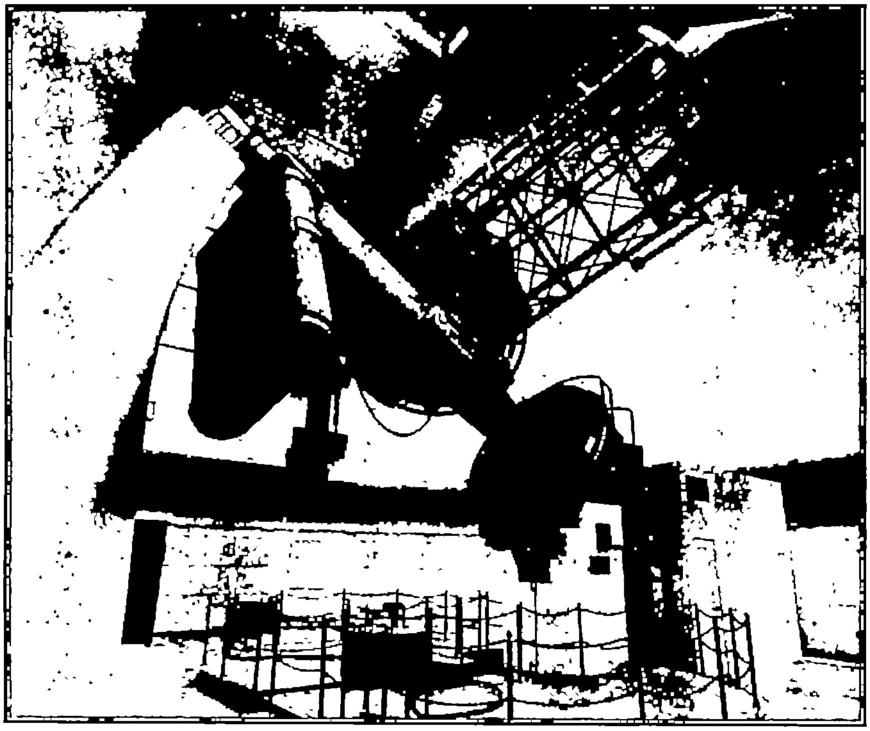
McDonald Observatory at Fort Davis, Texas, on Mount Locke.

"The 82-inch mirror was thoroughly tested in the optical shop by measures of radius of curvatures of various zones. The resulting longitudinal aberrations at the focus were on the average only one thousandth of an inch and these, translated into deviations of the surface from tl
amount to seven ten millionth
thirtieth of a wave of visual li
diffraction disk at the focus l
a
tl
in
ag
c
m
3(
tl
T
te
tl
di
m
di
or
sa
le
w
tl
tl
ar
of
m
te

a
tl
us
D
T
sc
re
p
o
T

is quite short, in order to allow
the polar axis after two refle
plane mirrors. At the lower end
is a constant temperature room
large Coudé spectrograph emplo
inches in height and five inches
prisms were made by Adam H
light flint glass by Chance. The
of the present arrangement is
additional cameras of the Sch
powerful diffraction grating as t
will be provided in the near fut
focal length of the Coudé arrangem

The Cassegrain focal length is 91 ft. (*f*/13). Three spectrographs are now in use. The dispersing nit of one consists of a pair of quartz prisms, made by Bausch and Lomb, four inches in aperure ; or of a pair of light flint-glass prisms made by William Gaertner of Chicago. The collimator is one metre in length. A camera lens of *UV* Jena glass, having a focal length of 500 mm., gives a inear dispersion of 50 A./mm. at 4000 A. with the quartz prisms, or of 25 A./mm. with the glass prisms. Three Schmidt cameras of *f*/2, *f*/1 and *f*/0·5 provide smaller dispersions. The limiting magnitude with the 50 A./mm. dispersion is about 9·5 ; that of the *f*/1 Schmidt camera is about 15.



THE 82-INCH REFLECTOR OF THE McDONALD OBSERVATORY.

Another spectrograph is equipped with a diffraction grating ruled by Prof. R. W. Wood (aluminium on glass) and with a grating ruled by Dean Henry G. Gale of the University of Chicago (speculum metal). Both gratings were excellent and concentrate a large amount of light in the first order on one side. We expect that the aluminium grating will be particularly useful in the infra-red, while the speculum metal grating, recently plated with gold, will be used in the green and near red regions of the spectrum. There are two camera lenses, one designed by Dr. G. W. Moffitt, the other by Prof. F. E. Ross. The linear dispersion of the shorter focus lens is 80 A./mm. This lens, as were several other spectrograph lenses at the McDonald Observatory, was made by J. W. Fecker of Pittsburgh, Pennsylvania.

A low-dispersion spectrograph is used at the Cassegrain focus interchangeably with a large direct camera and a filar micrometer for visual double-star work. This spectrograph is used principally for the determination of spectral types and luminosities of very faint stars.

There is no Newtonian arrangement, and the principal plate holder is in the prime focus itself. The guiding is done from the rim of the tube. The mechanical construction of this elaborate instrument is due to Dr. G. W. Moffitt and Prof. G. Van Biesbroeck.

The prime focus is also equipped with a slitless spectrograph of novel design, due principally to Mr. L. McCarthy. The field is approximately 40′ in diameter, and the limiting magnitude is 15 or 16. The dispersion is about 250 A./mm.

PROGRAMME OF WORK AND ORGANIZATION

The telescope has already produced valuable results. Dr. G. P. Kuiper has obtained numerous spectra of faint proper motion stars and has discovered several new white dwarfs and about two dozen stars of a class designated by him as subdwarfs. Dr. A. Unsoeld of Kiel and the present writer have obtained a large amount of valuable spectrographic material for the study of line-profiles and of equivalent widths in the ultra-violet region of the spectra of early-type stars. Dr. J. Greenstein and Dr. C. K. Seyfert have taken photographs in the prime focus for star counts and for the determination of the colours of condensations in large spirals. Dr. Elvey and the writer are collaborating in the determination of the spectroscopic orbit of the remarkable spectroscopic binary and eclipsing variable μ^1 Scorpii; the former will undertake the study of the line profiles of the principal helium lines broadened by an unusually large amount of rotation, while the latter will measure the radial velocities. Remarkable, but as yet unexplained, variations in the line profiles have been detected.

One of the most interesting features of the Observatory is its organization. The entire Observatory was built from a bequest of one million dollars left by Mr. W. J. McDonald, a banker of Paris, Texas, to the regents of the University of Texas, "for the purpose of aiding in erecting and equipping an astronomical observatory . . . for the study and promotion of the study of astronomical science". Under a 30-year contract, the McDonald Observatory will be operated jointly by the University of Texas and the University of Chicago, the Yerkes Observatory supplying the staff and the larger part of the operating expenses. The present writer combines the functions of the directors of both observatories. Dr. C. T. Elvey acts in the capacity of assistant to the director, and is in charge of the McDonald Observatory during the absence of the director. The permanent staff of the McDonald Observatory includes Dr. C. K. Seyfert, Dr. Daniel Popper and Mr. Walter Linke. The astronomers of the Yerkes Observatory rank as research associates and are given the privilege of using the reflector. The co-operative plan, now in force for seven years, has proved eminently satisfactory from all points of view. A considerable part of the original McDonald bequest has been saved and set aside for future development, or, in case the co-operative plan is dropped at the end of the present contract, for the independent operation of the Observatory by the University of Texas.

DEDICATION CEREMONIES

Through the generosity of the Warner and Swasey Company, a number of distinguished astronomers were invited as guests of the firm to attend the dedication and to take part in
day symposium on "Galactic and Extr
Structure". Prof. E. A. Milne came from
and spoke on "Cosmological Theories"
Bertil Lindblad, of Sweden, spoke on "Th
Interpretation of Spiral Structure" and
Oort, of Holland, discussed "Present Pr
Other invited papers were contributed b
Shapley, Dr. R. J. Trumpler, Dr. Edwin
Dr. B. J. Bok, Dr. Walter Baade, Dr
Payne-Gaposchkin, Dr. Joel Stebbins, D
Russell, Dr. G. P. Kuiper, Dr. S. Chand
Dr. W. W. Morgan, Dr. C. T. Elvey and
Struve. Several important papers w
presented at the session of the south
division of the American Association
Advancement of Science held at Alpine
forty-two miles from the Observatory,
day preceding the dedication. Prof. A
Compton, of the University of Chicag
an evening lecture entitled "Physics V
Future".

The dedication ceremony on May 5 was
by more than four hundred guests. So
astronomers, including the directors of n
large American observatories, attended t
posium and participated in the discussio
members of the staffs of the Yerkes and M
Observatories have derived an immense
of benefit from the papers and discussio
meeting has meant much for the Observa
the two universities, and it has been desc
a regent of the University of Texas as t
important scientific event in Texas hist
resolution passed by the visiting astronom
having been proposed by Dr. Hubble,
by Dr. Russell and transmitted by the c
of the meeting, Dr. W. H. Wright, reads

> "The astronomers who attended the dedi
> the McDonald Observatory and the confer
> galactic and extragalactic structure which
> were deeply impressed, not only by the si
> Observatory and the perfection of the gr
> scope, but also by the remarkably high st
> maintained throughout the discussions
> symposium is generally recognized as t
> profitable that has been held in America
> should serve as a model for future confere

The Warner and Swasey Company, in f
the symposium, in arranging a true Wester
wagon dinner' for more than four hundre
on the day of the dedication, in arranging
cowboy 'rodeo' at a neighbouring ranch,
inviting many of the visiting astronome
trip to the famous Carlsbad Caverns Nation
have set an example of generosity which
be hard to duplicate.

THE RECENT TREND OF RADIO DIRECTION-FINDING

THE radio direction-finder is an instrument for determining the direction of arrival of electric waves of the frequencies normally used in radio communication. Although it was introduced during the early years of the present century, it did not become a practically useful instrument until the valve-amplifying receiver was developed and provided the necessary sensitivity in the reception of radio signals. In its early form, the radio direction-finder, using closed loop aerials and operating on wave-lengths of from a few hundred to several thousand metres, was applied as an aid to marine navigation, and as a means of locating the position of unknown transmitting stations; in addition, however, the instrument provided a very useful tool in connexion with the study of the mode of propagation of electric waves.

Arising out of these applications, it was noticed that under certain conditions of wave propagation and beyond certain minimum distances of transmission, the directional indications of the instruments were subject to large and variable errors, which were found to be due to the action of the horizontal components of electric force in the arriving waves on the horizontal sides of the receiving loop. The remedy for this state of affairs was to be found in a British patent applied for by F. Adcock in 1918, in which it was proposed to replace the closed receiving loops by pairs of spaced vertical aerials, so connected together that the resultant action of any horizontal components of electric force could be reduced to a negligible amount. The practical utility of this invention was demonstrated in 1926, and soon afterwards the Adcock direction-finder became a commercial proposition for medium wave-lengths.

This advance had the effect of increasing the range of usefulness of ground receiving stations to several hundred miles, at which distances polarization errors ranging up to 45° or more with the loop aerial were reduced to less than one tenth of this amount with the spaced vertical aerial. Limitations of space have delayed the application of this improved direction-finding system on board ship, but the closed loop type used on medium wave-lengths has so far been found sufficiently accurate for the comparatively modest range requirements of marine navigation. Since about 1930, two factors have had a major effect upon the trend of radio direction-finding investigations and their application. In the first place, the growth of aerial transport has given rise to a demand for accurate radio bearings of aircraft at distances ranging up to several thousand instead of several hundred miles; and secondly, the general trend of radio communication to shorter and shorter wave-lengths has necessitated the extension of direction-finding technique in a corresponding manner. For the particular case of aerial navigation, various radio beacons have been developed by which a pilot may be guided to an aerodrome and enabled to land under conditions of poor visibility, but the scope of such aids is usually limited to comparatively short ranges, except in the case of long straight air routes, such as exist in the United States of America.

In order to provide a useful radio-bearing service to aircraft at ranges between 200 and 2,000 miles, it is necessary to resort to the use of short waves, so that the comparatively minute transmitter power available on the aircraft may produce sufficient field intensity at the ground receiving station. For this purpose, spaced aerial direction-finders have been developed to a high standard of performance for the wave-length band 10–100 metres. Such instruments are now available, with either a simple aerial receiver in which the bearing is determined by rotating a goniometer search coil to a zero or minimum signal position, or a dual receiver and cathode-ray tube indicator in which the bearing is read from a visual trace on the fluorescent screen.

A detailed theoretical and experimental study of the principles of design and construction of such short-wave direction-finders has led to the conclusion that their inherent instrumental accuracy should be of the order of 1°, with maximum error values of 2° or 3° under the most severe conditions of reception of horizontally polarized waves. When such direction-finders were used in practice, however, it was found that the observed bearings of transmitting stations in known positions were subject to errors much greater than this, sometimes ranging up to 10° or 20°. This raised the question as to whether the instrument was still defective due to some undetected fault, or whether the measurements indicated departures of the arriving waves from the great circle plane between transmitter and receiver.

To assist in the resolution of this question, resort was had to an alternative means of direction finding, which, although first described by T. L. Eckersley in 1921, has not been brought into use as a practical instrument until within the past few years. In this case, the reception takes place on a pair of identical vertical closed loops, spaced a fraction of a wave-length apart and symmetrically connected to the central receiver in such a manner that certain instrumental defects inherent in the use of open aerials can be eliminated. It is convenient to use a visual receiver of the cathode-ray tube type, and various tests have demonstrated that the inherent instrumental accuracy of such apparatus is somewhat higher than that previously attainable.

When used for taking bearings on short-wave transmitting stations, however, it was found that the accuracy was not materially better than that hitherto obtained. It is to be concluded, therefore, that on the short wave-lengths under consideration, a severe limit is set to the accuracy of radio direction finding under certain conditions by vagaries in the propagation of the electric waves employed. The direction-finding instruments indicate the actual direction of arrival of the waves to a high order of accuracy, but this is not necessarily the direction of the transmitter, but rather that of the point of reflection or scattering of the waves from the ionosphere. It is perhaps fortunate that it is possible to avoi bearings obtained under such cond increased knowledge and experience indicate in precisely what circumstanc to rely upon the radio bearings obtai while, the use of these short-wave finders is adding considerably to our k the mode of propagation of electric wa the ionosphere.

In the range of wave-lengths below direction finding is in the early stages ment, but instruments of the close spaced aerial types have already bee ascertaining the possibilities of the a lengths down to 3 metres. It seems within this wave-length band, some a likely to be found in ascertaining the radio sounding balloon transmitters at one hundred miles or so. In this spher much more research is needed on the of waves as well as on the design and of the direction-finding instruments.

R

BIOLOGY, THE SCHOOL AND SOCIETY*

BY T. H. HAWKINS

EDUCATION OFFICER, BRITISH SOCIAL HYGIENE COUNCIL

THE acceleration of scientific invention during the last generation has been such that it has now considerably outdistanced the ability of man to assimilate knowledge and to make it an essential part of his social and ethical relationships. This was the theme of the address given before the Ninth Imperial Social Hygiene Congress by Prof. J. Ritchie, of the University of Edinburgh, who suggested that the failure is in some measure due to the exclusiveness of science, and that its remedy partly lies in the creation of a world-wide appreciation of the social and moral implications of scientific knowledge. That this appreciation can in part be brought about by biological knowledge was the keynote of the educational sessions of the Congress, which was attended by delegates from all parts of the Empire.

At the opening session, the speakers concerned themselves with the teaching of biology as a factor in health and character training. Mr. C. R. E. Gillett, University of Reading, in comparing the older public and newer State schools, suggested that the latter are now attempting to turn out a product which hitherto has presumably belonged exclusively to the former, namely, qualified to play his part in our chang democratic government. This citize keenly aware of his responsibilities t munity and would be imbued with suc social duty that he would readily und tasks which contribute to the welfare lishment of communal life. But whet to serve has demonstrably expressed matter of great doubt, and here onl would make it effective. The part t can play in health and character fo only become apparent if the pupil be keenly aware of the value of his train co-operation will be needed between physical training, domestic science, a and this should be unified by a 'p tude towards health on the part o staff as a whole. The part of the biolo in this co-ordinated form of health educ be that of the true scientific investiga with the children to elucidate rea rather than being a mere imparter information. If children were allo operate fully in the elucidation of sim biological problems, they would not fa

---

* Survey of the educational sessions of the Ninth Imperial Social Hygiene Congress, held in the Hastings Hall, British Medical Association House, July 10-14.

itical and inquiring attitude to their own health
blems, one which is active and forward and
a mere morbid dwelling on bodily ills.

n considering character formation, it is well to
ne the main objectives of biological teaching;
, the acquisition of information; secondly, the
elopment of methods of thinking; thirdly, the
uction and application of principles; and
rthly, the formation of attitudes. The forma-
n of desirable attitudes can be fostered by
ctive science teaching based on direct personal
eriences. The problem of sex education is
nplex and difficult, but at least the biology of
can be treated objectively by the teacher as a
blem which is as vital as any other. Whether
teacher is able to deal with the ethical, moral
l emotional aspects of sex will depend largely
his own personality and character. The recogni-
n that most of the problems besetting the world
fundamentally biological might lead people to
k for biological solutions. Ecology and heredity
ld be used to discuss the inter-relationships of life
l the effects of selective breeding, while, in common
th other sciences, laboratory methods could be
ed to distinguish between speculation and opinion.

Dr. F. C. Kelly, director of the Iodine Educa-
nal Bureau, dealt with the efforts that are
ing made to reduce the gap between those who
e engaged in ascertaining the theoretical facts
nutrition and those whose duty is the applica-
on of that knowledge to the practical affairs of
ublic health. Co-operation between educationists,
edical men and agriculturists might be consider-
ly extended. While the vital problem of mal-
trition and sub-standard health is fundamentally
ne of food production, yet education also has an
sential place. The application of education
hould be extended in two directions. The newer
nowledge of nutrition and its principles must
rst be made known to those who are in a position
influence others, such as Government officials,
ealth, agriculture and education officers, em-
loyers of labour, missionaries and other welfare
orkers. But there is also the great problem of
ducating those whose nutrition it is desired to
nprove. Besides teaching the right use of food
relation to such aspects as cooking, storage and
reservation, there is urgent need for educational
easures to overcome innate conservation, pre-
udice, religious scruples and food taboos. The
eaching of biology in schools might help to over-
ome these prejudices by reaching towards the
ssential unity of Nature, and, in checking the
ontinually increasing pace of analytical inquiry,
ffect a harmonious synthesis of all the complex
nowledge now at our disposal.

Prof. H. D. Kay, University of Reading, suggested that the gaps in the teaching of nutritional science will only be filled when two conditions have been satisfied. One is the need for the training of a sufficient number of teachers capable of dealing with agricultural and rural biology to enable *all* senior and secondary school children in country districts and small towns to receive adequate elementary instruction in environmental science. The other is the need for the training of a sufficient number of teachers having a sound up-to-date knowledge of the elements of nutritional science to enable *all* pupils in senior and secondary schools, in town and country alike, to receive adequate instruction in this field. That the former condition merits immediate attention is borne out by the fact that less than ten per cent of the future farmers of Great Britain attend agricultural colleges or farm institutes, whereas practically all now pass through senior or secondary schools.

An educationist, Mr. W. L. Sumner, of University College, Nottingham, went on to explain the function of the school in creating an ideal of health as an attainable goal. Whilst no detailed physiological knowledge is required, on the other hand a smattering of the old formal botany and zoology would not suffice, a statement which was expanded by Prof. L. P. W. Renouf, University of Cork, and Mr. J. H. Lloyd, University of Wales. Throughout all science courses, the human and everyday value of science should be stressed. Food and feeding and problems connected therewith might find their way into other school studies. Arithmetic might deal with food prices and food values, lists of ingredients, comparison of consumption, etc. The pages of history and geography are full of stories of diet which could be used to good advantage. A knowledge of elementary dietetic principles would enable the public to distinguish between what is true and what is misleading in the advertising of foodstuffs. This knowledge would have far-reaching effects on the health of the nation; during the last twenty years amazing changes have taken place, but the problem of better food for all has still to be resolutely tackled. The psychological and æsthetic aspects of food and feeding are further considerations to which the teacher might give his attention. The presentation of food in attractive form and in pleasant surroundings is a matter in which English people might gain much from Continental methods. Although it would be inadvisable to attempt to copy directly these methods, their study might lead to the introduction of an eclectic spirit.

With these considerations in mind, the Congress turned to discuss the equipment of the ordinary teacher in biology. Although the development of biology in schools during the last ten years has been really remarkable, Prof. Ritchie pointed out that Great Britain still lags far behind nearly every other country in the world, and school courses are often ill-adapted for their purpose in education. Now that the educationist has realized that the pupil is no empty sarcophagus into which the mummy called 'information' should be stuffed, then the objective of making use of the child's own initiative and response might be achieved. As in the world of living things, the educationist is realizing that it is the response from within and not the impression from without which counts. Another conception which is helping to direct the flow of educational practice has arisen from the difficulties and disturbances which have upset the peaceful course of national life in recent years. By inducing independence of thought and balance of mind, school education should lay the foundations of mental stability and of the appreciation of the significance of social relationships which would prepare the child for the responsibilities of citizenship.

The fundamental interest of children in Nature opens up easy ways of inducing response and initiative. To be effective, biology teaching should run in graded stages throughout the whole school period, as indeed it does in many countries. Further, it should place the pupil in contact with living things, in school and out of school, as a basis for the understanding of the activities and relationships of life. Finally, it should in its later stages boldly proceed to link man with the rest of the animate world, and show how he, too, in his relation to natural environment, and to his animate or social environment, is constrained by the laws of Nature.

The difficulty of finding teachers qualified to conduct biology teaching with these ends in view, leads to the question as to whether the universities have attempted to meet the need for teachers of biology. They should introduce more of the liv animal ; there should be more first-hand cont with Nature, a greater familiarity with Brit plants and animals, their relationships with e other and with man himself. In their glorificat of research, which is often pedestrian in natu and their belittling of school teaching, furt blame must be apportioned to the universities.

Other speakers amplified three main poi which arose from the addresses : the need inculcating the right mental outlook and developing perspective and initiative, and a c demnation of academic biology. During the d cussions, one felt that a genuine attempt is bei made to meet those criticisms of school scien teaching which is contained in the Spens Repo and that a step forward has been made to app hend the possibilities of biology. Prof. F. Brooks, University of Cambridge, suggested th the wide extension of 'refresher' courses in t universities would make a valuable contributi to meet present deficiencies.

The part played by biological education contributing to the welfare of native societies w described by delegates from New Zealand, Au tralia, Africa, Malaya, West Indies, Ceylon a other parts of the Empire. Sir Frank Stockdal agricultural adviser to the Colonial Office, e phasized the need for co-operation betwe education, agricultural and health officers communities that live close to the soil. In mo tropical countries, a bias is already being given education in teaching improved methods agriculture, personal and social hygiene, housin and sanitation. In this connexion the need f an adequate training of teachers in huma biology was stressed by many of the coloni visitors.

OBITUARIES

Maria Ogilvie Gordon, D.B.E.

DAME MARIA OGILVIE GORDON died on June 24, and with her has passed a pioneer in woman's share of scientific education and research. Eldest daughter of the Rev. Alexander Ogilvie of Aberdeen, she received her schooling in Edinburgh. She then, 1889–90, studied at University College, London, where she won the gold medal for zoology and comparative anatomy under Ray Lankester. In 1893 she was awarded the London D.Sc. Meanwhile, 1891–95, she had undertaken an investigation of recent and fossil corals under Hertwig and Zittel at Munich. She could not in those days enter the University of Munich as an official student, but merely as a private research worker, receiving kindly assistance from the professors and others of the staf Under these conditions she published two importan papers on corals, one in the *Transactions of the Roya Society* and the other as a supplement to *Palæonto graphica*. In recognition of their merit, she was i 1900 granted the Ph.D. of Munich with highes honours. The occasion was specially noteworth because it was the first time this degree had bee conferred upon a woman.

Corals led Dame Maria into other fields tha zoology and palæontology. In 1891, she accompanie Baron von Richthofen on a geological excursion t the South Tyrol, and listened to him expounding hi thirty-year-old application of Darwin's theory o atolls to the irregularly disposed Triassic dolomite he region. Afterwards, without losing Richthofen's ndship, she contested his interpretation, and ributed most of the seemingly capricious behaviour the rocks to hitherto undetected thrusts. Those o recall the fate of somewhat similar criticisms of ldeman's reef-knolls in the Carboniferous of Great tain may expect that a considerable proportion Richthofen's conception will survive; but there be little doubt of the permanent value of many Dame Maria's contributions to the palæontology, atigraphy and tectonics of the district. Here we y single out, as specially characteristic, her claim have established recurrences of powerful earth vements with pronounced changes of strike.

n the fastnesses of the Tyrol, Dame Maria suffered m more than the usual isolation of a research rker in field geology, but at home she never lacked -operation in the discussion and presentation of r observations. In 1932, when she received the ell Medal of the Geological Society, she gratefully alled help received from men like Geikie, Topley, pworth, Peach and Horne. Altogether, she pubhed about thirty original works, rather more than lf of them in German. British readers also will ver forget her translation of Zittel's "History of ology and Palæontology" (1901).

Dame Maria, in spite of her scientific activity, und time to take a leading part in advancing the lfare of women and children in general. She rried in 1895, and had one son and two daughters, whom the elder was christened 'Coral'.

E. B. BAILEY.

Sir Henry Stuart-Jones, F.B.A.

WE regret to record the death of Sir Henry Stuart-nes on June 29, aged seventy-two years.

Few men of learning in this generation have mbined so fully the widest and most exact scholarip with academic statesmanship and administrative ive. Best known among students as editor of the vised "Greek Lexicon" of Liddell and Scott, Henry uart-Jones will be remembered among Welshmen principal of University College, Aberystwyth, and ce-chancellor of the University of Wales.

Born on May 18, 1867, and educated at Rossall nd Balliol, he had an academic career of exceptional istinction, and was elected in 1890 to a fellowship t Trinity College, Oxford, to which (after busy years f travel and study in Greece and Italy) a tutorship as added in 1894. He had already taken pupils at xeter College for Henry Pelham. As temporary lief from characteristic overwork, he held from 903 until 1905 the directorship of the British School f Archæology in Rome, without severing his conexion with Trinity; but at the end of 1905 he left xford and settled at Saundersfoot near Tenby, evoting himself mainly to Roman history and ntiquities.

In 1911, however, Stuart-Jones seemed the obvious an to edit a new edition of "Liddell and Scott", hich involved drastic changes of plan and the rganization of wide collaborated research, in which he was ably assisted (1921–37) by the late Roderick McKenzie. This great task remained a central interest for him through life.

After valuable war services to the Foreign Office, Stuart-Jones had scarcely resumed work on the "Lexicon" when the Camden chair of ancient history fell vacant by the premature death of Francis Haverfield. Stuart-Jones could have filled any of the Oxford chairs in classics, ancient history, or archæology with distinction, and his inaugural lecture as Camden professor was a fine piece of research and exposition. But he published nothing further. He lectured mainly on the provincial administration of the Roman Empire, and was lavish of his varied learning to colleagues and advanced students. Though living still at Saundersfoot in vacations, and retaining his editorship of the "Lexicon", he took an active part in college and university business; and his appointment in 1927 as principal of the University College of Wales at Aberystwyth, though surprising to some of his friends, actually concentrated his manifold equipment and exceptional energies into a less diffuse career, though he continued to edit the "Lexicon", and rendered valuable services to the council of the British Academy.

At Aberystwyth, Stuart-Jones's rapid and intimate mastery of academic detail, and his newly won proficiency in Welsh, enabled him to take the initiative in many directions: college-buildings, status and salaries of his staff, courses in arts and crafts, research in agriculture and plant-breeding in the institute endowed by Sir Julien Cahn. He was vice-chancellor of the University of Wales during 1929–1931, and found time for work on the Representative Council of the Welsh Church, and in the Diocese of Saint David's.

His impressive appearance and forcible personality were, however, always ill-served by a delicate constitution; and in March 1934 he found it necessary to resign his academic work. But the "Lexicon", now nearly completed, occupied him still, and the premature death of Roderick McKenzie threw heavy burdens on him in the last two years.

Stuart-Jones was knighted in 1933. All his three colleges elected him to honorary fellowships; he was a member of many foreign institutes, and the Society for the Promotion of Roman Studies celebrated his seventieth birthday with a complimentary volume of its *Journal*, with portrait and bibliography.

J. L. MYRES.

WE regret to announce the following deaths:

Brigadier-General the Hon. C. G. Bruce, C.B., M.V.O., leader of the Mount Everest Expeditions of 1922 and 1924, on July 12, aged seventy-three years.

Prof. W. A. Jolly, professor of physiology in the University of Cape Town and past president of the Royal Society of South Africa.

Prof. John Mellanby, F.R.S., Waynflete professor of physiology in the University of Oxford, on July 15, aged sixty years.

NEWS AND VIEWS

Prof. R. D. Haworth

As announced elsewhere in this issue (p. 168), Dr. R. D. Haworth, lecturer in chemistry at King's College, Newcastle-upon-Tyne, has been appointed professor of chemistry in the University of Sheffield after graduating at the University of Manchester in 1919, and spending some time there working with Prof. Lapworth. Dr. Haworth, having been awarded in 1921 the distinction of an 1851 Exhibition, proceeded to Oxford, where he began his work with the late Prof. W. H. Perkin, jun., on isoquinoline alkaloids, leading to the synthesis of cryptopine and protopine; and to important derivatives of the apomorphine series. This work received the well-merited recognition of the doctorate in science from Manchester in 1930. Since 1927 Dr. Haworth has been a member of the staff of the Chemistry Department of King's College, Newcastle-upon-Tyne, in the University of Durham, where, besides carrying on his work on alkaloids, he has had marked success in the investigation of naturally occurring derivatives of phenanthrene. In this connexion his general method for the synthesis of phenanthrenes has had a wide application. During recent years he has added materially to our knowledge of the structure of natural phenolic resins. He has displayed abilities of a high order as a teacher, both of undergraduates and research students, and has, for some years, been senior tutor in science. Besides these academic interests, Dr. Haworth is a keen and accomplished cricketer. He leaves behind him at Newcastle a host of friends won by his sterling qualities, and their good wishes go with him to Sheffield for the future.

Mr. T. E. Wallis

Mr. T. E. Wallis, reader in pharmacognosy in the University of London, has been awarded the Hanbury Medal of the Pharmaceutical Society of Great Britain. Mr. Wallis has contributed thirty-seven papers describing original work to various scientific societies and their official organs. Roughly speaking, his work can be divided into six parts: (*a*) to discover those details of gross morphology and of microscopical structure by which it is possible to identify correctly vegetable materials used in medicine or as foods or spices either in the entire condition or in the form of powder; (*b*) to provide characters by which adulterants can be detected in foods and drugs, especially when in the powdered form or in broken pieces; (*c*) to discover general methods by which the proportions by weight of powdered materials—drugs or foods—may be accurately determined by means of the microscope; (*d*) to devise improved optical apparatus and mechanical contrivances for use with the microscope in the study of food, drugs and powdered substances; (*e*) the production of books for the use of food analysts and the instruction of students of food and drugs; (*f*) to devise new methods for the determination of the purity of certain chemi substances used in medicine and pharmacy. Wallis's work has extended over the past thirty-n years, and its effect as a whole has been to mak much more possible to maintain an efficient cont over the purity and quality of food and dru especially when in the form of powder. The Hanb Gold Medal is a memorial to Daniel Hanbury w died in 1875. It is awarded periodically for "h excellence in the prosecution and promotion original research in the natural history and chemis of drugs". The Committee of Award comprises presidents for the time being of the Chemic Linnean and Pharmaceutical Societies, the chairm of the British Pharmaceutical Conference, and o pharmaceutical chemist.

Political and Economic Planning

A broadsheet (No. 149) recently issued by P E (Political and Economic Planning) gives a br review of the social and economic surveys whi have already been made by P E P or other agenc or are still in progress. The research group of P E which has already issued a report on agricultu research in Great Britain is now engaged in a surv of British scientific research in general. By th group research activity has been classified under fo main headings: background research, or the pursu of knowledge for its own sake; basic research, the study of broad subjects with a pronounc practical bearing; *ad hoc* research or the study specific practical problems; and pilot or develo ment research, bridging the gap between survey experiment and practice. Social or economic surve generally fall into the second or third group, whi studies of housing problems or of opportunities f industrial development appear to be comparable w such types of *ad hoc* research as the control of foc and-mouth disease. Broader studies of the inciden of poverty or of the factors determining the locatic of industry fall into the same category as the stu of animal genetics.

A feature of the position is the lack of security f the personnel concerned in social and econom surveys, as well as the serious absence of provisic for recruitment and training and for the publicatic of results. Moreover, much of the survey work regarded as compromised by excessive concentratic on immediate practical questions and by a failure develop tested fundamental questions as a chec upon passing fashions of thought. The question co-ordination in the organization and scope of futu surveys is urgent. Voluntary surveys are likely i future to consist chiefly in supplementing or inte preting the more voluminous and basic offici surveys, except in pioneer fields, although even he more systematic methods are required. The educational aspects of survey work also require great attention, both from the point of view of using the results in educating local or national opinion and from that of training personnel. Notes on the more important recent surveys are included.

Air Raid Defence

In the June number of *Air Raid Defence* the nature of the air threat is critically examined, including the factor of increased numbers of aircraft, the costs involved, the method of attack and the functions of the incendiary bomb and the gas bomb, as well as of the high explosive bomb, which is considered to be the main weapon of attack. London is regarded as the most probable target in the lightning attack, although key strategic points such as the steel-making district of Sheffield might also become main targets. Civil defence, it is emphasized, differs entirely from traditional defensive strategy in which the war effort is developed as the war progresses in that the maximum demand will be made of it on the very day that war breaks out. Our organization must be ready to operate effectively immediately peace is despaired of, not a few weeks, or even a few days after war has begun. Moreover, since the lightning attacks are only likely to be delivered for a few weeks, short-term measures are entirely justifiable in our main civil defence scheme. It is wrong to plan on the assumption that the intense pressure of the initial blows can be maintained by the enemy throughout a long war. The parrying of the lightning blow is a problem of imperial strategy; the strategic defence aims at giving the best protection where it is most required. We have hitherto been too much inclined to treat civil defence as a matter for local authorities, with their local responsibilities. What is required is not something for everybody, but a great deal for those who are most likely to be attacked.

Rabbit Control by Virus Infection

Disappointment has attended the latest experimental work of the Australian Council for Scientific and Industrial Research on myxomatosis virus as a means of destroying rabbit populations in the field. On Wardang Island, off the coast of South Australia, a colony of about one thousand adults and as many young, in thirty-three warrens, was built up in a ninety-acre enclosure. The disease was introduced into about half the warrens, and in a hundred days some eight hundred infected animals were collected. Very few warrens not deliberately infected became contaminated. The end result, when the disease had practically disappeared, was almost inappreciable, the death-rate being balanced by the birth-rate. It appears that a sick rabbit leaves its colony, wanders aimlessly away and lives only two to four days. It therefore has little opportunity for infecting other rabbits in its colony, and probably none of giving the disease to other colonies. Thus, although the virus is very virulent indeed, and maintains its toxicity, and although there is no evidence of development of immunity, its capacity to kill off a rabbit population is defeated by the instinctive behaviour of the animal. An insect vector is a possibility that is being explored, though without much hope of success.

Science Review Broadcast

The British Broadcasting Corporation has decided to continue its fortnightly "Science Review", which was begun in January this year. These programmes provide a service of first-hand news from the world of science in a form that is assimilable by the interested layman, and it has the unique advantage of bringing the man of science, whether he is describing a piece of his own research or explaining the significance of an announcement from abroad, into direct contact with his public; and he need fear no false emphasis nor misrepresentation because it is he who does the talking. The programmes last twenty minutes and are usually made up of two separate items, one of which is selected from the physical or mechanical sciences and the other from the natural sciences. In this way they cater for as wide an audience as possible. Some of the more outstanding talks so far have been Dr. B. A. Keen's "What Happens to the Rain" (following on one of the wettest weeks in January and his own presidential address to the Royal Meteorological Society); Dr. P. I. Dee's description of the splitting of atoms of uranium; Dr. E. I. White's talk on the South African 'fossil' Cœlocanth; Dr. Maurice Burton's "Recent Sponge Epidemic in the West Indies"; Donald Carmichael's "How Eskimos Think", and periodic talks on various topical aspects of astronomy by Dr. W. H. Steavenson. If this programme is to retain the standard of interest and topicality it has succeeded in maintaining so far, it must continue to be largely dependent on the co-operation of scientific workers, who are invited to offer suggestions for suitable subjects.

The Science Museum: Acquisitions

A series of interesting transparencies, illustrating recent work of the National Physical Laboratory, on such problems as the accurate measurement of precise components, the determination of the temperature and the pressure of the atmosphere and the speed and direction of the wind during the ascent of a radio-sounding balloon, and recent research in metallurgy, has been set up in the Museum. Photographs of John Fitch's Steamboat Model (1785) have been presented by G. H. Eckhardt, of Philadelphia. John Fitch, of Windsor, Connecticut, is said to have first conceived the idea of marine steam propulsion in April 1785. The steamboat model shown was the first made by him, and was laid before the American Philosophical Society, at Philadelphia, on September 27, 1785. The steamboat was to have been propelled by an endless paddle-chain, which is shown fitted on the port side of the model; on the opposite side is a lee-board. There is no record that such a steamboat was ever tried experimentally. A print of the P.S. *Savannah* (1818) has been presented by the United States National Museum. The *Savannah*, the first vessel fitted with auxiliary steam propulsion to cross the Atlantic, was a three-masted carvel-built ship of 350 tons burden. To aid her spread of sail, she was fitted with an inclined direct-acting low-pressure engine of 90 nominal h.p., constructed by Stephen Vail, at the Speedwell Iron Works, near Morristown, New Jersey. There was one cylinder 40 in. in diameter by 5 ft. stroke. The paddle-wheels were made detachable, so that they could be taken on deck when not in use. The *Savannah* sailed from the port of that name on May 24, 1819; she was off the coast of Ireland on June 17, and arrived in Liverpool three days later. Other accounts state that the *Savannah* arrived in Cork harbour with insufficient coal to raise steam, and that most of her Atlantic crossing was made under sail alone, doubtless with the paddle-wheels on deck. The Museum has also acquired an early machine for covering wires with silk and cotton used from about 1837. It was at one time owned by Mr. W. T. Henley, a pioneer in this field, and was probably made by him. It is still in workable condition.

Roman York: A Recent Discovery

IN the course of carrying out a municipal scheme of improvement, further remains of the fortifications of Roman York have been brought to light, which, it would appear, are part of the curtain wall erected by the emperor Constantinus Chlorus in the fourth century to strengthen the fortifications of the city against the attacks of pirates coming up the river (*The Times*, July 11). In driving an arcade through Coney Street, the remains of an internal tower were discovered which was built astride the wall, and was not external as towers previously revealed had proved to be. Its walls are of dressed stone, and on the south side stand to a height of nearly four feet. On the north side are the remains of what would appear to be a pier of dressed stone, three feet high and connected with the main wall by layers of stone slabs. This is believed to have been either the support of a platform of the tower, or the pier of a bridge, carrying the rampart walk over the interval formed by the tower. Remains of the cobbled rampart walk, with the foundations of another building on the east side, have been found. The position of the tower corresponds with what has hitherto been believed to be the character of the curtain wall, where it ran from the Multangular Tower to the angle tower at the south-east corner of the junction of Coney Street and Market Street. It is the fourth interval tower that has been found.

Anglo-Saxon Burials in Rutland

To a large number of scattered burials forming an Anglo-Saxon cemetery in a pit at North Luffenham, Rutland, belonging to Mr. A. H. Lewis of Morcot, have now been added the graves of a man and woman, in which the male skeleton presents the unusual but not unknown feature in an Anglo-Saxon burial of the period of being in the crouched position (*The Times*, July 11). The grave furniture in this burial consisted of a spear, a pottery bowl, and a large bronze bowl, much crushed. All traces of the woman's body had disappeared, but the grave contained a spindle-whorl, a pot, some beads and a glass bottle. The spear is an unusually long specimen of th 'angular' type, the blade measuring 10½ inches. fragment of the shaft is still embedded in the head The bronze bowl, the most notable object found belongs to a well-known type of the pagan Anglo Saxon period. It is a wide elliptical dish, 16½ inches by 12½ inches, with a depth of about 6½ inches. horizontal projecting flange is about an inch in width and on it is embossed a continuous series of studs The foot ring, of 4½ inches diameter, is cast separately. The bowl has been repaired twice near th rim by the addition of small strips of metal rivete over cracks.

The Golden Gate Bridge, San Francisco

Engineering of July 7 contains the first of a serie of articles on the Golden Gate Bridge, San Francisco. by Mr. C. E. Paine, who acted as principal assistant engineer during its construction. This bridge, which was opened in May 1937, is notable as having the longest suspension span of any bridge yet erected, the length of the span being 4,200 ft. as against the 3,500 ft. of the Hudson River Bridge built in 1931. Its side spans are 1,125 ft. long, giving a total suspended structure of 6,450 ft. The two supporting towers are 690 ft. 4 in. from the top of the piers to the bottom of the saddles and have a combined weight of 35,178 tons, while the wire cables are each over 36 inches in diameter and contain 27,572 steel wires 0·195 inches in diameter, arranged in 61 strands. The roadway across the bridge is 60 ft. wide, giving room for six lines of motor traffic, and there are two side-walks 10 ft. wide. The dead load of the main span per lineal foot is 9·51 tons and the live load allowed for is 1·78 tons per lineal foot. The bridge leads from San Francisco to a district ideal for suburban development and for recreational purposes, and it has closed almost the last break in the two thousand miles long coast road which extends from Canada to Mexico. The American Institute of Steel Construction selected the Golden Gate Bridge as the most beautiful bridge, costing more than 1,000,000 dollars, completed in the United States in the year 1937.

The L.C.C. as an Electricity Consumer

IN a recent paper read before the Association of Supervising Electrical Engineers by Mr. Forbes Jackson, the quantity of electricity consumed by the London County Council and the difficulty experienced in reducing its cost are discussed. The area of the L.C.C. is 116 square miles, and it has a population of more than four million. It consumes approximately for its own services, including drainage, schools, hospitals, fire brigades and administrative buildings, 35 million electric units a year. As this supply is taken from 1,100 different points and from various supply authorities, it is not able to reap the benefit of its great diversity of supply and get an inclusive tariff. This is perhaps the reason why electric supply is not more largely used. Mr. Forbes says that there are only three hospitals which use electric cooking, and its use is not increasing. The L.C.C. deals irectly or indirectly with 1,200 schools, and whilst big programme of conversion from gas lighting to lectric lighting has taken place, the conversion to lectric heating, with the exception of reflector fires n open-air schools, has been slow. The standard adopted for the lighting of schools is 8–10 foot-andles. Mr. Jackson points out that the low ceilings now favoured in modern schools make totally ndirect lighting of class rooms undesirable, for a ow ceiling when too bright has a depressing effect. It is known that the all-electric housing experiments of the L.C.C., of the St. Pancras Housing Association and others have been great successes. During the ast four years, 23,000 houses or flats have been converted from gas to electric lighting by the L.C.C. More than 80 per cent of the tenants had electric ight installed although their rent was raised to meet the cost of wiring.

Preventing Oil Fires in Power Stations

A STUDY of the inflammation of lubricating and similar oils recently made in the research laboratories of Messrs. Mather and Platt, Ltd., Park Works, Manchester, has elucidated the mode of combustion of these oils and led to the development of the Mulsifyre' system of extinguishing oil fires (*Beama Journal* of June). It was found that when lubricating oil was heated in a container to the temperature commonly employed with modern steam turbines, the oil does not take fire. The danger arises when there is a relatively thin film of the oil falling on, or flowing over, a steam pipe. As the oil flows over the hot surface, the complex molecules are 'cracked' and new substances are formed. The heavier fractions remain clinging to the metal surface, while the lighter fractions volatilize. Between these volatilized fractions and the oxygen of the atmosphere an exothermic reaction takes place causing a considerable increase of temperature, and new substances appear, aldehydes, acetic acid, bituminous matter and saponifiable oil.

IT was found that whilst the open flash point of the oil used was greater than 400° F., the flash point of the volatile fractions was only about 175° F. When ignition takes place in these circumstances it never does so at a point in contact with the steam pipe. The flame can often be seen to develop in the air several inches above the pipe. In order that the oil spurting from a defective pipe joint may catch fire, it must be sprayed in the air in a finely divided form. The underlying principle of the 'Mulsifyre' system of quenching oil fires is to change the nature of the liquid. By emulsifying it, the inflammable liquid becomes incapable of burning. With the 'Mulsifyre', the mechanical agitation is provided by discharging water under pressure through a special form of nozzle on to the surface of the oil. The water, issuing from this projector in a strong, driving, well distributed spray, it strikes the oil with considerable force. The projectors are effective either when quite close to the oil or when many feet away from it. A large-scale demonstration plant has been erected at Park Works, Manchester.

The Universal Decimal Classification

MANY classifications have been evolved rather as an intellectual exercise than with any specific aim in view. Others have been made in the attempt to devise a so-called logical system. Most have lapsed already into obscurity. The success of the Decimal Classification, which has survived sixty years of test and is still being adopted at an increasing rate, is a testimony to the qualities inherent in its structure and order. No alternative has been found to be sufficiently valuable to justify detailed development to the extent which the Dewey Classification has experienced, and no classification which lacks such detailed expansion is capable of replacing the Universal Decimal Classification. This classification was adopted unanimously as the international standard classification by representatives of more than forty Governments at the World Congress of Universal Documentation held in Paris in 1937. The Classification is employed in thousands of institutions throughout the world for the indexing and arrangement of public and private archives, books, references to published articles in literature and documents and apparatus of all kinds. Some 150,000 published references to literature in the field of science and technology alone are classified annually in accordance with this code, besides many hundreds of thousands of items in private files. The total work will comprise about 2,000 pages of printing in double column, including about 70,000 classes, and costing about £6. The appearance of "Section 54, Chemistry" (London: Messrs. Simpkin and Marshall, 1939. 7*s.* 6*d.*) will be welcomed by all those concerned with the progress of bibliography. The new Section comprises pure and theoretical chemistry. The industrial processes for the manufacture of chemicals will appear as Section 66. The present section contains about 4,000 main clauses, capable of dealing, in the minutest detail, with every aspect of modern chemistry; as an example of its application may be mentioned the Royal Dutch Petroleum Company, which utilizes the classification to index annually some 120,000 items, mainly of chemical interest.

Evolution of the University Clinic and its Laboratories

Two lectures were delivered by Prof. Simon Flexner at Oxford early in the present year, in which he traced the establishment of clinics in medicine and surgery on a university basis. He suggested that this involves three factors: (1) the provision of laboratories in the clinic for scientific research, (2) the appointment of clinical professors qualified in at least one subject of medical research, and (3) the power of these professors to command time for the patients from whom the research problems are derived. The key to the achievement of these conditions, Prof. Flexner considers, lies in laboratories attached to the clinics, where investigator and student meet and labour together, and he proceeded to review the history of the development of such laboratories. The establishment of clinical laboratories was traced back to John Hughes Bennett and Lionel Smith Beale in the middle of last century in Britain, to Frerichs and Traube in Germany, and to Bowditch and Newell Martin in America. In conclusion, a tribute was paid to Lord Nuffield who, in making his wise and munificent benefaction for medicine, recognized the need to aid the pre-clinical, as well as the clinical, laboratories. The lectures constitute a valuable history of the subject, and have been issued in pamphlet form by the Clarendon Press, Oxford.

Currents in the South Pacific

AN atlas has been constructed by the Marine Division of the Meteorological Office from observations made by merchant vessels and H.M. ships during the period 1910–1937 (H.M. Stationery Office. 7*s*. 6*d*.). No previous atlas of the currents of this ocean has been published since 1897. The new atlas is a definite contribution to our knowledge of the surface drifts of the oceans, for this is the first time that the currents of the South Pacific have been treated statistically. Two charts are given for each quarter of the year. One shows the mean set and drift for each of the small areas where observations are available; the other chart gives roses showing the percentage frequencies of current in any direction for larger areas. In addition, the percentage frequencies of currents, flowing in the same direction, of various strengths, are indicated. In this manner all possible information as to the variation of current is graphically illustrated. The investigation into the currents of this ocean has brought out many important points which are summarized in the text, tables and graphs.

Objectives of Higher Education in India

REFERENCE was made in NATURE of May 6, p. 757, to an article in *The Mahratta* about a proposal for the establishment by the Bombay Government of a Deccan College Institute for higher education in mathematics, philosophy, English, philology, Indian languages, history and economics. The paragraph in question concluded: "In view of the growth of unemployment among the educated classes . . . the comment suggests itself: higher education for what?" The writer of the article has taken exception to these words as implying "a desire to restrict the functions of universities to utilitarian subjects only". They were, in fact, meant to call to mind the danger of promoting educational undertakings without a clear sense of direction and purpose. The whole subject of the unemployment of university graduates is dealt with by W. M. Kotschnig in his "Unemployment in the Learned Professions" (Oxford University Press, 1937). In his survey of the problem in India, he points out that unemployment is worst amongst graduates in liberal arts courses and that this is traceable to a wrong emphasis in education, too much stress being laid on higher literary and theoretical studies. A proposal to establish a new college providing liberal arts courses for graduates appears to call for an answer to the question whether these courses are likely to qualify not merely for the conferment of higher degrees but also for careers which are not already overcrowded.

High Resistance Resistors

THE Zenith Electric Co., Ltd., Villier
London, N.W.2, has issued a catalogue d
its wire-wound vitreous embedded resist
sistances). They consist of a ceramic tub
spirally wound with resistance wire and e
in vitreous enamel. This company was the
produce resistors of this type in Great
Modern requirements have created a need
sistors of comparatively small size characte
their resistance remaining steady under all
conditions. The requirements of high ohm
necessitate resistance wires of the smallest
gauges; they are naturally delicate and fra
trustworthiness makes it necessary that the
embedded in, and protected by, a covering a
impervious to the entry of moisture or to the
of acids, alkalis or other deleterious substa
must be capable also of withstanding high o
and repeated heating and cooling, without de
flaws, crazing or cracks which would permit t
of moisture, and quickly lead to open circuit
corrosion of the fine-gauge wires employe
foregoing requirements seem to be fully
practice by the 'ceramite' embedding proces
is much superior to ordinary vitreous
Being akin to porcelain, it has very high in
properties, possesses great mechanical stren
resists chemical attack. The new 'ceramite'
complies with all the latest Government speci
for tropical grade resistors.

Anti-Rabic Treatment in India

DETAILS are given in the annual report, f
of the director, Dr. R. O. A. Smith, recently
of anti-rabic treatment carried out at the
Institute of India, Kasauli, and its attached
The total number of patients attending was
of whom 18,620, made up of 17,263 Asia
1,357 Europeans, received the full course of
tions with vaccine. Of these, 97 Asiatics died,
rate of 0·56 per cent, but no Europeans. The
employed was a carbolized 5 per cent emulsion
of sheep inoculated with Paris fixed virus, a
of cases suffering from severe bites of rabid
receiving anti-rabic serum treatment in additi

THE annual report of the director, Lieut.
K. R. K. Iyengar, for the year ending Decem
1937, of the Pasteur Institute of Souther
Coonoor, has recently been issued. At the I
426 patients, and at subsidiary centres
patients, underwent the full course of tre
The number of deaths from rabies reported
all treated cases (complete and incomple
twenty-one, giving a mortality rate of 0
cent. Death followed dog-bite in ninetee
while one death was due to fox-bite and one t
bite. The shortest incubation period observe
the year was sixteen days (dog-bite) and the
was 169 days (jackal-bite). The vaccine u
Semple's 5 per cent carbolized sheep-brain sus
of Paris fixed virus, which was in its 994th
at the close of the year.

yphus Fever in the United States

IN a recent communication to the permanent com-ittee of the International Office of Public Health ull. *Off. internat. d'hyg. publ.*, 30, 1780; 1938), rgeon-General H. S. Cumming stated that endemic phus transmitted by fleas, as distinct from classical phus transmitted by lice, of which no case had curred in the United States recently, was on the crease in the United States, where three thousand ses had been reported in 1937. In addition to an crease in the number of cases, there had been an xtension of the disease into the interior of the ountry from its original foci on the Atlantic coast nd Gulf of Mexico. Typhus was now being notified the north of Alabama and Georgia and in Tennessee. n recent years, endemic typhus had shown a tendency o spread from the towns to the rural areas, especially hose in which pea-nuts were grown on a large scale, hich suggested that the grey rat, a well-known eservoir of the disease, was being attracted into the ural districts by this kind of food. Another reservoir f the disease was a native rodent known as the ldfield mouse, and about a dozen other native odents which had been found to be susceptible to nfection by typhus were potential reservoirs of the isease. The case mortality of endemic typhus is elow 5 per cent, most of the deaths occurring in atients more than fifty years of age.

The National Research Council of Japan

THE report of the National Research Council of Japan, volume 2, No. 7, covering the period April 1937–March 1938, lists the serial publications issued during this period and includes notes on the general meeting of the Council and on divisional and committee meetings as well as on the international scientific meetings at which the Council was represented. Discussions at meetings of the Committee on Pacific Investigation have dealt with fishes of the Pelew Islands, the fluctuation of water temperature in the north-eastern sea region adjacent to Japan of the North Pacific Ocean, the vertical distribution of plankton in relation to submarine illumination and temperature, the propagative protection of the few seal in the North Pacific. Discussions at meetings of the Committee on Engineering Research have covered television, the technical development of the broadcasting service and the research problems of electric arc welding. A full list of officers and members of the divisions and committees is included with a list of serial publications received from abroad and a table of serial publications already issued by the Council.

Contraceptive Advice by Local Authorities

THE Family Planning Association directs attention to the fact that the Ministry of Health has during the last nine years issued four memoranda to local authorities in England and Wales on the provision of contraceptive advice for married women, but states that of 409 authorities so notified less than half have taken any effective action. The Committee on Abortion in its report (see NATURE, June 1, p. 19) stated that the available facilities for contraceptive advice are inadequate and should be extended. The Family Planning Association, which incorporates several bodies that formerly dealt with questions of birth control, now has sixty-six voluntary clinics where advice on birth control and sterility is given to married women. Information on the subject may be obtained from the Secretary of the Association, 69 Eccleston Square, London, S.W.1, and financial support would be welcomed.

International Geological Congress

THE Second Circular for the eighteenth session of the International Geological Congress, London, 1940, has now been issued. The sessional meetings will be held during July 31–August 8, 1940, and the following ten subjects have been listed for discussion: (1) metasomatic processes in metamorphism; (2) rhythm in sedimentation; (3) the geology of iron-ore deposits; (4) the geology of petroleum; (5) the geology of sea and ocean floors; (6) the pliocene-pleistocene boundary; (7) faunal and floral facies and zonal correlation; (8) earth movements and organic evolution; (9) the geological results of applied geophysics; (10) the geology and paragenesis of the ores of lead and zinc. One of these, the geology and paragenesis of the ores of lead and zinc, will form the subject of a symposium to which recognized authorities have been asked to contribute. It is intended to issue these accounts before the Congress and to promote discussion on them at the sectional meetings.

THE Circular contains details of a series of geological excursions covering most of the British Isles, together with a route-map indicating the principal localities to be visited. In all, fourteen pre-Congress and ten post-Congress excursions are offered and a series of guide-books to be presented to the members is in course of preparation. The arrangements for the Congress are now well in hand and upwards of 1,200 geologists from home and abroad have already signified their intention of being present. Sir Thomas Holland has been elected president of the General Organizing Committee and president-designate of the Congress. All communications should be addressed to the General Secretaries, Eighteenth Session International Geological Congress, Geological Survey and Museum, Exhibition Road, London, S.W.7.

Speleologists in South Wales

THE fourth annual conference of the British Speleological Association will be held at Swansea on August 5–9. In the preliminary programme it is announced that the meetings and administrative organization will be housed in the buildings of the University College of Swansea, while the students' hostel has been placed at the disposal of visitors. The Conference will meet under the presidency of Dr. R. R. Marett, rector of Exeter College, Oxford, whose work in the exploration of the Mousterian cave of St. Brelade, Jersey, is familiar to all students of palæolithic man. August 6 will be devoted to cave exploration, when the members of the Association will be divided into two bodies, one, the archæological section, visiting such famous archæological sites as Bacon's Hole, Paviland Cave, in which was found the well-known Paviland skeleton, and many years ago the late Prof. Sollas claimed to have discovered palæolithic painting, the Long Hole and others. Visits to the museum of the Royal Institution of South Wales and the Caermarthen Museum have also been arranged. The second section on this and succeeding days will engage in pot-holing, visiting Dan-yr-Ogof, Craig-yr-Nos, Penwyll, Porth-yr-Ogof, Wills caves, and others, all of noted difficulty of access. In addition to Dr. Marett's presidential address, a lecture will be given by Prof. T. Neville George, professor of geology in University College, Swansea, and a number of papers on speleological subjects have been arranged. The conference will be preceded by a camp at Lamb's Leer in the Mendips, where a camp held at Easter last discovered a new rift chasm, descending to a depth of 260 ft. below ground. This and other discoveries here of the south regional members of the Association will be reported at the Conference.

Announcements

Prof. W. L. Bragg, Cavendish professor of experimental physics in the University of Cambridge, has been elected *correspondant* of the Section of Mineralogy of the Paris Academy of Sciences.

The Royal African Society has awarded silver medals to the late C. F. Massy Swynnerton, formerly director of tsetse research in Tanganyika Territory. Dr. Edwin W. Smith, editorial superintendent of the British and Foreign Bible Society and editor of the Journal of the Royal African Society, and Miss Margery Perham, research lecturer in colonial administration in the University of Oxford.

Mr. Frederick P. Mills has been appointed honorary secretary of the North of England Institute of Mining and Mechanical Engineers, Neville Hall, Newcastle-upon-Tyne, 1.

The first award from the Anna Fuller Fund of New Haven, Connecticut, has been made to Prof. Ernest Kennaway, Prof. J. W. Cook, Dr. C. L. Hewett, Dr. I. Hieger and Dr. William Mayneord, who are all workers in the research department of the Royal Cancer Hospital (Free), London. The prize, which is worth about £1,500, is awarded for a "real and outstanding contribution to knowledge on the subject of the cause, care, prevention or cure of cancer".

The Thirteenth International Congress of Zoology, which should have been held this year at Rio de Janeiro, will take place in July or August of next year. Further information can be obtained from the Secretary-General, 55 rue de Buffon, Paris, 5.

An international course of malariology will be held at the Institute of Malariology, Rome, on July 25–September 20. The fee is 400 lire. Furt
tion can be obtained from the Istituto di
Policlinico Umberto 1, Rome.

A free course on instruction in th
medicine will be held at the Institute for
of Medicine, Berlin, by Profs. Diepgen a
Drs. Artelt and Heischkel on July 25–
information can be obtained from th
Universitätsstrasse 3 b, Berlin, N.W.7.

An International Air Congress will
Stratford-on-Avon during July 8–13, 194
by the Royal Aeronautical Society, at
will be papers and discussions on the tech
of aviation. Further information can
from the Organizing Secretary, Internatio
gress 1940, 4 Hamilton Place, London,

The eleventh Congress of the Interna
against Tuberculosis will be held in B
August 11–September 20 under the p
Dr. Otto Walter. The discussion will be
three principal subjects: (1) the prob
virulence of the tubercle bacillus, (2) th
tuberculosis in subjects more than fifteen
(3) the re-adaptation of tuberculous patie
Further information may be obtained fro
internationale contre la tuberculose, 6
Saint-Germain, Paris 6ᵉ.

A photographic competition for pict
flowers and plants has been organized b
Cross Society, 47 Victoria Street, Lon
The general object of the competition is t
the temptation to pick wild flowers or t
plants. At the same time it is hoped
interest in and knowledge of this mi
delightful form of wild Nature—includ
sedges, ferns and even fungi. Furth
tion can be obtained from the Secre
Society.

According to international statistics,
tion of the globe at the end of 1937 was 2,
Half this number belonged to Asia.
297,000,000 inhabitants; the most thickl
countries were Germany, England and

A new international "Address Boo
Taxonomists, Geographers, and Ecologis
prepared by the editors of *Chronica Bota*
be issued in the near future in the ne
"Plant Science Books". The Address B
only give the names and addresses of me
included, but also their scientific interes
with a conspectus of current and plann
As it is no longer practicable to compile
book for the whole of plant science, it is
similar address books will be prepared f
branches of the plant sciences. Further
can be obtained from the Editor, *Chroni*
P.O. Box 8, Leiden, Holland.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 159

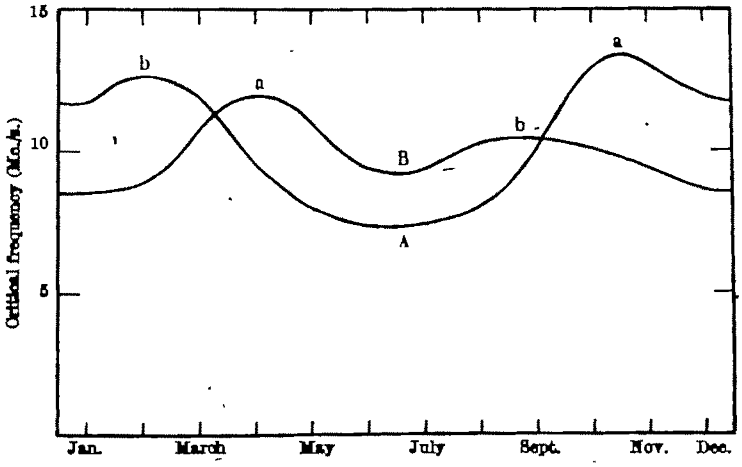
Correspondents are invited to attach similar summaries to their communications.

Characteristic Variation of Region F_2 Ionization Throughout the Year

In a letter from W. M. Goodall, which appeared Nature of June 10, p. 977, there is made one rther step in the elucidation of the complex haviour of Region F_2 of the ionosphere, in that it shown that there is a better correspondence be- reen ionization and calcium flocculi figures for the ntral solar disk than there is between nization and the usual sunspot num- rs. From the determined relation tween ionization and solar activity s expressed by the calcium flocculi gures), it is possible to estimate e average seasonal variation of nization over a number of years, e varying influence of solar activity eing removed. Assuming, for ex- nple, that the solar activity had mained constant at a level ex- ressed by the calcium flocculi char- ter figure 3·0 throughout the period 935–38 (actually, of course, it was radually altering), the seasonal varia- on of the Region F_2 critical fre- uency at Washington (lat. 39° N.) as shown in curve *A* in the accom- anying figure. The trend of such curve confirms the observations f Appleton and Naismith[1,2], who arlier found a similar variation in he northern hemisphere during sunpot minimum at both Slough and Tromsø during he Polar Year 1932–33, and at Slough in succeed- g years. The continuance of the radio work at romsø by Harang[3] has provided further con- rmatory evidence, and we may now feel confident hat a curve of this type represents fairly accurately he seasonal variation of noon critical frequency (and hus ionization) in the absence of marked ionospheric torms.

It will be seen that in curve *A* the two maxima of onization do not occur at the equinoxes, and they may not be associated without qualification, as Mr. Goodall suggests, with the well-known maxima of magnetic activity which occur in March and September. The ionospheric data may now be regarded as sufficiently accurate and extensive for us to be able to say that at the northern hemisphere stations, Tromsø, Slough and Washington, the spring ionization maximum occurs earlier than the spring magnetic activity maximum, while the reverse is the case in the autumn. The maxima of magnetic activity can, moreover, be recognized in the ionospheric data, since in March and September there are found to be the most violent examples of the depression of the critical frequency during ionospheric storms.[4]

Data for the southern hemisphere are not yet sufficiently extensive or concordant for us to be able to specify the variation of ionization with the same assurance as in the case of the northern hemisphere, but from the published data for Watheroo (lat. 30° S.)[5] and from data kindly communicated to me by Prof. F. W. G. White (Christchurch, lat. 43½° S.) and by Dr. D. F. Martyn (Sydney, lat. 33° S.), I have estimated what would be the variation of the critical frequency for a station at lat. 39° S. for the same degree of solar activity represented by *A*. This variation is shown in curve *B*. A seasonal relation is apparent and I suggest that the four maxima in the two curves are correlated as indicated.



Characteristic variation of noon Region F_2 critical frequency for period of constant solar activity. Curves *A* and *B* relate to lat. 39° N. and lat. 39° S. respectively.

(A remarkable feature of the results available to date is that while a variation of the type *A* has been experienced each year since 1932 in the northern hemisphere, the published data for the southern hemisphere station at Watheroo[5] indicate something entirely different. In that case, the (*a*) maximum has consistently occurred in April but the (*b*) maximum has shifted steadily from November to September with increasing solar activity. It will be important to see whether this remarkable anomaly indicated by the published figures is confirmed during the next solar cycle.)

The characteristics of the variation of Region F_2 noon ionization as illustrated by the figure may now be summarized as follows:

(1) The principal feature of Region F_2 ionization is an anomalous seasonal one in that summer ionization is less than we should expect from consideration of the winter value. This may be due to the fact that

the higher atmosphere has a different molecular distribution at high levels in summer and winter, the scale height being increased in summer (such an increase of scale height could result from an increased air temperature or from a reduction in the molecular mass of the ionized air component) or to a seasonal alteration in the type or intensity of the ionizing radiation. This anomalous seasonal effect is most strikingly illustrated by the summer minimum.

(2) There is, in addition, a minimum of ionization in midwinter. This either may be a normal reduction of ionization due to the increased obliquity of the incidence of the ionizing radiation, or may be due to a semi-annual variation of the intensity of the ionizing radiation (photons or corpuscles) arising from the fact that the two sunspot regions north and south of the equator are more directly exposed to the earth at the equinoxes than in summer and winter[5]. In the latter case, it is seen that the influence of the summer minimum mentioned in (1) would tend to make the semi-annual maxima occur earlier and later than the spring and autumn equinoxes respectively.

(3) There is a fairly detailed correspondence between ionizing radiation and solar activity as expressed by central zone character figures.

(4) There is also a remarkable asymmetry between the ionization trends in the northern and southern hemisphere, which is perhaps best described as due to an influence which causes a depression in the critical frequency in both hemispheres during the northern summer[6].

E. V. APPLETON.

London.
June 26.

---

[1] Appleton, E. V., and Naismith, R., *Proc. Roy. Soc.*, **A**, **150**, 685 (1935).

[2] Appleton, E. V., Naismith, R., and Ingram, L. J., *Phil. Trans.*, **A**, **236**, 191 (1937).

[3] Harang, L., *Terr. Mag.*, **42**, 55 (1937); **43**, 41 (1938); and **44**, 15 (1939).

[4] Appleton, E. V., and Ingram, L. J., NATURE, **136**, 548 (1935).

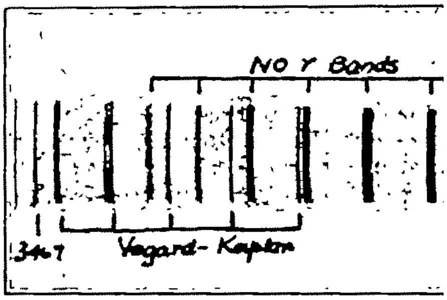
[5] Cortie, A. L., *Mon. Not. Roy. Astro. Soc.*, **73**, 52 (1912).

[6] Berkner, L. V., Wells, H. W., and Seaton, S. L., *Terr. Mag.*, **41**, 173 (1936); and Berkner, L. V., and Wells, H. W., **43**, 15 (1938).

Nitric Oxide in the Earth's Upper Atmosphere

THE failure to observe nitric oxide bands in the auroral spectrum or in that of the light of the night sky has long been a puzzle to me. One of the most conspicuous characteristics of nitrogen afterglow spectra is the intense excitation of the β- and γ-systems of NO in active nitrogen even in the presence of only a trace of oxygen. Of these two systems, the β-bands are the more intense, and the strongest members lie on the long wave-length side of the great Hartley absorption band of ozone. The γ-system lies on the short wave-length side. This description is significant for the interpretation of the experiments which will be described below.

The spectrum which is reproduced here is the spectrum of an afterglow which is produced by passing an extremely weak discharge through nitrogen at a pressure of 10 mm. The nitrogen contained a trace of oxygen, and with a strong discharge showed the strong auroral afterglow which has been studied by me. The spectra of the strong and weak afterglows are as different as those of the aurora and the light of the night sky. The Vegard-Kaplan bands, λ 3467, and the auroral green line are strong in the weak glow and almost entirely missing from the strong glow, which consists of the bands typica spectra. The NO bands are entirely missi strong glow and very strong in the weal The remarkable fact concerning the N the weak glow is the absence of the β-syste the stronger of the two sets of bands. its other features this spectrum represen laboratory reproduction of the light of th so far achieved, we must conclude tha oxide bands are present in the light of th but are not observable because of ozone



Several striking conclusions are inevite that nitric oxide must play an importe excitation processes in upper atmosphere the one which appears to be quite reasoi dissociation of excited nitric oxide by col metastable nitrogen molecules yielding O^1 This is a process which should go on n at higher pressures and thus it leads to the of a very low altitude origin for much of tl from metastable states. This agrees wit observation of λ 2844 as the lower limit sky spectrum. In fact, it would not radical a postulate to suggest that the al low as 25 km., that is, the layer of maxi content.

It may be of interest to point out Compton[2] and his collaborators recentl 25 km. as the altitude at which mesotron took place at a latitude of about 38°. Th the observations reported above, make i to give serious consideration to cosmic ra possible major contributor to the light c sky.

JOSEPH

Departments of Astronomy and Physics,
University of California at Los Angeles.

---

[1] Gauzit, J., *Ann. d'Astrophys.*, 334, July 1938.

[2] Compton, A. H., Schein, M., and Gill, P. S., *Science*, 89

A Determination of the Half-Value P Radium C′ and Thorium C′, with a Time Lags in a Geiger Count

DURING the development of the meth cidence counting for nuclear investig appeared useful to construct a coincider with a variable electrical resolving time provide a method for determining radio value periods of the order of 1 second o basic principle is that if a radioactive placed between two Geiger counters con coincidence counter with resolving time τ the course of successive disintegration, emits pairs of particles which are both detectable by the counters, a genuine coincidence rate of

$$G_\tau = G_\infty(1-e^{-\lambda\tau})$$

will result, where λ is the disintegration constant of the short-lived nucleus.

This method has been successfully applied to the determination of the period of radium C′, and a value of

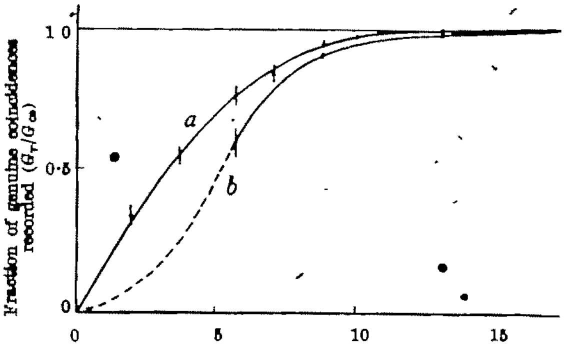
$$1{\cdot}50\,(\pm\,0{\cdot}20)\times 10^{-4}\ \text{sec.}$$

has been obtained for the period, in fair agreement with Jacobsen's determination[3].

The same method of experiment is now being used for a determination of the period of thorium C′. Preliminary experiments yielded curve (*b*) for the variation of the α–β coincidence rate G_τ with the resolving time τ. As a check on the satisfactory operation of the apparatus, experiments were then made with other sources for which no variation in coincidence rate would be expected. None was found (to an accuracy of 1 in 1000) in the range of resolving times 2×10^{-6} sec. to 10^{-3} sec. However, for resolving times below 2×10^{-6} sec. the curve (*a*) was obtained. At this stage, therefore, it became clear that most of the effect with the thorium C′ source, curve (*b*), was spurious. On the other hand, further experiments have shown that the difference between curves (*a*) and (*b*) is really significant, and from this difference a period of

$$3\,(\pm\,1)\times10^{-7}\ \text{sec.}$$

for thorium C′ has been deduced. No previous measurements of the period have been made, but Gamow[4] has estimated it theoretically to be of the order of 10^{-7} sec.



The curve (*a*) has been found to be independent of the source used to provide the true coincidences (for which $\lambda \gg 10^7$ sec.$^{-1}$) and is not materially affected by altering the input capacity of the electrical circuits within reasonable limits. Further, if both valve lines of the coincidence counter are connected to the *same* Geiger counter, each impulse from the counter is recorded as a coincidence by the circuits (for circuit resolving times down to $1{\cdot}5\times10^{-7}$ sec., which is the lowest used so far in coincidence measurements). Clearly the only explanation consistent with all the facts is that the loss of coincidence counts, curve (*a*), must be due to a variable time lag between the formation of the primary ionization inside the counter and the sudden appearance of an appreciable voltage drop across the counter.

This result is qualitatively in agreement with the theoretical suggestions which have been made concerning the action of a Geiger counter[5,6,7]. The time lag which I have observed would correspond to the time taken for an electron formed by primary ionization near the walls of the counter to reach the neighbourhood of the wire, where the electric field is strong and it can give rise to a sudden burst of ionization in the counter. From the present observations, the order of magnitude of this time appears to be 10^{-6} to 10^{-7} sec. The agreement with theoretical predictions is therefore roughly quantitative as well.

It is hoped to publish full details of the experiments very shortly.

J. V. DUNWORTH.

Cavendish Laboratory,
Cambridge.
June 6.

---

[1] Dunworth, in the press.

[2] Feather and Dunworth, *Proc. Roy. Soc.*, A, 168, 566–585 (1938).

[3] Jacobsen, NATURE, 133, 565 (1934).

[4] Gamow, "Structure of Atomic Nuclei and Atomic Transformations" (1938).

[5] v. Geel and Kerkum, *Physica*, 5, 609 (1938).

[6] May, *Proc. Phys. Soc.*, 51, 26 (1939).

[7] Werner, *Z. Phys.*, 90, 384 and 92, 705 (1934).

Binocular Stereoscopic Vision

PROF. T. S. PATTERSON's recent letter[1] gives further evidence of the principle illustrated in my letter to NATURE[2], namely, that, in binocular vision, the apparent distance, and (consequently) the apparent size of the object, depend on the angle of convergence of the two eyes.

The more general principle—that 'seeing' is a function of the brain, in which our eyes act as scouts but do not themselves draw the picture—may be exemplified as follows.

(1) When we look, with both eyes, at any relatively near object, the retina of each eye necessarily receives a substantially different two-dimensional picture. Yet we do not 'see' a blurred combination of the two pictures, but invent, or rather, model, for ourselves a third well-defined 'stereoscopic' three-dimensional image.

(2) When we move our eyes, so as to take a panoramic view of our surroundings, each retina necessarily receives a moving picture traversing its surface. But what we 'see' is not a moving picture, but successive portions of an extended *fixed* picture.

On the other hand, when a cinema camera performs the same manœuvre, the projected picture shows the scene—whether interior or landscape—revolving relative to the audience.

The fixity of the picture seen when our eyes make a panoramic movement is, of course, due to the fact that we *know* that the external object is *not* moving, and that our brain therefore rejects the retinal evidence of motion which it knows to be illusory. But this process takes time, and if we turn our eyes, or our head, too quickly, for example, if we shake our head rapidly, the outer world appears to shake in the opposite direction.

It would appear that actual measurement of the angular speed at which this illusion occurs might give a measure of the time required by the brain to correct this form of retinal illusion.

It follows that there is a close analogy between normal vision and vision in dreams. The principal difference is that in normal vision the three-dimensional model is built up largely from retinal evidence, whereas in dreams the evidence is wholly, or nearly wholly, provided by the mind of the dreamer.

R. A. S. PAGET.

1 Devonshire Terrace,
London, W.2.
June 29.

---

[1] NATURE, 143, 1026 (1939).

[2] NATURE, 142, 77 (1938).

THE explanation sought by Prof. T. S. Patterson[1] of the apparent reduction in size of the 'squint' stereo-image may be this. The apparent position of the 'squint' image is at the intersection of the crossed optic axes about half the distance of the stereo-card. Meanwhile, the angle subtended by the picture at either eye remains roughly what it was for the 'parallel' image. The inevitable instinctive comparison results in the apparently nearer presenting itself as proportionately smaller.

The reversal of the stereo-photo, left-right, right-left, prescribed by Father O'Leary, does not seem to be necessary. The solid image can be obtained, with or without reversal, as in the stereoscope, so also by direct vision, squint or parallel.

After some not too fruitful experimenting with Prof. Patterson's 'thumb' method, I found it easier to switch from the 'parallel' image by deliberate squint. Then, with a little practice, one can alternate almost at will between the two positions. The accompanying contraction and expansion of the image is most striking. The trick of collimating the optic axes to obtain the 'parallel' image, I am convinced (after years of experimentation upon colleagues and pupils), can be acquired by almost anyone (Old Testament scholars, for some reason, are invariably recalcitrant subjects). The squint habit, I imagine, will prove much more difficult to induce.

W. MCENTEGART.

Heythrop College,
Chipping Norton,
Oxon.

---

[1] Patterson, T. S., NATURE, 143, 1026 (1939).

An Increase in the Rate of Growth of Paramecium Subjected to the Blastogenic Hydrocarbon 3 : 4-Benzpyrene

IN order to demonstrate a growth-rate larger than the normal, it is necessary to have optimum conditions for growth. If some factor other than the experimental is controlling growth, then of course growth-rate above the normal cannot occur.

Superabundant food was supplied by Peters's medium containing 1,500 million of *Staphylococcus aureus* per c.c. Staphylococcus was chosen because it does not grow in Peters's solution at room temperature, and therefore cannot be stimulated by benzpyrene. Abundant oxygen was provided by growing the cultures, 0·2 c.c. in volume, in shallow well slides. The well slides were kept in petri-dishes containing blotting-paper moistened with tap water. Warm room temperature was used.

The cultures were seeded with about 100 organisms taken from a rapidly growing culture: a rapidly growing culture must be used in order to avoid an initial lag in growth, which occurs when organisms from old cultures are used for seed. Counts were made 24–48 hours after seeding. It is unsafe to count cultures more than 48 hours old because growth rate then begins to fall off owing to exhaustion of food. During 48 hours growth is exponential, and the time from one division to another is about five hours.

The 3 : 4-benzpyrene was applied as a colloidal emulsion in glass-distilled water: to produce, for example, a concentration of one in a million, 0·1 c.c. of a one in five hundred thousand emulsion was added to 0·1 c.c. of a seeded-Peters's-Staphylococcus liquid: the addition of distilled water alone made controls. On account of the strong photo-dynamic action of benzpyrene, all manipulations must be carried out at very low illumination, preferably behind a 2a Wratten filter; and the cultures afterwards kept in the dark. Leaving the cultures at ordinary laboratory illumination, if it does not kill them, greatly reduces their growth rate. When ready for counting, 0·05 c.c. of 'Susa' was mixed into the cultures; after fixation the organisms are no longer light sensitive and can be counted at ordinary illuminations.

Counts of control cultures show some variation, so that sets of four or five pairs were used in all cases.

All these details must be followed for successful experiments. The results obtained in six consecutive experiments are given in the table; in No. 6 sugar was omitted from the Peters's medium; in all cases the dilution of benzpyrene was one in a million.

		Hours of cultivation	Numbers counted	Percentages
1	Benzpyrene Control	24 24	549 467	118 100
2	Benzpyrene Control	30 30	1095 949	115 100
3	Benzpyrene Control	30 30	389 308	126 100
4	Benzpyrene Control	30 30	364 256	142 100
5	Benzpyrene Control	48 48	1363 884	154 100
6	Benzpyrene Control	48 48	773 507	152 100

Benzpyrene was also tested against the non-blastogenic 1 : 2-benzanthracene and gave 115 per cent against 101 per cent, the control taken as 100 per cent. In a single experiment, using benzpyrene in dilutions of one in 100,000, one in a million and one in ten million, the results were 99, 137 and 100. Thus was demonstrated a growth-stimulating property of 3 : 4-benzpyrene on Paramecium in a dilution of one in a million, provided that the cultures were kept in the dark. The method enables one to express quantitatively this action on an animal cell. No attempt has yet been made to estimate the volume of the organisms. In this connexion it may be mentioned that no differences in size between experimental and control were observed.

When benzpyrene is applied to the tissues of animals a localized hyperplasia occurs; from the above results it seems that this is probably due to a direct action on the cells, to growth stimulation.

J. C. MOTTRAM.

Mount Vernon Hospital,
Northwood, Middlesex.
June 25.

Distribution of Fluorosis in India and in England

Endemic fluorosis has been described in many different parts of the world. Dental fluorosis is found with waters having a fluorine content of one part per million, and in the United States considerable thought has been given to the elimination of 'mottled enamel' by improving water supplies[1]. Stiff backs and other signs of toxic fluorosis are found when the halogen exceeds three parts per million, and in North Africa, where the amount of fluorine in the soil is considerable, attention has been directed to the agricultural and veterinary, as well as to the human aspects of the problem[2]. Industrial fluorosis among aluminium workers who handle cryolite has been described in Denmark[3]. In Arizona, Smith and others[4] found that fluorine plus diet deficiency was a more potent cause of mottled enamel than fluorine alone.

India. Endemic fluorosis has been recognized among men and animals in the Madras Presidency, and fluorine has been found in the well water[5]. In the adjacent areas of the Nizam's dominions, I, with the assistance of Dr. B. K. Badami, director of Veterinary Services, Hyderabad, found dental fluorosis among children in the Mahubnagar district. The cattle, moreover, in this area develop bone lesions with exostoses, which clinically resemble those found among animals suffering from toxic fluorosis, incurred whilst grazing near aluminium factories in Denmark.

During the past few years I have examined more than 9,000 children in various parts of the Punjab, and in certain clearly defined areas I have found evidence of dental fluorosis in the milk and permanent teeth. These areas include the eastern parts of the Mianwali district, villages near Sargodha, Hundewali near Chiniot, villages around Sangla Hill, in and around Kasur, villages near Ferozepore, and certain villages between Bhiwani and Hissar. I found that the teeth were most 'mottled' among children from the lowest social classes, who showed also irregularity in the size of the individual teeth. Stiff backs and elbows have been observed among village children who used deep well water in the neighbourhood of Kasur[6]. The Irrigation Research Institute, Lahore, at my request, kindly had water from a number of wells in the Kasur area analysed, and obtained from nil to four parts fluorine per million.

All the places where dental fluorosis has been detected in the Punjab are situated on the Indo-Gangetic alluvium, which is of practically the same composition all over the Province, and there is no reason to suppose that this alluvium contains any fluorine[7]. Geodetic research, however, has shown the existence of a ridge of rock causing shallowing of the alluvium[8]. The places from which I have collected records of clinical fluorosis may fairly be said to lie over this buried ridge. Dr. Heron considers it is reasonable to think the rocks forming the ridge may include lavas, and associated granites and rhyolites.

England. Dental fluorosis has been described at Maldon and in certain other parts of Essex[9]. Essex waters have been found to contain fluorine up to six parts per million, and on a visit to that county I found that cases of mottled enamel may be met with in many different areas. Mottled teeth have also been described from parts of Somerset and Suffolk, and have been noted at Ashford, Kent, and at Leicester[10], and in Derbyshire near Chesterfield[11].

At Bampton, Oxfordshire, where I am living while on leave from India, I noticed dental fluorosis in adults and children in different parts of the village. Mr. Ainsworth very kindly came to Bampton and has confirmed my findings. Fluorine has now been found in Bampton well water. I have also recognized numerous cases of dental fluorosis among people who have been born and spent most of their lives in the Marston Valley, Bedfordshire. Analysis has shown that the 'knotts' clay in the Marston Valley has a fluorine content of more than 450 parts per million. We do not know the source of the fluorine in the other parts of England where human fluorosis is found. The brownish-yellow flecks and spots of pigment, together with the dull white opaque areas of dental fluorosis are easily recognized, and if borne in mind, may be noted possibly in other areas.

Dental fluorosis in Oxfordshire. E.G.B. male, seventeen years, born and has lived all his life at Bampton in the Bush. Until the age of thirteen years drank well water.

D. C. Wilson.

Department of Medicine,
Cambridge.
June 21.

---

[1] Dean, H. T., Office International d'hygiène publique, *Bull. mensuel*, 30, 1204 (1938).

[2] Gaud, M., Office International d'hygiène publique, *Bull. mensuel*, 30, 1280 (1938).

[3] Roholm, K., "Fluorine Intoxication" (London: Lewis, 1937).

[4] Smith, M. E., Lantz, E. M., and Smith, H. V., "The Cause of Mottled Enamel, a Defect of Human Teeth", *Univ. Arizona Tech. Bull.*, No. 32 (1931).

[5] Shortt, H. E., McRobert, G. R., Barnard, T. W., and Nayar, A. S. M., *Indian J. Med. Res.*, 25, 553 (1937).

[6] Stratford, L. H., personal communication (1939).

[7] Heron, A., personal communication (1938).

[8] Survey of India, Geodetic Report, Dehra Dun (1936).

[9] Ainsworth, N. J., *Brit. Dental J.*, 233 (1933).

[10] Report of a meeting on May 18, 1933, of the British Dental Association, Metropolitan Branch.

[11] Donaldson, S. K., personal communication (1939).

Insect Size and Temperature

When an insect is reared at graded temperatures, it is commonly found that the size of the resultant offspring decreases with increasing temperature[1]. Evidence of the working of this principle in Nature has emerged in a study of the competition amongst the various organisms which scour and keep open the bacteria beds of sewage works[2]. Four species of these nematocerous Diptera have been systematically measured for eighteen months, the wing-length of the female being taken as a convenient criterion of size. The flies were trapped on the beds of Leeds and of Huddersfield sewage works, where the monthly mean bed temperatures have a range of about

7°–18° C. They were sorted into monthly groups and the standard sample measured varied from 50 to 200 from each of several trapping sites.

Each species measured has a maximum size in one of the winter months and a minimum in one of the summer months with fairly steady intergrading. The extent of the variation is shown in the following data giving the maximum and minimum wing lengths in millimetres recorded in the samples and the percentage difference.

Metriocnemus longitarsus, 2·66 ± 0·010 in January 1939 to 2·01 ± 0·040 in September 1938, 21 per cent difference.

Spaniotoma minima, 1·61 ± 0·007 in January 1939 to 1·19 ± 0·008 in August 1938, 26 per cent difference.

Psychoda alternata, 2·58 ± 0·022 in January 1938 to 1·86 ± 0·016 in June 1939, 28 per cent difference.

Psychoda severini, 2·41 ± 0·012 in January 1939 to 1·89 ± 0·013 in June 1939, 21 per cent difference.

The figures are complicated by the fact that competition, which is most intense in the warmer months, also leads to a reduction in size, and samples taken at the same time from different positions on the beds may vary considerably according to the local composition and density of the population. It is evident, however, that temperature is the conditioning factor and that a rise of 1° C. in the monthly mean entails a reduction in wing-length of the order of 1–2 per cent for each of the four species.

Mr. Glenny Smeal has kindly aided us in the statistical treatment of the data.

W. H. GOLIGHTLY.
LL. LLOYD.

The University,
Leeds.
June 27.

[1] Uvarov, B. P., *Trans. Ent. Soc. Lond.*, 79, 38 (1931).

[2] Lloyd, Ll., *Proc. Roy. Ent. Soc. Lond.*, 10, 34 (1935); *J. Inst. Sewage Purification*, Part 1 (1937).

The Mexican Loggerhead in Europe

THE valid scientific name of the Mexican loggerhead turtle, described as *Thalassochelys* (*Colpochelys*) *kempi* Garman 1880, is uncertain, since the animal is figured as *Testudo caretta* in the first specific account of a loggerhead[1]. Originally, Linnæus (1758) had conferred this name upon a now unrecognizable form he had attempted to describe by publishing a single family character.

My examination of specimens in 1938 revealed that the Mexican loggerhead is the western sub-species of a monotypic genus, its eastern relative being described in 1829 from the Pacific by Eschscholz as *Chelonia olivacea*. Boettger (1888) and Baur (1890) were the first to record the latter from the Atlantic, and in 1938 I identified specimens from West Africa in the collections of the British Museum and Museum d'Histoire Naturelle, Paris[2].

The costal scutes of the western form are more or less constant and arranged in five pairs; in the eastern sub-species their arrangement is usually asymmetrical, their numbers varying up to as many as nine, on one or both sides. The monotypic genus containing these two sub-species is characterized by four enlarged, pore-bearing inframarginal scutes, separating each side of the plastron from the carapace, and by the olive dorsal colour. The other genus of loggerhead is also monotypic with two sub-species, but possesses only three, poreless, inframarginals on each side and is brown-red dorsally. Both genera differ widely in osteology[2,3].

The two sub-species do not overlap in distribution, consequently the recent discovery that the Mexican loggerhead is washed on to the British Isles[4] has given rise to considerable speculation as to the route and locality whence it arrived. Mr. H. W. Parker, of the British Museum, has suggested[5] that individuals either drift eastwards with the Gulf Stream and West Wind Drift or that the distribution of this turtle is more extensive than is at present known, while Dr. F. S. Russell[6] has suggested that the northward extension of the warm area of the Atlantic might bring these turtles into regions where they could be carried to the British Isles by the surface drift.

The more or less uniform size of the three individuals I identified at the Dublin and British Museums in 1938 suggests that newly hatched young are transported from one and the same locality, and by the time they are stranded off the British Isles have just about reached sexual maturity, although they have by no means attained to their maximum size. The question of the locality whence they were transported is partially answered by my recent discovery of a young specimen from the Azores[7], which supports Parker's view that this turtle possesses a wider distribution than is generally known.

It is probable that while individuals from the Azores travel northward with the extension of the warm area of the Atlantic, and are swept to the British Isles, others are transported from the Gulf of Mexico. Marking experiments both at the Azores and the Gulf of Mexico alone will solve the problem.

P. DERANIYAGALA.

Colombo Museum,
Ceylon.

[1] Schoepff, "Historia Testudinum" (1792).

[2] Deraniyagala, *Spolia Zeylanica*, 18, 61 (1933).

[3] Hay, *Proc. U.S. Nat. Mus.*, 34, 183 (1908).

[4] Deraniyagala, NATURE, 142, 540 (1938).

[5] Parker, *Proc. Linn. Soc.*, 151, 127 (1939).

[6] Russell, NATURE, 143, 206 (1939).

[7] Deraniyagala, *Bull. Institut Océanographique*, 772 (1939).

THE discovery of Kemp's loggerhead in the Azores is of considerable interest, but we obviously still need much more information before we can do more than guess at the causes underlying the movements of these turtles. Among other things, it is essential to discover whether the species is resident around these western islands, for it is quite possible that the single young one found there is a stray similar to those which reach the British coast. The Azores, like the British Isles, lie within the area to which larval eels are carried from their breeding grounds in the western Atlantic. Is it possible that there may be a correlation between the migration of *Leptocephalus* and the movements of these turtles? Or is it a coincidence that 'glass-eels' (larval stage 5) appear off the Spanish coast in September and October, off Ireland in November, and that turtles are stranded on the south-western coast of Great Britain in November and December?

Another point raised which may prove to be significant is the fairly uniform immature size of the examples of Kemp's loggerhead which reach our coast. The three additional specimens examined by

which were washed ashore in 1939 are of the same
neral size as those reported by Mr. Deraniyagala,
d his suggestion thus receives additional support.
his explanation is the correct one, another problem is
sed : Why does not the same apply to the Atlantic
gerhead ? Both species appear off the coasts of the
itish Isles at the same time, and so it appears likely
at both arrive from the same region and on account
the same conditions. But specimens of the Atlantic
gerhead vary from immature individuals of 195 mm.
rapace-length to adults of 900 mm. or more. Have
ults of Kemp's loggerhead a more developed
ming instinct, or are they more powerful swimmers
le to return against winds and currents which the
her species is unable to combat ?

Unfortunately, there is one minor point in the fore-
ing letter which must be challenged. The initial
ragraph, with its implication that the name
studo caretto Linn. should be applied, not to the
lantic, but to Kemp's loggerhead, is misleading.
ne 'species' to which it was originally applied (Linn.
58[1]) was a composite, a fact which its describer
mself realized and tried to correct in 1766[2] by his
oposal of the name *imbricata* for part of his original
retta. This later action was undoubtedly intended
restrict the name *caretta* to one of the loggerheads,
distinct from the Green and Hawksbill turtles
hich received distinctive names.

Unfortunately, no type-specimen has been pre-
rved (if one ever existed), but the locality "ad insulas
mericanas" restricts the possible species to two,
nose discussed above. It is contended by Deraniya-
ala that Schoepff's figure[3] of a turtle named *Testudo*
retta is drawn from a specimen of Kemp's logger-
ead, because, apparently, four inframarginal scutes
re shown (Pl. 16). But it must be pointed out that,
lthough this is undoubtedly true for the right side
f the animal, the left side is depicted as having
hree inframarginals and one smaller scale, a condition
hich is exactly matched by some specimens of
tlantic loggerhead, but which has never been
eported in the other species ! This figure consequently
annot be identified with certainty, and to reverse the
ccepted nomenclature of half a century or more on
uch a slender basis cannot be held justifiable. In
ny event, Schoepff's is not "the first specific account
f a loggerhead". There are many pre-Linnæan
ccounts of these animals, and both Lacépède (1788[4])
nd Bonnaterre (1789[5]) recognized such a form. They
elieved it to be the same species which Linnæus
alled *Testudo caretta* but, for reasons which need not
e detailed here, they preferred the name La Caouanne
r *Testudo caouana* ; as Daudin[6] puts it : "Linnaeus,
Daubenton et d'autres naturalistes ont donné à cette
ortue le nom de *caret* ; mais c'est une erreure que le
rofesseur Lacépède a redressée avec raison, en lui
ubstituant la dénomination de *tortue caouanne* . . ."
The "caouanne" is described as yellow in colour, a
escription which is quite inapplicable to the dark
live Kemp's loggerhead, but which would apply
o specimens of the Atlantic loggerhead.

H. W. PARKER.

British Museum (Natural History),
London, S.W.7.

Linnæus, "Syst. Nat.", 10th ed (1758).
Idem, op. cit., 12th ed (1766).
Schoepff, "Historia Testudinum" (1792).
Lacépède, "*Hist. Nat. Quad. Ovip.*", 1, 95 (1788).
Bonnaterre, "Encycl. Méthod., Erpét.", 20 (1789).
Daudin, "*Hist. Nat. Rept.*", 2, 54 (1802).

The Colour-Producing Structure in the 'Dominant Grey' Budgerigar

THERE are some distinct structural differences between the feathers of the 'Dominant Grey' budgerigar and those of other races. In the wild coloured form the feathers of the lower abdominal region show in transverse section a somewhat triangular outline, and the vacuoles are arranged along the median axis of the section (see Fig. 1*a*). In the grey bird, the outline appears rounder, and the medulla of the barb is composed of a larger number of relatively small cells, the vacuoles occupying more or less the central parts of the cells and appearing therefore more equally distributed (see Fig. 1*b*).

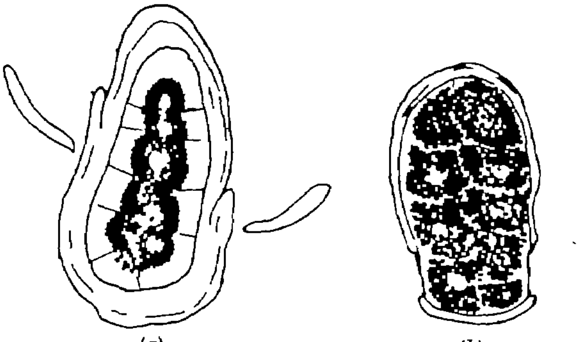

(*a*) (*b*)

FIG. 1. (*a*) WILD-COLOURED BUDGERIGAR. T.S. OF BARB OF FEATHER FROM LOWER ABDOMEN (×600); (*b*) 'DOMINANT GREY' BUDGERIGAR. T.S. OF BARB OF FEATHER FROM LOWER ABDOMEN (×650).

In the green bird, and also in other races, the melanin granules in the medulla appear concentrated chiefly around the vacuoles. The peripheral part of each medullary cell contains no pigment and forms by its canalicular structure the cloudy medium, producing the basic blue colour. In the grey bird the granules form a rather broad and closed zone around each vacuole. This zone is followed in each cell by a much narrower, cloudy one, which surrounds the cell completely. Thus, in the grey bird the melanin granules do not form a continuous axis in the centre of the medulla. Such an axis would be one of the means of forming a black under-layer, absorbing all rays, except the blue ones. Instead, they are arranged in a more decentralized manner, while the arrangement of the cloudy medium appears not as a broad ring, as in other races, but as a network of narrow stripes.

This arrangement is obviously inadequate to produce an intensive blue shade, the more so since the canalicular structure in the cloudy parts of the cells in the grey feather is a rather imperfect one. It gives in reflected light only a white effect instead of a blue one, and in transmitted light only a buff colour instead of an orange one. This imperfect structure, causing rather dull shades of blue, was first described by Steiner[1] in the races with the factor 'Dark', namely, 'olive', 'cobalt', etc.

Kawamura[2] described in the germ of the green feather a considerable growth of the cell-bodies of the medulla, directed towards the peripheral parts of the section, just before the time of ceratinization and the replacement of the nuclei by vacuoles. During this growth, the nuclei remain in the median region of the barb and thus secure the central arrangement of the vacuoles, shown later in the completed feather. As a modification of this type of development, the medullary cells of the grey feather appear to undergo a more frequent division during growth, and it may be assumed that the growth of the cell-plasm is not limited peripherally.

The structural arrangement of the medullary cells in the grey feather corresponds in general to that of most typical bird-feathers without structural blue colour. The cell-mosaic in the 'normal' green budgerigar, and in many other green and blue feathers, seems to be the outcome of continued growth and retarded cell-division.

LUDWIG AUBER.

Department of Zoology,
University of Edinburgh.
June 12.

---

[1] "Vererbungsstudien am Wellensittich", Zurich, 133 ff. (1932).

[2] *J. Sci. Hiroshima Univ.*, Ser. *B*/1, 3, 149 (1935).

Insects in Aircraft

THERE has, during the past months, been talk of an alternative air route, via Africa, to India and Australia. The recent survey flight of the flying boat *Guba* has brought matters a step farther forward, and in the *Daily Telegraph* of June 22 Capt. P. G. Taylor, the pilot, is said to have expressed the opinion "that as all the island bases fulfilled expectations, there was no reason why an air service should not be started at once".

I have been engaged for the past four years upon an investigation into the carriage of insects by aircraft arriving at Khartoum airport, and during the latter part of this period have been studying the question in relation to disease, particularly malaria and yellow fever. The results are shortly to be published in the *Bulletin of Entomological Research*.

In view of the present situation it would seem to be a matter of some urgency to point out certain facts that are perhaps not so widely known or appreciated as they might be.

In Africa and South America the areas of endemic yellow fever have been shown, by means of the mouse protection test, to be considerably greater in extent than was realized, even a year ago. In Africa in particular the area has been extended by recent findings considerably farther east, and according to Findlay[1] may quite possibly be found to extend to the Abyssinian foot-hills.

The discoveries by Shannon, Whitman and Franca[2] of the existence of the virus of 'jungle' yellow fever in the mosquitoes *Aedes leucocelaenus* Dyar and Shannon, *Hæmagogus capricorni* Lutz, and certain Sabethine species, and of the ability of the two former to transmit the virus by bite; and by Findlay and MacCallum[3] of the possibility of infecting monkeys with yellow fever via the alimentary canal, together with the fact that the virus, if introduced into the body cavity of the cockroach *Blatella germanica* L., keeps its activity, at 19° C., for at least 15 days, have lent additional significance to the lists of insects that (*a*) are able to transmit the virus of yellow fever by bite, and (*b*) although unable to transmit by bite, nevertheless retain the virus in their bodies for varying periods of time. These lists are steadily being added to, and the evidence deduced therefrom is reinforced by epidemiological evidence collected during field investigations of recent outbreaks of 'jungle' yellow fever.

The results of recent research upon insects c lected from aircraft have shown a surprisingly lar range of families and species. More than 2,000 a craft were examined at Khartoum airport duri the period July 1935–August 1938. Including u identified specimens, 146 species of insects, numberi 1,960, were collected. If all specimens of *Mus domestica* and *M. sorbens* be included, the total wou be nearly 3,000.

Including *Musca spp.*, the great majority of aer planes contained insects; excluding *Musca spp.* 1 aeroplanes contained insects, distributed fairly even over every month during the three-year period, with slight increase during July–October. The avera number of aeroplanes per month containing insec (other than *Musca spp.*) for the three years was 5·1 with a maximum of 9·5 and a minimum of 1·33. Fo species of *Anopheles*, one of *Theobaldia*, three *Mansonia*, six of *Aedes*, including two *A. aegy* taken at Malakal, and four of *Culex* were found. Th significance of the list is not confined to mosquitoe

In view of the above facts it would seem unwi to start an airline from or via Africa to India an Australia until the problem of the control of insec in aircraft has been solved.

F. G. SAREL WHITFIELD.

Imperial College of Science and Technology,
South Kensington, London, S.W.7.
June 22.

---

[1] Soper, F. L., *Trans. Roy. Soc. Trop. Med.*, 32, 297–322 (1938).

[2] *Science*, 88, 110–111 (1938).

[3] NATURE, 143, 280 (1939).

Scientific Research in the Region of Mount Evere

A RECENT communication in the press states tha an Indian scientific worker, Swami Prananabanand is proposing to lead a party of ten scientific investi gators to the Himalayas to study the geology anthropology, botany and geography of the regior He proposes to spend four months on the work at total cost of £300. This news contrasts sharply wit the English attitude towards science in mountai exploration.

As Mr. N. E. Odell recently pointed out in NATUR of April 1, p. 545, the scientific aspects of exploration with the exception of geography, have been sadl neglected by the more recent expeditions to Everest Indeed, it is largely true that "such work . . . ha been in no way encouraged, but rather discouraged, b those responsible both for their organization and thei leadership". From this stricture the Mount Everes Committee itself must be excused, for it has learne from experience that it can best discharge its functions by choosing a leader and leaving everythin except finance to him. As the primary object o Everest Expeditions has been in the past the ascent of the mountain, it is understandable that scientifi observations have been made only with great difficulty.

Expeditions to Mount Everest may have, as some believe, a spiritual significance; they may enhance British prestige; they may be of great interest to arm-chair adventurers. These, however, to 'cut out cant', are not the real motives of the climbers, who go either because it is fun or in order to satisfy a psychological need of a purely personal kind. Though the 1938 Expedition was organized with the most rigid economy and without appeal to public funds, a vast amount of money has been spent in earlier empts to reach the summit. It is questionable ether this expenditure has been justified by the ults and whether even purely private expeditions be excused for letting slip such rare opportunities scientific research. Yet the only permanent ults of past expeditions have been the scraps of ormation gained with great difficulty by geologists, teorologists, botanists, zoologists and physio- ists who have been included in Everest 'teams' ause they happened also to be mountaineers. w much more satisfactory it would be if parties ich failed, through no fault of their own, to reach ir objective, could bring back with them the ults of organized scientific work.

It has been argued that this could be more easily ne on other high mountains. The geology of the erest district must be studied in the district itself, d the same might be said of many other sciences. Of the more general subjects, I am informed that there is no place more suitable for geophysical studies. As for physiology, I am unaware of any place at which a laboratory could be erected at so great an altitude and in such convenient touch with greater altitudes still.

It is possible that many years may pass before the Tibetans allow again within their borders the representatives of a civilization of which they are comprehensibly suspicious. This time might well be occupied by the planning of research and of its financial support, in order that, if and when an opportunity occurs, no time need be lost in putting the plans into operation.

Raymond Greene.

8 Upper Wimpole Street,
London, W.1.
June 27.

Points from Foregoing Letters

E. V. Appleton illustrates the characteristic varia- n of the ionospheric F_2 region ionization throughout e year by curves of critical frequency for stations similar latitude in both hemispheres. The curves e adjusted to relate to constant solar activity. They ow fairly detailed correspondence between ionizing diation and solar activity.

By studying an afterglow produced by very weak ctrical discharges, J. Kaplan has obtained certain nds of nitric oxide in association with the well- cognized features of the night-sky spectrum. He ggests that much of the night-sky radiation iginates as low in the atmosphere as 25 km. and at the absorption of cosmic rays may be responsible r much of the energy of the light of the night sky.

J. V. Dunworth has constructed a coincidence unter with an electrical resolving time variable in e range 10^{-7} sec. upwards for the determination of nall radioactive half-value periods. The method of periment has yielded values of $1{\cdot}50 \times 10^{-4}$ sec. nd 3×10^{-7} sec. respectively for the periods of dium C′ and thorium C′. Information has also been tained concerning time-lags occurring in a Geiger unter between the formation of the primary ioniza- on in the counter and the appearance of an appre- able voltage drop across the counter.

Sir Richard Paget points out that apparent stance, and consequently apparent size, depend n the angle of convergence of the eyes. We 'see' ith our brains; our eyes are only scouts—on whose vidence (*inter alia*) the brain models its own ree-dimensional image. W. McEntegart states that roduction of a 'squint' stereo-image (without stereo- ope) does not require left-right reversal of the ereo-photograph. The reduction in size of the squint nage, compared to the parallel image, results from e crossing of the optic axes at a point nearer to the server than the object viewed.

The blastogenic hydrocarbon 3 : 4-benzpyrene has en found by J. C. Mottram to increase the growth- ate of Paramecium. Optimum conditions for growth ust be provided. The cultures must be kept in the ark and all manipulations carried out behind a 2a Vratten filter. Stimulation of growth was observed hen the dilution of benzpyrene was one in a million. colloidal preparation of benzpyrene was used.

The distribution of fluorosis in India and in England is considered by D. C. Wilson, and the finding of dental fluorosis in Oxfordshire and Bedfordshire is recorded.

W. H. Golightly and Ll. Lloyd demonstrate a seasonal grading in size in the flies breeding in sewage bacteria beds, the insects being largest in mid-winter. Temperature and competition both influence size, but the former is the conditioning factor and a rise of 1° C. in the monthly mean temperature entails a reduction of about 1–2 per cent in wing length.

P. Deraniyagala records the discovery of a Kemp's loggerhead at the Azores, suggesting a wider distribution for this turtle than has been hitherto known. H. W. Parker discusses the relation of this find to that of other individuals of the species found recently on the coasts of Great Britain. Deraniyagala suggests that there is a doubt as to the valid name for this species, but Parker does not agree that any change is necessary.

According to L. Auber, differences in the colour-shades of budgerigar's feathers are due to the cell structure and distribution of melanin in the barbs. Blue colours are produced by centrally grouped melanin granules reflecting blue due to cloudy peripheral portions of the medullary cells; grey is produced by scattered melanin in medullary cells where there is no large peripheral cloudy area.

F. G. S. Whitfield points out that insects other than *Aedes ægypti* L. have been implicated in the transmission of yellow fever under natural conditions, and that recent researches upon insects collected from aircraft reveal a surprisingly large range of families and species. It is suggested, in view of these facts, that the inauguration of an air line from or via Africa to India and Australia would be inadvisable until the problem of the control of insects in aircraft has been given further consideration.

R. Greene points out that scientific research in the Everest region has been either neglected altogether or pursued under great difficulties during past expeditions to the region. He believes that the time has come for the organization of a scientific expedition.

RESEARCH ITEMS

Causes of Deafness

IT has been estimated that 10 per cent of the population of the United States have impaired hearing. A study of the condition has been made on 487 children in the Pennsylvania School for the Deaf. The investigation was undertaken by the Office of Child Hygiene Investigations of the United States Public Health Service and the Otologic Research Laboratory of the Abington Memorial Hospital. A preliminary account of results is published by Drs. W. Hughson, A. Ciocco and C. Palmer (*Arch. Otolaryngology*, 29, 403). Audiometric records were made for air conduction and also for bone conduction. In a large proportion of cases the diagnosis was hereditary deafness and otosclerosis. A high correlation in auditory acuity between the two ears was found, and sex is not a significant factor. Fifty-four per cent of the children were said to be born deaf. Deafness developing later (generally before six years of age) was attributed to many pathological conditions, meningitis causing 17 per cent and together with trauma of the head, measles, otitis media or scarlet fever accounting for nearly half the cases. There was no apparent association between the auditory threshold and the stated cause of deafness, but the close resemblance between the auditory threshold pattern of children grouped together according to cause and age of onset indicates the importance of the biological constitution as a factor in the causation of deafness. The same authors in another paper (*Human Biology*, 11, No. 2) have made a statistical study of auditory acuity in forty pairs of siblings from the same material. In 70 per cent of cases both siblings were said to have been born deaf, in three cases both were deaf from the same disease, meningitis or whooping cough. The cause of deafness was different in only nine of the forty pairs and the age of onset was different for only nine pairs. Auditory acuity therefore differs significantly less between siblings than between non-siblings.

A Reclassification of the Dragonflies

IN the *Australian Zoologist*, 10, Pt. 2, 30, November 1938, there is published the first part of a comprehensive paper on the above subject by the late R. J. Tillyard. At the time of his death the author was engaged upon a new classification of the order Odonata and had almost completed two parts of this work. It is due to Lieut.-Colonel F. C. Fraser that this contribution has been enabled to be published, since he has corrected it where necessary, added notes and a preface and completed the work so far as has been possible. Although the paper was very incomplete at the time of its author's death, it is abundantly clear that Dr. Tillyard had abandoned his former theory that the whole order Odonata had been evolved from a simple-winged zygopterous type, in favour of one advanced by Prof. Carpenter, who holds that the two sub-orders of dragonflies had an independent origin from zygopterous and anisopterous types respectively. In the new grouping the extinct Protodonata are separable from the Odonata, or true dragonflies, in that they possess a complete series of alternating convex and concave veins, including fully developed posterior media and anterior cubitus. the true dragonflies the two last-named veins usually entirely absent or only short basal remna of them persist in a few fossil representatives. effect, this new grouping removes the Meganeuri from the Protodonata and places them among true dragonflies, with the consequent result that old order Protodonata becomes reduced to a remn with three genera only. To these is added the ger *Palæothemis* of Martynov which forms the s order Archodonata. The position of the Meganeur among the Odonata is that of the most primit group, to which the subordinal name of Meganisopt is applied.

Embryology of Fleas

IT appears that only five contributions have be made to the subject of the embryology of fleas : are brief and fragmentary incursions into the proble Edward L. Kessel, of the University of San Francis has described observations which he has made on t development of three species of these insects whi are of diverse taxonomic affinities (*Smithsonian Mi Coll.*, 98, No. 3 ; 1939). The species were *Cten cephalides felis* of the cat ; the rat flea, *Nosopsyll fasciatus*, and *Hystrichopsylla dippei*, a giant for which lives in nests of the wood rat, *Neotoma*. T actual mode of development proved to be essential the same in these three forms and indicates that the is most probably very little diversity in the proce among fleas as a group. The germ band is partial superficial and partially involuted at the time of t differentiation of the mesoderm. The amnion ar serosa are formed by the overgrowth and fusion the amnio-serosal folds, aided posteriorly by t involution process. Segmentation is evident exter ally towards the end of the third day : a head six segments, thorax of three and an abdomen eleven segments are described. Anterior and posteri mesenteron rudiments are in association with t stomodæum and proctodæum respectively, and t growth of these invaginations pushes the rudimen before them. The latter each proliferate to form tw latero-ventral ribbons and, enclosing the remainin yolk mass, they give rise to the lining of the mi intestine. Sixteen pairs of cœlom sacs are formed– one pair in the antennal segment and in each of the fir fifteen segments posterior to the stomadæal inva ination. The author refrains from drawing any con clusions as to the phylogenetic position of the flea until he has studied personally the embryology c those insects that are suspected of being most closel related to them. Only then, he claims, can it b certain that the same methods and interpretation have been applied to the different subjects and suc comparisons become worth while.

An Inter-generic Hybrid

A SHORT paper by B. O. Mulligan (*J. Roy Hort. Soc.*, 64, Pt. 3, 125–127, March 1939) an nounces the appearance of a fertile hybrid betwee *Gaultheria Shallon* and *Pernettya mucronata*. Th hybrid is a pleasing garden shrub which bear racemes of pearl-white blossoms in June, and the name *Gaulnettya* × Wisley Pearl is suggested for it. Direct crosses between the two species mentioned have never yielded fertile offspring, and the plant at Wisley is apparently a chance seedling. Its morphological and anatomical characters are intermediate between those of *G. Shallon* and *P. mucronata*, whilst seedlings raised from fruits of the hybrid show gradation between the parents. *Gaultheria* and *Pernettya* are at present considered to be separate genera; but the close relationship demonstrated so effectively by this hybrid would be regarded by some investigators as evidence for their union in one taxonomic group.

Leaf Cuttings

Propagation of plants by means of leaf cuttings is often mentioned as a somewhat abnormal method of increase; but it is possible that most evergreen plants would respond to such a means of multiplication. Leaf cuttings from gymnosperms have been struck, and W. Lloyd McCaskie, in a recent short paper (*Gard. Chron.*, June 3, 1939) mentions successful propagation from leaves of several other species. The difficulty appears to be the inaptitude of the severed leaf to produce a bud. Roots are readily formed, and often a considerable amount of callus. Mr. McCaskie has also investigated the part played by this callus. He removed it from leaf cuttings of *Osmanthus Forrestii*, and no buds were formed, whereas a certain proportion of buds appeared on cuttings with normal callus. Young leaves form callus at the base of the petiole much quicker than old foliage. It seems possible that when more practical details are known, propagation by leaf cuttings will offer a very economical means of increase, as the parent plant is not greatly damaged.

Grasshoppers

H. Klingstedt (*J. Genet.*, 37, 389–419) has crossed *Chorthippus bicolor* and *Ch. biguttatus*. The hybrids are intermediate in most characters. The cytological behaviour of the hybrids is abnormal in several respects. The chromosomes are more slender and less contracted, therefore the centromeres of a bivalent may not be brought close together. As a consequence normal disjunction may not take place at metaphase. At anaphase the chromatids sometimes tend to stick together. The author believes that these abnormalities are due to a difference in the timing relationships of the spindle and chromosomes during mitosis or meiosis. Structural changes such as inversions, deficiencies and translocations were indicated.

Crossing-Over Near the Centromere

It is well known that the rate of crossing-over varies along the chromosome. Near the region of the centromere, crossing-over is lower and more variable than elsewhere. K. Mather (*Genetics*, 24, 413–435) uses an ingenious method of showing that low crossing-over is related to position, but variability and sensitivity of the rate of crossing-over to environmental factors is a property of the heterochromatin. Several inversions of the *X*-chromosome which included smaller or larger parts of heterochromatin were genetically studied. These inversions contained genes in a new order relative to the centromere. Whenever the genes were nearer than normal to the centromere, the linkage value was reduced whether or not different amounts of heterochromatin were adjacent to the genes. By treating the flies with heat it was found that the linkage value across a portion of heterochromatin was greatly disturbed, even if the heterochromatin was near the distal end of the *X*-chromosome.

Fruit Pest Control in the U.S.A.

W. P. Flint has recently written an article on the control of codling moth (*Cydia pomonella*) by insecticides other than lead arsenate (*American Fruit Grower*, February). Numerous attempts have been made in recent years to find a substitute for lead arsenate and several substances have been used with some success. Phenothiazine is sufficiently toxic, but its solubility in water renders it almost useless except in arid regions. Cryolite is probably equal in toxicity to lead arsenate but lacks the adhering qualities of the latter. Most success has been gained by the use of various preparations of fixed nicotine. The nicotine volatilizes slowly from these compounds and acts as a stomach poison rather than as a contact poison. Fixed nicotine preparations have the advantage that they contain no substances toxic to fruit or foliage, whilst the percentage of volatile nicotine remains sufficiently high to control aphides to some extent during the growing season. On the other hand, they cannot be combined with fungicides without some reduction in toxicity. Moreover, as their toxicity does not persist as long as that of lead arsenate, more applications are necessary than with the latter. New forms of fixed nicotine are being produced by several different companies under trade brands and are finding a definite place in codling moth control. O. T. Snapp writes in the same journal on the use of ethylene dichloride emulsion as a fumigant for the control of the peach borer. It has several advantages over paradichlorobenzene. It is effective at low soil temperatures and therefore can be used late in autumn and early in spring when it is too cold for paradichlorobenzene to be effective. It is safer on young trees and more effective. The diluted emulsion, prepared by adding nine parts of ethylene dichloride to one part of potash fish-oil soap, may be poured on the soil around the trees or sprayed on the trunks in concentrations varying with the age of the trees.

Evolution of the Earth's Atmosphere

The *Meteorological Magazine* of February, 1939, contains an article by the Astronomer Royal, Dr. H. Spencer Jones, on the evolution of the earth's atmosphere, based on the Norman Lockyer Lecture, delivered under the auspices of the British Association on December 6, 1938 (see also Nature, Dec. 10, 1938, p. 1019). Dr. Spencer Jones begins by explaining how it is that a gas molecule can escape away into space from a planet if it has a radial velocity above a certain critical value which depends upon the force of gravity, and therefore upon the mass and radius of the planet. Jeans has calculated that if this 'velocity of escape' is four times the mean molecular velocity, the atmosphere would be entirely lost in 50,000 years; if five times, the time becomes twenty-five thousand million years. In the case of the earth, the velocity of escape—11·2 km./sec.—is six times the mean molecular velocity of hydrogen at 0° C., which apparently makes the atmosphere virtually immune from loss of hydrogen and still more so for other gases. Nevertheless there is evidence that helium is being lost from the atmosphere. It is believed that this is the result of collisions between atoms of helium with atoms of oxygen that are in a metastable state, whereby the latter unload their energy as kinetic energy and so enable the atoms of helium to acquire a speed of more than 12 km./sec. Another problem is to explain the relatively small amounts of nitrogen and neon in the earth's atmosphere compared with their abundance in the sun and other stars, and the theory is advanced that these and other differences have arisen because much of the original atmosphere was lost into space during the period when the earth was very hot, the present atmosphere being made up partly of the remains of the original atmosphere, from which the lighter gases would have been entirely lost, and partly from gases evolved from the solidifying magma as the earth cooled. Another anomaly, the presence of free oxygen, despite the loss going on in the weathering of igneous rocks, can easily be explained as the result of the break up of carbon dioxide by vegetation.

Tidal Effect on the Variation of Latitude at Greenwich

H. SPENCER JONES has described the method for investigating the lunar tidal effects on the latitude of Greenwich, from the observations for latitude variation made with the Cookson telescope during 1911–36 (*Mon. Not. Roy. Astro. Soc.*, 99, 3; January 1939). From the general formula, which gives the theoretical value of the effect on the variation produced by the semidiurnal lunar tide, the effect for the latitude of Greenwich is easily derived and is $0{\cdot}0077\ (1+\chi)\cos 2t$. The expression inside the brackets takes account of the elastic yielding of the earth, and its value according to W. D. Lambert lies between 1·1 and 1·2; t is the hour angle of the moon. The residuals of the observed minus tabular zenith distances north for each group were used, the total number of plates employed being 4,553, and 24 groups, corresponding to hour angles 0^h to 1^h, 1^h to 2^h, 2^h to 3^h, etc., were utilized. After various corrections the tidal effect, derived from the observations, was expressed in the form $(0{\cdot}0050'' \pm 0{\cdot}0013'')\cos(2t - 2° \pm 15°)$. It will be noticed that the coefficient in this case is smaller than the theoretical value, but the latter is reduced by the rise and fall of the tide in the Thames. A numerical estimate of the effect due to the tides in the river has been made and its amount is $0{\cdot}0021''\cos(2t - 5{\cdot}5°)$. The true lunar effect in the observations is, therefore, $(0{\cdot}0071'' \pm 0{\cdot}0013'')\cos(2t - 3° \pm 15°)$. Comparing this with the theoretical effect, it will be seen that the difference is not of great significance.

Computation of Total Solar Eclipses

FOR about a century, Bessel's method for investigating the circumstances of total solar eclipses has been used almost exclusively. This method is based on the geometry associated with the varying fundamental plane, the normal to which at any instant is parallel to the line joining the centres of the sun and moon. M. Davidson has now described (*J. Brit. Ast. Assoc.*, 49, 299, June) a new method of dealing with the problem, in which the earth's equator is taken as the plane of reference and rectangular co-ordinates are used throughout, the origin being the apex of the cone formed by the tangents to the sun and moon. In this way points on the central line of totality are readily computed. The author gives some comparisons of results obtained by his method with results calculated, as in the *Nautical Almanac*, by the Besselian method. An interesting fact emerges from his discussion; considering the degree of accuracy with which the spherical co-ordinates of the sun and moon are known, Dr. Davidson shows that it is impossible to be certain of the position of the central line to an accuracy greater than about a quarter of a mile when the sun's altitude is about 20°, the uncertainty in the general case being proportional to the cosecant of the altitude. The author proposes, in future papers, to discuss other eclipse problems by his method.

Creatine as a Product of Methylation

C. J. Kelly and H. H. Beard (*J. Biochem.*, Japan, 29, 155; 1939) injected parenterally various compounds containing methyl and methyl-amino groups into young rats to study their influence upon creatine formation and excretion in the body, with special reference to the methylation process involved: 87 control and 105 experimental animals were used in the muscle studies and 44, each of which was its own control, in the urine studies. Their principal conclusions were as follows. (1) Compounds containing methyl groups which were not known to be methylating agents in the body did not influence creatine formation. (2) Those containing methyl groups attached to nitrogen as in methylamine, methyl urea, prostigmin, mecolyl or caffeine increased creatine formation and excretion. (3) Methylating agents, such as methyl alcohol, methylamines, glycolic acid, and paraformaldehyde, also increased creatine formation and excretion. These increases were similar to those obtained from a creatine precursor containing the methyl group. (4) Methyl urea gave the largest increases in creatine excretion of any compound injected. (5) Glycine, by hydrolytic deamination, was converted into glycolic acid, which served as the normal methylating agent for glycocyamine in creatine synthesis in the body.

Oxides and Hydroxide of Gallium

IT was known that gallium oxide Ga_2O_3 exists in two forms and a compound GaO(OH) has been reported, but knowledge of the system $Ga_2O_3 - H_2O$ has been incomplete. A. W. Laubengayer and H. R. Engle (*J. Amer. Chem. Soc.*, 61, 1210; 1939) have made a comprehensive study of the system with the object of obtaining more exact information concerning the phases which occur, their stability ranges and relationships, and their properties. Improved methods of establishing equilibrium with the aid of fused mineralizing agents and of superheated steam in a bomb were used to supplement dehydration studies, and the X-ray patterns of the products were investigated. The existence of the two forms of the oxide and of GaO(OH) was established, and in addition the compound $Ga(OH)_3$, the normal hydroxide of gallium, was established for the first time. This result is of interest since formerly the existence of definite hydroxides of many metals which normally tend to precipitate as hydroxides in a highly hydrous and gelatinous condition was doubted. Many examples of definite hydroxides have lately been established, and the extension of this result to gallium is therefore of some importance.

THE NATIONAL PHYSICAL LABORATORY

ANNUAL INSPECTION AND VISIT OF THE UNIVERSITIES

THE annual inspection of the National Physical Laboratory was held on June 27, when some ,200 technical representatives of industry from all parts of Great Britain met to review the work of the Laboratory and the advances made during the year. The visitors were received in the High Voltage Laboratory by Sir William Bragg, chairman of the Board, Lord Rayleigh, chairman of the Executive Committee, and Dr. C. G. Darwin, director of the Laboratory. Numerous exhibits illustrating the manifold activities of the eight departments into which the Laboratory is divided were available for inspection and demonstration.

This year an opportunity was also provided on July 14 for the staffs and post-graduate research students of the physics, engineering, and related departments of universities to visit the Laboratory. On this occasion the visitors were received by the director, and a programme of exhibits embracing the more academic activities of the Laboratory was drawn up for their benefit.

The following exhibits, noted amongst those on view, illustrate some of the current work done at Teddington.

PHYSICS DEPARTMENT

In the section of the Physics Department concerned with thermal problems a method of measuring the diathermancy of mica and other refractories at elevated temperatures was shown. Black-body conditions are avoided by rotating a disk of the material between parallel heating surfaces in which coaxial eccentric holes permit radiation measurements to be made on the portion of the heated disk which passes between them. The radiation from this portion is measured separately and deducted from the total in order to obtain the transmitted fraction. A method of avoiding convection currents in measuring the thermal conductivity of gases is of interest. The gas is enclosed between concentric cylinders maintained at appropriate temperatures and rotated together at a suitable angular velocity.

The radium or emanation content of feebly active sources such as mineral waters or ores is measured with an alpha ray electroscope. The sample is obtained in aqueous solution and, in the case of radium determinations, allowed to attain equilibrium with its emanation. The latter is then boiled off and passed into an evacuated chamber connected with the electroscope; its activity is compared with that of the emanation from a known quantity of radium.

Extensions to the Acoustics Laboratory have been made to carry out large-scale tests of the acoustical insulation of floors. A room with a massive floating floor has been constructed above one of the sound-transmission rooms. An aperture 8 feet square in the centre of this floor is covered with the sample floor under test, and microphones in the upper and lower rooms enable the measurement of impact and air-borne noises via the test floor to be made. The determination of loud-speaker response curves was also demonstrated. The speaker is mounted in the open, free from any reflected disturbances, and fed with a constant input from a beat-tone oscillator the frequency of which is varied over the whole audible range. A calibrated microphone situated in front of the speaker is connected to automatic recording apparatus which traces the response curve.

An exhibit which has had important practical applications showed the method which has been evolved for the measurement of the temperature of liquid steels, both in the furnace and at various stages after tapping. A high-temperature thermocouple, mounted on the end of a long tilting arm, is provided with a very light silica sheath, and immersed for about ten seconds in the steel. A steady reading is attained within this time, and the thermocouple is then immediately withdrawn. The sheathing will stand up to a number of such quick immersions and is in any event cheap to replace.

X-ray investigations of the structural changes associated with fatigue of metals under a variety of types of stress are still continuing, and work on single crystals is being resumed. Electron-diffraction studies of the surface films of iron and zinc are being carried out in connexion with researches on corrosion undertaken by the Chemical Research Laboratory.

A glimpse of an extra-mural activity in which the Laboratory is now concerned was seen when a cinematograph film illustrating a short-circuit test on an oil-immersed circuit breaker loaded beyond its capabilities was shown. Under an arrangement with the Association of Short-Circuit Testing Authorities, the Laboratory is able to issue certificates on circuit breakers, which may be tested at one of the stations belonging to the Association.

The technique of preparation of high-voltage cable samples for puncture tests under impulse voltages was demonstrated in the High Voltage Laboratory, and the results of such tests were also shown. The layout of the lower stages of a large-capacity impulse generator, utilizing a four-column assembly of the condensers and internal wave-tail and damping resistances, was another exhibit in this building.

In the Photometry Section a comprehensive investigation of the recovery of the eye after transient exposure to a field of high brightness is in progress. The results with white light indicate that, even for foveal vision, a double mechanism of recovery is in operation. The experiments are now being extended to include coloured conditioning and test fields. The measurement of the brightness of a luminescent road sign, mounted on a photometer bench and activated by a 'black' ultra-violet lamp was demonstrated: samples of various fluorescent and phosphorescent materials were also shown.

Apparatus for the preparation of tungsten lamp colour-temperature standards was exhibited. In this work use is made of the fact that incandescent tungsten behaves, within the limits of the visible spectrum, as a 'grey' body. The radiation from a tungsten lamp can, therefore, be colour-matched photometrically with that from a black-body furnace the temperature of which is simultaneously determined with an optical pyrometer. In practice, a substitution method is used in which a comparison lamp is colour-matched first with the black body and afterwards with the standards.

RADIO DEPARTMENT

The meteorological radio-sounding equipment developed in the Radio Department has now been arranged to record atmospheric humidity, in addition to temperature and pressure. A working model of the cathode-ray direction finder designed in this Department for use in marine navigation was an attractive exhibit. The direction of arrival of signals from a model lighthouse and lightship in a marine panorama were indicated on the screen of a cathode ray tube, graduated similarly to a compass dial. The position of the ship on which the visitor was assumed to be standing was hence easily determined from the known positions of the transmitting points. Transmitting equipment for ultra-short wave-lengths was also shown. This consisted of a Class *C* amplifier of 300 watts output working on 2 metres and a frequency doubler with a 50-watt output.

METROLOGY DEPARTMENT

An interesting exhibit in the Metrology Department was an experimental pneumatic slip gauge comparator. This instrument measures the width of the gap between the upper surface of a slip gauge and a fixed orifice by determining the resistance of the narrow gap between them to the flow of air from the orifice. When the width of the gap is changed by substituting a different gauge, the air pressure difference is a measure of the difference in thickness of the gauges. This is measured by projecting the meniscus of a manometer on to a screen, where a movement of half an inch represents a difference of 10^{-5} inch in the thicknesses of the gauges.

A highly sensitive calliper has been developed for use in connexion with the checking of spline gauges for the propeller shafts and hubs of aircraft. The permissible tolerances on these gauges are exceptionally fine. The calliper may be used for pitch and diameter measurements, and incorporates a small smoked glass disk on which the readings are recorded. An image of the disk is afterwards projected at suitable magnification so that errors are readily observed.

Tests on watches and chronometers are made regularly in this Department. The standard clocks used in these tests are checked daily against radio time signals from Greenwich, Paris and Hamburg, and also with the quartz ring oscillator clocks maintained by the Electricity Department. In these comparisons the clocks and the time signals are made to record on a chronograph comparator which is used to measure the small differences in time between the two.

ENGINEERING DEPARTMENT

Several exhibits in the Engineering Department were concerned with the improvement of the accuracy of tensile tests. A set of four secondary standards of ring form which have been calibrated in a dead-weight testing machine have been obtained. These are of a special low-hysteresis steel and their maximum loads range from 3 tons to 150 tons. The load is applied along a diameter of the ring, and the resulting extension or compression is measured by a sensitiv built-in micrometer. By means of these rings th stress imposed by a testing machine may be accurately measured. Good agreement has been obtained in the case of the 100-ton testing machine in th Department, between the stress as obtained b indirect methods and as measured directly on th proving rings. In the course of the indirect determination, the measurement of the knife-edge distanc under load is made by swinging the beam an balancing the rotation imposed on a ray of light by mirror fixed to a beam by an equal and opposit rotation derived from another mirror on a carriag carrying knife-edges bearing on the column and th shackle of the machine. The optical system involve two reflections from the beam mirror, so that th distance between the knife edges on the machine i twice that between those on the optical carriage Improved extensometers for the measurement o strain in tensile tests were also shown. These als employ an optical lever and are arranged for eas calibration by means of slip gauges.

A new electrically heated pipe has been installed for making tests on materials used for pipe lagging 'End effect' has been eliminated by the use o 'guard' heaters 1 ft. 6 in. long at the ends; a third heater 6 ft. long occupies the central portion. The temperatures can be adjusted so that there is n longitudinal flow of heat from the central portion and hence the loss through the lagging may b determined.

METALLURGY DEPARTMENT

Most of the investigations in the Metallurgy Department fall into one of two groups. One is concerned with steels, especially those intended for use at high temperatures as in steam boilers, turbines, and superheaters. The other group deals with alloys of the two light metals, aluminium and magnesium, which are finding increasing applications in the construction of aircraft. The rolling mill is specially designed for work on light alloys, and the slow rolling of magnesium alloys was demonstrated.

The results of X-ray investigations on the age-hardening of single crystals of an aluminium-copper alloy show that the initial stages of hardening consist in the separation of small groups of copper atoms from the mass of the crystals, the groups forming sheets along certain crystal planes. After being formed at a low temperature, a short heating causes them to disappear, and the alloy loses its acquired hardness. Continued heating leads to the formation of larger groups, and the hardness again increases. Finally, a second crystalline phase is produced.

The vacuum creep units designed for experiments in the range 350°–950° C. have been used to study the mode of deformation of pure iron and of steels with various carbon contents. A modified creep unit for the examination of the effect of steam and hydrogen on the deformation of molybdenum and plain carbon steels is now under construction. Apparatus for studying the action of superheated steam on steels under constant stress was also shown. The steel specimens are in the form of hollow thimbles, stressed in tension by the internal pressure of steam, and maintained at a constant temperature by external heating in a regulated atmosphere. After the experiment, the scale formed on the steel is measured and examined microscopically.

AERODYNAMICS DEPARTMENT

The Aerodynamics Department was found to be in tate of considerable activity and expansion. In a t. tunnel the measurement of the flutter derivaes on an aerofoil is effected by imparting an illatory motion to the aerofoil via a nickel tube, d recording the driving torque by an electrical thod which depends on the change of permeability nickel with stress. A systematic investigation of h oscillating forces is in hand, in the first instance aerofoils. A small water tunnel has been conucted for observing the nature of the transition m laminar to turbulent flow. An ultra-microscope ables the flow to be observed in detail by rendering ible extremely minute particles in the water.

The overall stability characteristics of a model roplane are being studied by observing its beviour in a wind tunnel when supported with a tricted number of degrees of freedom. If this thod can be developed to a satisfactory state, it s the great advantage that experiments of this nd can be made in any ordinary wind tunnel and not demand special apparatus. The measurement of gusts has been made for some time on high towers, but this is obviously limited to certain sites and altitudes. A gust recorder which has been designed for attachment to the cable of a kite balloon was exhibited. This will enable a much more extensive exploration of gusts to be made. Difficulties connected with the movement of the supporting cable have yet to be overcome, however.

WILLIAM FROUDE LABORATORY

In the William Froude Laboratory, tests of a model hull fitted with propeller, shafting and internal driving motor were being made in the Yarrow tank. The method of obtaining the propulsive efficiency and the interaction between the hull and the propeller were explained. In the new tank, rolling tests were being made on a model under way, and the effect of various keel and hull shapes on the decrement of the roll was demonstrated. Research on the prevention of cavitation is in progress in this Department, and in the propeller tunnel this phenomenon was exhibited, using stroboscopic illumination controlled from the propeller shaft.

INTERNAL STRAINS IN SOLIDS

A CONFERENCE on "Internal Strains in Solids" was held at Bristol on July 11–13 under the int auspices of the Physical Society and the Unirsity of Bristol. Of the large number of subjects scussed, it will only be possible to mention a few re. Most of the papers presented to the conference ill be published in a special number of the *Proedings of the Physical Society* which it is hoped will pear next autumn.

There was a discussion on the nature of slip in etal crystals. While there was by no means general reement, the following picture of the process uld perhaps find a certain number of supporters: Slip takes place through the passage through the ystal of 'dislocations', in the sense in which the ord is used in the theories of G. I. Taylor, Orowan d Polanyi. The dislocation theory pictures a *rfect* crystal as an elastic medium having the eoretical yield point and no plastic properties; the eoretical yield point is the stress required to pull e plane of atoms over the next all at once, and is any thousands of times higher than the yield oints of hard metals. According to the theory, owever, if the crystal contains any dislocations at ll—and in practice it always does—the crystal will ave a very much lower yield point, because the islocations can move easily through the crystal.

The rate at which a crystal will yield under stress ay be determined, according to Orowan, by one of wo factors: (1) the rate at which new dislocations re formed; (2) the rate at which they move under he external stress. Orowan believes that in general he second factor is the important one, and that the ield point is the stress at which the dislocations ove fast enough to give observable slip.

As regards the origin of the dislocations, it is elieved that they are formed at special spots in the rystal where the stress is particularly high. Thus regularities in the crystal have two roles: to make possible the formation of dislocations, and to hinder their motion. Thus if (1) determine the resistance to glide, irregularities may soften the material, and if (2) determine it, irregularities may harden it. Orowan gives evidence to show that both cases may occur in practice.

It was suggested that glide starts by the formation and motion in a given crystallographic direction of a dislocation of atomic dimensions; but that as soon as the stress reaches the point at which a dislocation can move at all rapidly, the heat developed would cause a dislocation of much larger order of magnitude, giving the macroscopic slip bands observed.

As regards the factors resisting the motion of a dislocation, Peierls' paper shows that a finite stress is required to move a dislocation even in a perfect crystal; thus (in contradiction to G. I. Taylor's hypothesis) a perfect crystal containing just one dislocation should have a finite if small resistance to shear at a low enough temperature.

The much greater resistance to the motion of a dislocation in an age- or work-hardened material must be due to deviations from the ideal lattice. Two hypotheses are possible: (1) that the dislocations are stopped at surfaces of misfit between crystallites; (2) that the motion of dislocations is impeded by the presence of internal strains. (G. I. Taylor's theory makes use of both hypotheses. The dislocations are supposed to be stopped by surfaces of misfit in the lattice; but this does not lead to any resistance to shear, because it is assumed that new dislocations can always be formed at surfaces. The hardening comes from the fact that the strain around the stuck dislocations prevents new dislocations from moving.) If σ_s is the internal shear stress at any point in the lattice, the directions of σ_s will be random. Thus at some points along the length of a dislocation the dislocation will be pushed one way, at other points in another; and for the dislocation to move in a definite direction, the external stress σ must be greater than σ_0 at all points along the dislocation. Hence the observed yield point should be of the order of the mean value of σ_0.

There was a discussion of the mechanism of precipitation of one phase from another, and of the cause of precipitation hardening. Prof. R. Becker emphasized that in alloys in which the degree of supersaturation is small, the time taken to form a nucleus will be long, because a small nucleus will be unstable owing to surface tension, and will usually evaporate before it can grow to a size at which it will be stable. Thus on cooling an alloy, the precipitation is not so rapid on first entering the two-phase region as at a lower temperature where the degree of supersaturation will be greater; and this is so in spite of the very rapid drop in the diffusion rate as the temperature is lowered (cf. R. Becker, *Ann. Phys.*, 32, 128; 1937).

The distinction was emphasized between precipitates which have broken away from the parent lattice and form a new phase, and the smaller nuclei or 'knots' which are formed in the parent lattice, without breaking away. A thermodynamical equilibrium is possible between such knots and the original solid solution, and probably exists in duralumin.

In cases where the two phases have widely differing lattice parameters, it may be impossible for a stable nucleus of one phase to form in the lattice of t other, without breaking away; the energy requi to expand or compress the nucleus is too great, that precipitation would lead to an increase in t free energy. Thus any stable nucleus must alrea have broken away from the parent lattice. It w suggested, however, that the strain energy would less if the nuclei assumed a plate-like shape; a that this might be the cause of the segregation copper atoms on the (100) planes of the alumini lattice observed by Preston in single crystals copper aluminium alloys.

Prof. W. L. Bragg described a theory of t structure of a cold-worked metal. The boundar between the crystallites of a metal must in gene be mobile at room temperature; it was suggest that these boundaries are not frozen in position b are in dynamical equilibrium under their surfa tensions. Thermal fluctuations will cause the boundaries to wave about, and will lead to t gradual disappearance of the smaller crystallit Thus if a metal is thrown into an amorphous sta by cold-working, it will rapidly self-anneal up to certain coarseness of crystallite size, characteris of the temperature, beyond which point crystalli growth should be very slow. According to the ideas, no truly amorphous state is possible in metal.

N. F. M.

POPULATION PROBLEMS OF HOUSING ESTATES

A CHARACTERISTIC of the admirable series of studies issued by the Social Science Department of the University of Liverpool* is their attempt to foresee the problems which social and economic tendencies are presenting to-day and to indicate measures which might be taken either to solve them as they arise or to prevent them becoming too intractable. The latest addition to the New Merseyside Series is no exception. In this survey of the population problems of new estates, with special reference to Norris Green, Mr. Norman Williams indicates the difficulties caused in such districts by a failure in human understanding, together with a serious lack of co-ordination between the different departments of the local authority in the early stages of development. In regard to the provision of schools, for example, the survey reveals grave weaknesses in our present system of local government, an entirely new area with entirely new problems being administered by numerous departments, out of touch with the estate, often acting independantly and sometimes in opposition to each other.

The acute problem of school accommodation in Norris Green resulted directly from the policy of the Housing Committee, but it was left to the Education Committee to solve. Mr. Williams indicates some of the serious consequences of this lack of foresight and co-ordination: the exclusion of children from infants' schools until they were considerably beyond the normal age; the very frequent transference of pupils from one department to a higher; the unusually large classes (up to fifty-six), first in the junior schools and then in the senior schools. Accompanied by these features has been a steady decline in number children seeking admission, which has resulted in steady decrease in the mean age of admission in infants' schools, and it is anticipated that within tw or three years sufficient spare room will be availab in most infants' schools in Norris Green for t organization of nursery classes.

Mr. Williams, however, is not content with direc ing attention to the mistakes of the past and t disastrous consequences of lack of accommodati and large classes for a few children. He is equal concerned with the future. The figures he quot indicate that the big fall in school populati will be accompanied by a big rise in the supply juvenile labour, and since the local demand for labo shows no signs of increasing, a big increase in u employment is to be expected amongst boys a girls. It is pointed out that among male adult unemployment rose from 9 per cent in 1930 to 22 p cent in 1937, the actual increase in numbers bein 550. In 1937 there were about 1,200 unmarried m of more than nineteen in Norris Green, a figure whi is expected to increase to 1,500 by 1942 and 2,1 in 1947. The chances of these men obtaining emplo ment are not encouraging and there is the prospe of about 1,400 of them being unemployed in 1942.

Transport provides another example of a proble created by the Housing Department and left another Corporation Department to solve. T amount of work in the locality is limited and th extra workers, if they obtain employment, must fi it at a distance and will need conveyance. It is doub ful whether the present extended services meet th need, and by 1947 it is possible there will be a increase of more than 50 per cent in those using th combined bus and tram services.

---

* University of Liverpool: Social Science Department, Statistics Division. Population Problems of New Estates, with Special Reference to Norris Green. Pp. 52. (Liverpool: University Press of Liverpool, 1939.) 1s. net.

Equally on the question of housing itself, Mr. lliams points to past mistakes and to errors which quire correction. In the early stages roads were made, there were no shops, several houses were thout light; public halls, cinemas, baths, libraries, d welfare centres found no place in the schemes. ith few exceptions all the houses in the earlier nicipal housing estates have three bedrooms, with e result that there are both empty and over-owded bedrooms even in the same street. To-day Norris Green there is little relation between the uses supplied and the accommodation required. ere is no suitable accommodation for the majority ordinary working-class families of seven persons, d none at all for those of more than seven. Similarly, the absence of accommodation for young couples when they marry is driving them to find accommodation elsewhere. Had the local authority given more attention to the social needs of the people in the early days the number of removals would have been considerably less.

The study shows conclusively the important contribution which the sociologist might make to the rectification of past errors and the prevention of similar mistakes in the future. It is an admirable illustration of the type of study for which there is indeed great need and which might well arrest the attention of scientific workers, as that of the local authorities primarily responsible for the housing estates.

ATMOSPHERIC POLLUTION

THE twenty-fourth report on "Atmospheric Pollution" issued by the Department of Scientific d Industrial Research appears in a new format and two volumes, namely, the report on observations p to March 31, 1938 (H.M. Stationery Office, 2*s.* net) d the other a supplement giving deposit tables over e same period (H.M. Stationery Office, 4*s.* 6*d.* net). his arrangement will be a convenience to those who re interested in the general results rather than the ctual observations. These show that there has een a tendency for the air to become cleaner. Again ardiff provides the lowest figure for sooty matter nd many will learn with surprise that the London rea provides some of the worst figures. Greenwich had he greatest number of days with heavy smoke haze. toke followed next and then Victoria Street, London.

The report contains a section explaining in simple erms how fogs are formed. In Great Britain fogs re said to be caused either by water droplets in the tmosphere or by smoky particles. The water roplets in a fog are only a few thousandths of a illimetre in diameter and for this reason the sun, f visible, appears as a white disk. In a smoke fog, articles are smaller and the sun therefore appears ed because the smaller smoke particles scatter light f shorter wave-lengths but not the longer red wave-engths.

It appears essential, the report continues, in the ormation of fog that the air should contain very small particles on which the water condenses, for xample, sea salt and nitrous and sulphuric acid. The other essential condition for the formation of a water fog is that the temperature of the air must be cold enough for condensation to take place. A high wind may prevent fog, but some wind is essential so that the air can be cooled rapidly.

During condensation fogs, there is usually at a few hundred feet above the ground a layer where the air is warmer than the air below. On a nearly calm day this layer of warm air forms a kind of lid or ceiling below which fog forms. The formation of this layer is an important link between a smoke fog and a water fog.

Smoke escaping from an ordinary chimney is accompanied by hot gases which carry it upwards and the smoke particles may then meet an upper air current which carries them away. If, however, they reach a layer of air which is as warm or warmer than themselves, they cannot escape through this ceiling. If the ceiling is well above the tops of the chimneys and there is not sufficient wind to carry off the smoke, it collects between the ceiling and the ground; we may then get what is known as a 'high fog' where the accumulation of smoke occurs in a layer above the house-tops of the city leaving the air in the streets comparatively clear. Should the level of the ceiling be low enough, smoke accumulation will occur near the ground.

"If," the report states, "we consider the extreme case which might occur, it may make the matter clearer still. Supposing that over a city like London, the wind fails completely up to a height above which the smoke cannot penetrate. The result of this will be that, after a few hours of a winter's day, the city will be covered by a pall of smoke, and this will get darker as the smoke accumulates overhead until the equilibrium is established between the rate at which the smoke particles settle out of the air on to the ground and houses and that at which they are poured from the chimneys. Ultimately, under such conditions the soot fall in the city would be just equal to the soot emitted from the chimneys; but before this condition could be reached, the city would probably be in complete darkness and life might become practically impossible, because not only would the smoke accumulate but also other products of combustion, such as carbon dioxide and sulphur dioxide. Wind is therefore of vital importance as the principal scavenger we have to rely upon to protect us from the smoke which we ourselves produce.

"The smoke fog of our large cities is simply a result of failure on the part of the scavenging forces of Nature, which we rely upon to clear away the smoke, as in the past we relied upon our streams and rivers to carry away our sewage.

"So far as condensation or water fogs are concerned, our cities are less likely to suffer from these than the surrounding country. This is due to two main factors, first that the air over the city is warmer than that in the surrounding country, while the drainage due to the provision for carrying away rain from roofs and streets is such that the ground is very rapidly dried up even after rain and has little opportunity of contributing to the water content of the air in contact with it."

The time is surely past when we should rely on the chance forces of Nature to scavenge our atmosphere and maintain tolerable urban conditions.

FELLOWSHIPS FOR SCIENTIFIC AND MEDICAL R

Leverhulme Research Fellowships

THE following Leverhulme Research Fellowships, tenable for varying periods up to two years, have recently been awarded for the research indicated: T. Burton Brown (Armenian archæology in pre-Christian and early Christian periods); W. H. B Court, lecturer in economic history, University of Birmingham (India and British economic policy in the past century); Dr. W. Cule Davies, lecturer in chemistry, University College, Cardiff (studies of the organic compounds of nitrogen, phosphorus and arsenic); Dr. R. M. Davies, lecturer in physics, University College, Aberystwyth (experimental investigations on turbulent flow in an air-tunnel); R. Dennell, assistant lecturer in zoology, Imperial College of Science and Technology, London (structure and physiology of the luminous organs of Atlantic deep-sea Crustacea); Prof. G. R. Driver, professor of Semitic philology, Oxford (languages and customs of the Semitic East); Dr. R. W. Firth, reader in anthropology, University of London (social structure and economic organization of rural Malays); D. Ll. Griffiths, clinical assistant, Orthopædic Department, Manchester Royal Infirmary (comparison of radiological and histological features in bone tumours); A. E. Ingham, University lecturer in mathematics, Cambridge (analytical theory of numbers); Dr. B. Jones, lecturer in chemistry, University of Sheffield (a study of reaction kinetics in solution); Dr. F. D. Klingender, investigator, Research Group, Political and Economic Planning (a survey of the social relations of scientific research in Great Britain); Dr. S. Maccoby, assistant master, Wolsingham Grammar School, Bishop Auckland, Durham (the character and influence of Radicalism, 1768–1832); Dr. E. B. Maxted, special lecturer in catalysis, University of Bristol (studies in catalyst poisoning); D. A. O'Duffy, research and development assistant, Bahrein Petroleum Company (lubrication problems at high temperatures and pressures); Dr. A. H. Smith, reader in English, University of London (scientific methods of dealing with damaged, imperfect and illegible medieval manuscripts); L. F. Taylor, late research lecturer in Indo-Chinese ethnography and linguistics, University College, Rangoon (an ethnographical and linguistic survey of Burma); Miss M. L. Tildesley, chairman of the Comité de Standardisation de la Technique anthropologique, London (definition, measurements and classification of anthropometric characters); Dr. W. A. Waters, lecturer in chemistry, University of Durham (mechanisms of reactions involving free organic radicals); Prof. E. L. E. Wheatcroft, professor of electrical engineering, University of Leeds (mechanism of development of electric sparks with reference to lightning discharges); Miss D. Whitelock, fellow and tutor in the English language, St. Hilda's College, Oxford (an edition of the Historia Eliensis, Parts I and II).

Rockefeller Travelling Fellowships in Medicine

The following Rockefeller travelling fellowships have been awarded by the Medical Research Council for the academic year 1939–40: G. Blackburn, demonstrator in anatomy, St. Bar
pital, London; Dr. J. C. Dick, assi
University of Glasgow and Glasgow
Dr. J. L. Henderson, assistant, Dep
Life and Health, University of Edin
Illingworth, resident medical assis
pathologist, Hospital for Sick Childre
Street, London; R. M. Kark, forme
in pathology and registrar to medi
Guy's Hospital, London; E. P.
first assistant, Department of M
Postgraduate Medical School, Lond

All these fellows propose to work
United States.

Travelling Fellowships in

The Medical Research Counci
Dorothy Temple Cross Research Fe
following candidates intending to st
tuberculosis at centres abroad, duri
year 1939–40: Dr. R. R. Hen
assistant physician, St. Thomas's H
A. H. M. Siddons, chief assistant,
Department, St. George's Hospita
J. M. Vaizey, medical first assista
London Hospital.

Beit Fellowships

Beit Fellowships for Scientific R
at the Imperial College of Science
during the academic year 1939
awarded as follows: Extensions of fel
satisfactorily held for one year to:
for the continuation of research on c
in relation to hydrocarbon combus
direction of Prof. A. C. G. Egerto
Michiels, for the continuation of
fission of uranium by neutrons, unc
of Prof. G. P. Thomson. New fellow
one year but renewable for a secon
Hatcher, for research on hybrid vigou
under the direction of Prof. W.
Pielou, for research on the olfact
insects, under the direction of Prof
A. L. G. Rees, for research on proble
chemical nature concerned with
germanium, under the direction of
Briscoe.

UNIVERSITY EVI

SHEFFIELD.—The following app
been made: Dr. R. D. Haworth,
chemistry, in succession to Prof.
resigned; Dr. Wilson Smith, to the
logy, in succession to the late Prof.
Dr. Brynmor Jones, at present a lectu
to be lecturer on organic chemistry
as assistant lecturer in geography
Wilson, as assistant lecturer in pha
R. Halle, as a research assistant in
of Glass Technology.

SCIENCE NEWS A CENTURY AGO

Railway Progress in 1839

In its monthly notes on Railway Progress the *Civil Engineer and Architects' Journal* of July 1839 referred to some twenty British lines. It recorded the opening of the Eastern Counties Railway from Shoreditch to Romford on which the rails had been laid to a five-foot gauge "which without greatly increasing the weight of the engines, gives them great mechanical advantages", and the opening of the London and Croydon Railway. Much work was being done on the Birmingham and Derby Railway; an experimental trip had been made on the Manchester and Leeds Railway on which it was calculated "that the expence of travelling in the third-class carriages, which are open and unprovided with seats, will not exceed one penny per mile"; and a portion of the York and North Midland Railway had been opened. By means of this and other lines it was hoped "a direct communication will be opened next year from Newcastle to London". Two further sections of 12 and 8 miles respectively had been opened on the London and Southampton Railway "leaving only eighteen miles, viz., the distance from Winchester to Basingstoke, to complete the whole undertaking".

Maskelyne's Observations at Greenwich

The *Mechanics' Magazine* of July 27, 1839, printed Airy's Report to the Board of Visitors of the Royal Observatory, Greenwich. One section of the report was devoted to the arrangement of the papers at the Observatory. "In my last report to the board," said Airy, "I intimated that it was necessary, before commencing any arrangement of the manuscripts, to divide many of the books into two or more parts. . . . The separation of these parts having been nearly completed, I have been able to proceed with the first step towards arrangement, namely, the marking on the outside of the book the whole of the contents of its interior. From the confused state of some of Dr. Maskelyne's books, this has sometimes been a task of much trouble. . . . I am, however, extremely glad that I have thus been compelled to become acquainted with the system and practice of my predecessors; and my estimation of their judgment and order, as well as their industry has been greatly raised. During the whole, or nearly the whole of Dr. Maskelyne's time, the daily observations of stars are reduced in ledger, and the solstices and equinoxes of each year are discussed, with as great regularity as at the present time; and the same is done with equal regularity, and on a more extended scale, through Mr. Pond's time.

Mexican Mummies

The issue of the *Athenæum* of July 27, 1839, contains the following information: "A million of mummies, it is stated, have lately been discovered in the environs of Durango in Mexico. They are in a sitting posture, but have the same wrappings, bands and ornaments as the Egyptians. Among them was found a poignard of flint, with a sculptured handle, chaplets, necklaces, etc., of alternately coloured beads, fragments of bones polished like ivory, fine worked elastic tissues (probably our modern indiarubber cloth), moccasins worked like those of our Indians, bones of vipers, etc. It is unknown what kind of embalming was used for the mummies above-mentioned, or whether they were preserved by nitrous depositions in the caves where they were found. A fact of importance is stated that necklaces of a marine shell are found at Zacatecas, on the Pacific, where the Columbus of their forefathers probably landed from Hindostan, or from the Malay or Chinese coast, or from their islands in the Indian Ocean."

The Scales of Fishes

"M. Mandl supports the opinion of M. Agassiz that the scales of fishes may serve as characters for classification; and states that these coverings are not to be considered as simply the production of secretion, but consist of a true organised substance. First, he says, that they are composed of an upper and an under layer; then that the upper layer is composed of longitudinal canals, departing from a centre, which is not always in the middle of the scale; of cellular lines produced by the union or fusion of cells; of yellow corpuscles, similar to those of bones and cartilages, and like them containing salts; of a centre or focus which appears to be the rudiment of the scale; of teeth, which, however, only exist on the terminal edge of the Acanthopterygii; thirdly the under layer is formed of fibrous plates, the middle of which are the shortest." (*Athenæum*, July 27, 1839.)

APPOINTMENTS VACANT

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant III (Engineer) at the Fuel Research Station, East Greenwich—Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (quoting J.39/9) (July 24).

Assistant Lecturer in Chemistry—Registrar, University, Sheffield (July 28).

Assistant Master to teach **Mathematics**—Headmaster, Royal Naval College, Dartmouth (July 29).

Established Civil Engineering Assistants in the Roads Department—Assistant Secretary, Establishment Department, Ministry of Transport, Metropole Buildings, Northumberland Avenue, W.C.2 (July 31).

Established Inspectors (10) for the purposes of the Diseases of Animals Act, 1894–1937—Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (July 31).

Assistant Meteorologist in the Meteorological Service, Posts and Telegraphs Department, Sudan—Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (August 1).

Lecturer in Physics—Secretary, Technical College, Lansdown Road, Cheltenham (August 3).

Junior Scientific Officer in the Headquarters Office—Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (quoting J.39/11) (August 8).

Assistant Inspectors of Ancient Monuments—Establishment Officer, H.M. Office of Works, Westminster, S.W.1 (August 12).

Assistant Dietitian—House Governor and Secretary, General Infirmary, Leeds (August 14).

Lecturer in Agricultural Chemistry—Registrar, University, Reading (August 14).

Lecturer in Agricultural Bacteriology—Registrar, University, Reading (August 14).

Assistant Lecturer in Botany (Grade III)—The Registrar, University, Liverpool (August 15).

Lecturer in Anatomy—The Secretary, University, Aberdeen (August 18).

Chief Electrical Engineer and an **Assistant Chief Electrical Engineer** under the Government of Bihar—High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appt. No. 6/49A) (August 19).

Research Assistant—Dr. F. Fairbrother, Department of Chemistry, University, Manchester (August 31).

Assistant Keeper—Director and Secretary, Victoria and Albert Museum, South Kensington, S.W.7 (September 2).

Assistant in Morbid Anatomy in the Department of Pathology—The Dean, British Postgraduate Medical School, Ducane Road, W.12 (September 11)

A **Chemist** and a **Mycologist** at the Long Ashton Research Station—Secretary and Registrar, University, Bristol.

Technical Assistant—Secretary, Air Registration Board, Brettenham House, Lancaster Place, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Institution of Electrical Engineers. Regulations for the Electrical Equipment of Buildings. Eleventh edition. Pp. v+174. (London: E. and F. N. Spon, Ltd.) Paper, 1s. net; cloth, 1s. 6d. net. [296

Home Office: Air Raid Precautions Department. Preliminary Memorandum on the Organisation of Air Raid Precautions Services in Industrial, etc., Undertakings and the Training and Equipment of Personnel. Pp. 16. (London: H.M. Stationery Office.) 3d. net. [296

British Non-Ferrous Metals Research Association. Nineteenth Annual Report and Notes on Researches in Progress. Pp. 35+3 plates. (London: British Non-Ferrous Metals Research Association.) [37

National Institute of Industrial Psychology. Report 8: Rest-Pauses and Refreshments in Industry. By J. Ramsay, R. H. Rawson and others. Pp. 52. (London: National Institute of Industrial Psychology.) 2s. [37

A Century of Fertilizer Progress. By E. H. Tripp and S. W. Cheveley. (Published on the occasion of the Royal Agricultural Society's Centenary Show at Windsor, 1939.) Pp. 32. (London: Dangerfield Printing Co., Ltd.) 1s. [57

The National Trust for Places of Historic Interest or Natural Beauty. Report 1938–1939. Pp. x+164. Freehold and Leasehold Properties of the Trust and Protected Properties. Pp. xix+58+8 plates+26 maps. (London: The National Trust.) [77

Proceedings of the Royal Society of Edinburgh, Session 1938–1939. Vol. 59, Part 2, No. 15: On Non-Associative Combinations. By Dr. I. M. H. Etherington. Pp. 153–162. 1s. Vol. 59, Part 2, No. 16: Cytogenetical Analysis of the Chromosomes in the Pig. By Prof. F. A. E. Crew and Dr. P. C. Koller. Pp. 163–175+1 plate. 1s. 3d. Vol. 59, Part 2, No. 17: Relations between the Elliptic Cylinder Functions. By Dr. E. L. Ince. Pp. 176–183. 9d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [77

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1846 (3604): The Vibration of Airscrew Blades—Extension of the Theory given in R. and M. No. 1758. By B. C. Carter. Pp. 8. 1s. 3d. net. No. 1848 (3694): The Principles of the Galerkin Method. By Prof. W. J. Duncan. Pp. 24. 3s. 6d. net. No. 1851 (3735): Simple Experimental Analysis of the Stresses in Rings. By Prof. A. J. S. Pippard and S. R. Sparkes. Pp. 17. 2s. 6d. net. No. 1852 (3460 and 3460a): Profile and Skin-Friction Aerofoil Drags. By A. Fage. Pp. 24. 2s. 6d. net. No. 1853 (3680): Further Development of a High-Speed Wind Tunnel of Rectangular Cross-Section. By A. Bailey and S. A. Wood. Pp. 16. 2s. 6d. net. No. 1856 (3599): Qualitative Experiments on "Reed Oscillation" of Elevators. By Prof. W. J. Duncan and W. Barnard. Pp. 4. 9d. net. No. 1858 (3678): Longitudinal Flow in a Trailing Vortex. By Dr. W. F. Hilton. Pp. 4+1 plate. 1s. net. (London: H.M. Stationery Office.) [87

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 3, No. 26: The Fresh-water Mollusca of the Tanganyika Territory and Zanzibar Protectorate, and their relation to Human Schistosomiasis. By Dr. Alan Mozley. Pp. 687–744+3 plates. 8s. 6d. Vol. 59, Part 3, No. 27: Further Contributions to our Knowledge of the Fossil Schizaeceae; Genus Senftenbergia. By Dr. Norman W. Radforth. Pp. 745–761+1 plate. 2s. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London. Williams and Norgate, Ltd.). [117

Other Countries

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige undersøgelser i Grønland. Bind 80, Nr. 5: The Godthaab Expedition 1928—Chaetognatha. By P. L. Kramp. Pp. 40. 1.75 kr. Bind 97, Nr. 3: Treaarsexpeditionen til Christian den X's Land 1931–34—On the Placoderm of the Upper Devonian of East Greenland, Second Supplement to Part 1. By Erik A:son Stensiö. Pp. 34+6 plates. 2.00 kr. Bind 108, Nr. 6: 6 og 7 Thule Expedition til Sydøstgrønland 1931–33—Birds. By B. Hørring. Pp. 44. 2.00 kr. Bind 108, Nr. 7: 6 og 7 Thule Expedition til Sydøstgrønland 1931–33—1: Supplementary List to "Spiders (*Araneae*) from Southeast Greenland"; 2: *Arctosa alpigena* Dol. og *Arctosa insignita* Th. (family *Lycosidae*). By Jens Braendegaard. Pp. 12. 0.75 kr. Bind 109, Nr. 3: 6 og 7 Thule Expedition til Sydøstgrønland 1931–33—Knud Rasmussen's Posthumous Notes on East Greenland Legends and Myths. Edited by H. Ostermann. Pp. 182. 6.75 kr. Bind 116, Nr. 4: Treaarsexpeditionen til Christian den X's Land 1931–34—The *Coccidia* of the East Greenland Hares, with a Revision of the *Coccidia* of Hares and Rabbits. By Holger Madsen. Pp. 38. 1.75 kr. Bind 116, Nr. 5: Treaarsexpeditionen til Christian den X's Land 1931–34—On *Lithoderma fatiscens* Areschoug and *L. fatiscens* Kuckuck. By Søren Lund. Pp. 18. 0.75 kr. Bind 119, Nr. 6: The Structure of the Kejser Franz Josephs Fjord Region, North-east Greenland. By N. E. Odell. Pp. 54+6 plates. 2.50 kr. Bind 119, Nr. 9: Investigations on the Copepod Fauna in East Greenland Waters. By P. Jespersen. Pp. 106. 4.75 kr. Bind 121, Nr. 3: The Zoology of East Greenland—Copepods. By P. Jespersen. Pp. 66. 3.00 kr. Bind 124, Nr. 2: The Natural History Expedition to Northwest Greenland 1936—Preliminary Investigations on Shallow Water Animal Communities in the Upernavik and Thule Districts (Northwest Greenland). By Christian Vibe. Pp. 43+4 plates. 2.50 kr. (København: C. A. Reitzels Forlag.) [276

Chinese Materia Medica—Fish Drugs. By Bernard E. Read. (Published by the Peking Natural History Bulletin.) Pp. 136. (Peiping: The French Bookstore.) 3 dollars. [296

The Economic Botany of the Kiowa Indians as it relates to the History of the Tribe. By Paul A. Vestal and Richard Evans Schultes. Pp. xiii+110. (Cambridge, Mass.: Botanical Museum.) [37

Union of Geodesy and Geophysics, Egypt. Survey Departmen Paper No. 44: Revision of First Order Levelling Lower Egypt. B J. H. Cole. Pp. 23+2 plates. (Giza: Department of Survey an Mines.) [5

Henry Lester Institute of Medical Research. Annual Repor 1937–1938. Pp. 90. (Shanghai: Henry Lester Institute of Medic Research.) [8

Crohamhurst Observatory. Observatory Paper 10: On the Method adopted as a means of Seasonal Forecasting at Crohamhurst Observa tory and the Reasons Therefor. By Inigo Jones. Pp. 15+5 plate (Crohamhurst: Crohamhurst Observatory.) [3

Memoirs of the Kyancutta Museum. No. 6: Development an Classification of Archaeos (Pleospongia). By R. and J. Bedford Pp. 67–82+plates 42–52. (Kyancutta: Kyancutta Museum.) 1s. [3

U.S. Department of the Interior: Office of Education. Bulleti 1938, No. 15: Education in Germany. By Alina M. Lindegren Pp. xii+145. (Washington, D.C.: Government Printing Office. 20 cents. [3

Commonwealth of Australia: Council for Scientific and Industri Research. Bulletin No. 126: Investigations on Chilled Beef. Part 1 Microbial Contamination acquired in the Meatworks. By W. A Empey and W. J. Scott. Pp. 71. Pamphlet No. 90: Studies of th Physiology and Toxicology of Blowflies. 1: The Development of Synthetic Medium for Aseptic Cultivation of Larvae of *Lucilia cuprina*. By F. G. Lennox. Pp. 24+1 plate. (Melbourne: Governmen Printer.) [4

Carnegie Institution of Washington. Publication No. 493: Studie on the Ice Age in India and Associated Human Cultures. By H. D Terra and T. T. Paterson. Pp. xi+354+56 plates. (Washington D.C.: Carnegie Institution.) [4

Journal of the Indian Institute of Science. Vol. 22A, Part 10: Researches on Utilisation of Cane Molasses. Part 3: A Dry Solid Product from Cane Molasses and its Possible Technical Applications. By T. R. Bhaskaran, S. C. Pillai and V. Subrahmanyan. Pp. 139–148. 14 annas. Vol. 22A, Part 11: Researches on Utilisation of Cane Molasses. Part 4: Vegetation Experiments to determine the Fertilising Value of the Solid Products prepared out of Cane Molasses. By T. R. Bhaskaran, S. C. Pillai and V. Subrahmanyan. Pp. 149–154. 14 annas. (Bangalore: Indian Institute of Science.) [47

Ministry of Agriculture, Egypt. Horticultural Section, Bulletin No. 211: Physiological Studies in Lime-induced Chlorosis. By Dr. Youssef Milad. Pp. iv+56+7 plates. (Cairo: Government Press.) 6 P.T. [57

Office National Météorologique et Société Météorologique de France. Bibliographie météorologique internationale. Nouvelle série, Tome 4, Année 1936. Pp. 358. (Paris: Office National Météorologique.) [57

Proceedings of the U.S. National Museum. Vol. 86, No. 3057: A New Cave Isopod from Florida. By James O. Maloney. Pp. 457–460. Vol. 86, No. 3064: Restriction of the Genus *Gelechia* (Lepidoptera: Gelechiidae), with Descriptions of New Genera. By August Busck. Pp. 563–594+plates 58–71. (Washington, D.C.: Government Printing Office.) [67

U.S. Department of Agriculture. Technical Bulletin No. 672: Vapor-Heat Treatment for the Control of Narcissus Bulb Pests in the Pacific Northwest. By Randall Latta. Pp. 54. (Washington, D.C.: Government Printing Office.) 10 cents. [67

Smithsonian Miscellaneous Collections. Vol. 98, No. 15: Sponges Collected on the Presidential Cruise of 1938. By M. W. de Laubenfels. (Publication 3540.) Pp. 8. Vol. 98, No. 17: Polyclad Worms Collected on the Presidential Cruise of 1938. By Libbie H. Hyman. (Publication 3542.) Pp. 14. (Washington, D.C.: Smithsonian Institution.) [67

U.S. Department of Commerce: National Bureau of Standards. Research Paper R.P. 1200: An Absolute Determination of the Ampere, using Improved Coils. By Harvey L. Curtis, Roger W. Curtis and Charles L. Critchfield. Pp. 485–518. (Washington, D.C.: Government Printing Office.) 10 cents. [67

Instituto Nacional de Tecnologia (Ministerio do Trabalho, Industria e Commercio). A estatistica nos laboratorios e no controle da producao. Pelo Paulo Sá. Pp. 64. As Manilhas Nacionaes. Por Domingos de Pontes Vieira. Pp. 30. Papeis da Industria Nacional. Por Antonio Russell Raposo de Almeida e Eudoro Lincoln Berlinck. Pp. 72. Conforto termico. Por Paulo Sá. Pp. 60+8 plates. A Noz de Kola no Brasil. Pelo Ruben Descartes de G. Paula. Pp. 48. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [67

U.S. Department of Agriculture. Leaflet No. 182: Housefly Control. By F. C. Bishopp. Pp. 6. Technical Bulletin No. 673: The Distribution of Insects, Spiders and Mites in the Air. By P. A. Glick. Pp. 152+5 plates. 25 cents. (Washington, D.C.: Government Printing Office.) [77

Smithsonian Miscellaneous Collections. Vol. 98, No. 9: Algae Collected on the Presidential Cruise of 1938. By Wm. Randolph Taylor. (Publication 3534.) Pp. 18+2 plates. (Washington, D.C.: Smithsonian Institution.) [77

Nyasaland Protectorate. Annual Report of the Forestry Department for the Year ended 31st December, 1938. Pp. 53. (Zomba: Government Printer.) 1s. [87

Indian Forests Records (New Series). Silviculture, Vol. 3, No. 5: An Investigation into the Best Age and Diameter of Stump to use when Stump Planting Teak (*Tectona grandis*) in Areas having a General West Coast Type of Climate. By A. L. Griffith. Pp. 161–194. (Delhi: Manager of Publications.) 1 rupee; 1s. 6d. [107

Institut français du caoutchouc. Pp. 24. Le caoutchouc et ses utilisations dans l'agriculture. Pp. 16. Applications au caoutchouc de la spectrographie par les figures de Hartley modifiées. 1: Généralités. Par Charles Dufraisse et Jean Houpillart. Pp. 8. (Paris: Institut français du Caoutchouc.) [107

Smithsonian Institution: United States National Museum. Contributions from the National Herbarium, Vol. 26, Part 10: The Andean Species of Pilea. By Ellsworth P. Killip. Pp. viii+475–530+plates 30–40. (Washington, D.C.: Government Printing Office.) 15 cents. [107

Editorial & Publishing Offices:
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, JULY 29, 1939 No. 3639

WHITE SETTLEMENT IN THE TROPICS

T is now more than a century since Sir Samuel Baker recorded his lamentable failure to stablish an English country gentleman's estate in the grassy plains of the heart of Ceylon. His pedigree cattle and sheep soon succumbed and his arefully selected wheat and oats showed early promise, but failed to come to harvest. No less oncerned was his coachman at the death of his arriage horses; with characteristic though misplaced resource, he sought to uphold his master's dignity by teaching an elephant to trot gracefully and so to replace the missing horses. He succeeded only in driving a fine elephant to death. Since hen; many advances have been made in the knowledge of tropical agriculture, yet many of the major problems of white settlement in the tropics and acclimatization to tropical environments remain unsolved.

The problem of finding areas for large-scale settlement of mid-European refugees has thrown nto prominence the need for more accurate knowledge of many of the more sparsely peopled areas of the earth's surface. Those that remain little known are mainly in the tropics. In particular, attention has been focused on British Guiana—in latitude but a few degrees from the equator and thus not very different from the scene of Baker's experiments in Ceylon, and at comparable elevations. In the latter part of 1938, the British Government made a tentative offer of lands in British Guiana as a possible site for the settlement of involuntary refugees created by recent events in Europe. An impartial international commission to investigate these areas was appointed by the President of the United States through the Advisory Committee on Political Refugees. The Commission was a strong one, including members with expert knowledge of health, engineering, colonization, tropical agriculture, soils and malarial control and, with the aid of air reconnaissance, it carried out in the short period February 14 to the early part of April 1939 a remarkable series of journeys, and has presented, with commendable speed, a general report*. A number of appendixes have been grouped together and published† separately, including an important note on the "Possibilities of Agricultural Settlement" by Sir Geoffrey Evans, formerly principal of the Imperial College of Tropical Agriculture at Trinidad.

British Guiana has an area of 89,480 square miles and a population of about 325,000, but the people are concentrated on the sugar and rice lands of the coastal lowlands. The vast interior is virtually uninhabited, save for scattered Indian settlements, mainly in reservations, and occasional mining camps or cattle ranches. The two main areas examined were both south of lat. 5° N.—that is, less than five degrees from the equator—and covered about 30,000 square miles on either side of the Essequibo River. The bulk is covered with dense forest; about one eighth is grassland.

The Commission summarizes its findings by expressing the "opinion that, while the territory is not an ideal place for refugees from Middle European countries, and, while the territory could not be considered suitable for *immediate* large scale settlement, it undoubtedly possesses potential possibilities that would fully justify the carrying out of a trial settlement project on a substantial enough scale that would make it possible to determine whether and how these potential possibilities could be realized".

---

* Cmd. 6014. (London: H.M. Stationery Office, 1939.) 4d. net.
† Cmd. 6029. (London: H.M. Stationery Office, 1939.) 1s. net.

This is a very guarded statement, and the plan recommended is for receiving camps and trial settlements, directed by properly equipped technical organizations, to be set up at properly chosen locations for some 3,000–5,000 carefully selected young men and women at a cost of about 3,000,000 dollars. The cost is given as a rough figure to be accepted with caution.

It is from Sir Geoffrey Evans's appendix that some clear indications of the possibilities are to be obtained. He emphasizes that the utilization of the open savannah country is essentially a pastoral problem, and that much of the forest country has the light, sandy, easily eroded and easily leached soils common to many of the hot, wet-forest regions of the world. The only areas capable of supporting a permanent agriculture are valley lands of unknown extent in the Kanuku mountains. A difficulty exists that large sections of the savannah country are flooded in the wet season, and drainage might be needed for health reasons; on the other hand, the areas liable to flood seem to support the best pasture. What is envisaged is a compact village community, raising by its own labour subsistence crops on the valley lands, managing cattle on neighbouring savannahs, and thus having not only an assured meat supply but also being able to sell to timber-working communities to be set up in the forest areas, and perhaps to feed a meat packing plant. The scheme incidentally involves the utilization by Europeans of unaccustomed tropical plants as the basis of diet.

It is interesting to note the insistence on the inherent poverty of many, perhaps most, tropical soils; an insistence emphasized by recent work in tropical Australia. There, in complete contrast to the patriotic optimism of only a decade ago, agriculturally utilizable soils have been stated recently to occupy not more than 5,000 acres in the 335,116,800 acres of the Northern Territory. Since the financing of private enterprise in this territory is obviously a concern of the great banks, the Bank of New South Wales recently commissioned Mr. A. G. Lowndes to make detailed investigations on the spot, and then to compare conditions in North Africa, Brazil and other comparable areas. His findings are pessimistic in the extreme: "Beyond the present limits of agricultural settlement, Australia has practically no areas which are definitely known to be suitable for close settlement".

The appearance of the Commission's report postdates by a few weeks the publication as a special
monograph of the American Geog
of what is really the first comprel
study of white settlement in the
author, Dr. Price, is an Australi
wide experience of tropical Aus
made detailed studies in many pa
but notably in the West Indies.
the contradictory views which are
authorites even at the present
Balfour summarized the conclusio
a lifetime's work on tropical dise
far as the race is concerned, I am
the hot and humid tropics are not
colonization and never will be w
knowledge, even if they are rende
disease as England". At the otl
those whose views are coloured l
success of General Gorgas in
epitomized by Guiteras in his st
"the tropical climate is compa
most elevated manifestations of l
and the acclimatization of the whi
tropics has been effected with co

Price entitles one of his ch
Failures in the West Indies"; b
show that the long and dismal rec
light on the effect of climate *per se*
invaders of the tropics still fa
obstacles: disease, which can and l
conquered, the coloured races, a
can be eliminated, and climate,
problem. It is rightfully pointe
effects of climate can be studied
the laboratory owing to the inter
logical, psychological and other fac
Despite the most adverse conditio
groups have maintained a remark
notably on the little island of Sal
Indies, and Price agrees with R.
failures in Central and South Ame
isolation rather than to climate.

So far there is nothing in the l
to negative the possibilities of settle
Guiana with the safeguards env
Commission. The admitted dan
ignorance, isolation and racial co
removed as largely as possible. C
held popular belief, medical opini
manual labour is not only pos
essential. Provided the soils pr

---

* White Settlers in the Tropics. By A. Gren
tional Notes by Robert G. Stone. (American
Special Publication No. 23.) Pp. xii+311+20
American Geographical Society, 1939.) 4 dollars.

upporting an adequate agriculture, the unknown actor is still, in the main, climate. Ellsworth Huntington contends that there are climatic limits nd optima for human beings as for all other forms of life, and that the tropics are beyond the climatic ptima and near the climatic limits for whites. n a series of long and detailed appendixes to Price's work, Mr. Robert G. Stone, of Harvard, has summarized the present state of knowledge. There are definite physiological changes of temporary and possibly permanent character produced in white peoples by a tropical environment; the real test must come in the second and third generations.

THE IMPACT OF CHRISTIANITY ON SOCIAL AND ECONOMIC LIFE

Christianity and Morals
By Prof. Edward Westermarck. Pp. xvi + 427. London: Kegan Paul and Co., Ltd., 1939.) 21s. net.

PROF. E. WESTERMARCK requires no introduction to the reader; his earlier works on ethics and sociology are well known, and anything that he says commands attention and respect. Several of his previous books have an important bearing on the present volume and in two of these, "The Origin and Development of the Moral Ideas", and "Ethical Relativity", he states his objections to the view of Rashdall and others on the objective validity of moral judgments. The present reviewer dealt with this subject less than two years ago in "Free Will or Determinism", and though his line of attack was somewhat different from that of Westermarck, his conclusions were the same, that belief in the objectivity of our moral judgments is untenable. In "Ethical Relativity", Westermarck argues that the predicates of all moral judgments, all moral concepts, are ultimately based on emotions. There are two moral emotions—moral approval and moral disapproval; the first of these is a form of retributive kindly emotion, and the second is a form of resentment. They are characterized as *moral* emotions, as distinguished from *non-moral* emotions, by the fact of disinterestedness.

In Chapter iii of the present work Westermarck shows that the ethics of Jesus are of a retributive character. It is difficult to read the synoptic gospels without agreeing with this view (John's gospel is in a different category, as few of the actual sayings of Jesus are recorded there). The moral teaching of Jesus is undoubtedly permeated with the principle of rewards and punishments. Although egoistic hedonism has usually been repulsive to the moral consciousness, yet it can have a plausible appearance, and Sidgwick recognizes it as an inevitable element in a complete system of ethics. He defines egoistic hedonism as "a system which prescribes actions as means to the end of the individual's happiness or pleasure". This differs considerably from the egoistic hedonism of the Cyrenaics and Epicureans, and there is nothing in the teaching of Jesus which is contradictory to this definition. In Chapters iv and v it is shown that the teaching of Jesus also emphasizes the disinterested and altruistic character of the moral emotions, and here we see the feature that distinguishes them from other, non-moral, retributive emotions. The Golden Rule brings this out very clearly, although it should be pointed out that this Rule is older than Christianity, and in its negative form is widespread.

There is a very marked contrast between the teachings of Jesus and of Paul. According to Paul, salvation is not a reward for righteous conduct, as Jesus taught, but is entirely dependent on divine grace, "through the redemption that is in Christ Jesus". His doctrine of justification by faith was accepted by the Church from the days of St. Augustine, though Catholicism has always recognized the meritoriousness of good works. The denial of this and the trust in justification by faith alone had very demoralizing effects amongst various Protestant sects, which even Luther himself was forced to admit and bewail. On p. 117 it is stated that Paul had imbibed from his Jewish upbringing the idea of all mankind doomed to death on account of Adam's sin. But the doctrine of 'evil impulse', not associated with the Adam story, was held in official and cultured scholastic Jewish circles, and there is much to commend the view of Dr. N. P. Williams, that the Adam story, held largely in backward Galilee where Jesus did most of his work, was adopted by Paul. This he did out of deference to those disciples, Peter in particular, who had seen Jesus in the flesh, and while it cannot be proved that Jesus in fact accepted the Adam story, yet in some of his sayings he appears to assume a sinful disposition inherent in man.

Nine chapters are devoted to a consideration of the impact of Christianity on ideas and conduct regarding the sanctity of human life (including warfare, infanticide and suicide), economics, slavery, regard for the truth, marriage, divorce, irregular sex relations, and consideration for the lower animals. It must be regretfully confessed that a large portion of this is an indictment of Christianity, and the Christian apologist will find it difficult to defend his position. It cannot be denied that the capitalist spirit influenced theological dogma, more especially in the sixteenth and seventeenth centuries. The attitude of Islam towards slaves contrasts favourably with that of Christianity, which was influenced by false Old Testament teaching. The personal independence enjoyed by the married woman under the later Roman law was lost through legislation influenced by Christianity. This personal independence wa regained, not because of, but in spite of, th Churches. The opposition that the Christia Churches have raised against divorce, even whe innocent people were living under condition compared with which the lot of the slave was happy one, will not be easily forgotten. Repentanc in sackcloth and ashes may be a prerequisite fo organized religion if it entertains any hope o moulding the future of Western civilization.

The work is extraordinarily interesting, an coming from one with Prof. Westermarck' reputation, will command a large reading public It is a little surprising that "The Laws of England" by the Earl of Halsbury, published in 1911, shoul still be quoted relating to the present law o England on marriage, and that no mention should b made of recent legislation. M. D.

CO-OPERATION IN RESEARCH

Co-operation in Research
By Staff Members and Research Associates of the Carnegie Institution of Washington. (Publication No. 501.) Pp. ix + 782. (Washington, D.C.: Carnegie Institution, 1938.)

ON December 31, 1938, Dr. John Campbell Merriam retired from the presidency of the Carnegie Institution of Washington. The volume under review, with its intriguing title, has been written by his colleagues to express to President Merriam "the appreciation felt by the members and research associates of the Institution for his continued inspiring guidance of their work and for his stimulating personal interest in their problems". It is no small task to have directed, for eighteen years, the policy of a great research organization like the Carnegie Institution, and it is possible that, at the last assize, the holder of such an office may be found to have exerted as great an influence on human progress as leaders in other spheres of activity whose names are much more prominent in the pages of the daily press. In this spontaneous tribute from his colleagues, however, Dr. Merriam will, we are sure, find ample reward for his service to science, and through science to humanity.

Commemorative volumes are not invariably—perhaps not even usually—of much intrinsic importance; they tend to belong to the ephemera of literature. "Co-operation in Research" is one of the exceptions. In the first place the responsible committee wisely decided that the papers included should deal with current problems, and should epitomize the activities of the Institution in various branches of science. As there are few branches of science in which the Institution is not active, the volume serves as an admirable conspectus of the present state of knowledge in many fields, and its perusal is a liberal education. Water in geological processes, the surface of the moon, sunspots and stellar distances, universal aspects of atmospheric electricity, eighteen years of research on the gene, "What and Why is Leukemia?", the influence of nutrition on the chemical composition of the normal body, the substance of American history, race and class in Yucatan, ancient forests of Oregon; these are a few topics—chosen at random—to indicate the scope of the volume. Nor are the articles, in spite of their number, in the least superficial Under the rule of Dr. Merriam, a piece of research was not considered finished until its results had been made available, not merely to the specialist in the subject itself but also to specialists in other subjects, and in their simplest form to the public at large. The articles in the present volume show that the members of Dr. Merriam's team have learned their job.

But the volume is something more than a record—it is a confession of faith. "Co-operation in Research" is the title of the book, and co-operation in research was the policy pursued by the Institution under the guidance of its chief. "Throughout his administration," says the foreword, "Dr. Merriam has stressed the need for co-operative attack on problems too large to be solved by a single observer, and has initiated many projects in which teamwork by different groups has been essential to success." The whole book is a tribute to the vital importance of the method, and the individual papers demonstrate, better than pages of argument, the value of co-operative endeavour in science.

This testimony is timely. In large industrial research organizations, no doubt, active co-operation between scientific workers of differing trainings has been, or is being, largely achieved; with results which amply justify the by no means excessive sums spent on the work. Pure science, however, still lags woefully behind. It is by no means easy to break down the partition walls which separate the sciences, and to bring together in equal partnership and in the same laboratory men of different training. It calls for vision and courage; more essentially still, it needs money. Yet there can be little doubt that the next great advances in knowledge are waiting to be made in those neutral territories which separate science from science. In particular, the time is ripe for a mass invasion of the no-man's-land dividing physics from biology: a territory in which neither physicist nor biologist can walk in safety alone. Something is being done, but far less than the opportunity warrants. It is much to be hoped that the considered testimonies to the value of the method contained in this commemoration volume may provide a stimulus to still further efforts at co-operation in research.

J. A. Crowther.

SCIENCE, ART AND DESIGN

The Scientific Aspects of Artists' and Decorators' Materials

By Dr. R. S. Morrell. Pp. xi + 142. (London: Oxford University Press, 1939.) 5s. net.

THE studio of the medieval artist or craftsman was very much more than a place where pictures were painted or pots were fashioned. It combined the functions of workshop and laboratory for the master's own activities, and for the instruction of his pupils. A long apprenticeship was demanded of those whose ambition it was to become master-craftsmen, and much of this period seems to have been devoted to an intense and intimate study of materials, which included the preparation of pigments, and the application of sundry metallurgical principles such as those of metal refining and extraction. In a word, this was a hard school of training in the properties of matter, somewhat far removed apparently from Ruskin's vision of Giorgione as he appears in "The Two Boyhoods".

Farther north, the van Eycks had been experimenting with the behaviour of emulsions and colloids, an adventure which, like many another, led to no startling discovery, no mystic secret, but which produced in the end (after innumerable transitional techniques) the supreme achievement of the Netherlands—the perfection of oil painting.

Nevertheless, the course of man's attempts to obtain the mastery over matter is strewn with failures, instructive but none the less unfortunate. Seventeenth-century Italian pictures executed upon slate supports have revealed an oil film under the paint layer which has brought about disastrous lack of cohesion, with consequent flaking; and the sequelæ of Reynolds' love of bitumen are all too obvious in the havoc which has surely followed upon a lapse from a rigorous appreciation of the laws of physical chemistry.

In our day, a return is noticeable to an interest in materials as such, but the focus of attention is naturally different. The urge is first to understand and then to apply all the manifold new products which synthetic chemistry has provided. Coal-tar derivatives such as monastral blue, substances of high molecular weight like the polyvinyls, bakelite and the rest, are the bricks of which the twentieth-century edifice may be built, and become a thing of beauty.

But with such plenty, the student will ask, "Where shall wisdom be found?" Fortunately, in the modest little book now under review, he can turn to the results of long experience of a teacher and worker in natural science applied to the arts. Dr. Morrell discusses supports, grounds, pigments, lacquers and varnishes not only with clarity, but always with an eye upon the reader who has no intention of becoming a specialist in technological chemistry, but wants to understand the scientific aspect of everyday materials. Yet these pages are no mere compilation of useful properties; they contain a number of sidelights upon art history which are illuminating, as well as necessary for a scholar's appreciation of the development of technique.

In a contribution so excellent, critical comment can only be made with hesitation; yet it is this. The bibliography, adequate as it is up to a point, ignores completely the numerous papers on these very subjects which have been appearing in "Technical Studies" of Harvard University for the past seven years. It seems a grievous pity not to mention them, and perhaps still more, the

"Trial Data" from the same source. Further, no place is found for a reference to the comprehensive work of the Carnegie Institution of Washington on coloured minerals, fundamental for our knowledge of the optical characteristics of pigments.

These researches have become inter
common property of artists and de
that Dr. Morrell's manual should
warmest of welcomes, there can be n

F. Ian G.

PURE AND APPLIED THERMODYNAMICS

(1) A Textbook of Thermodynamics

By Dr. F. E. Hoare. Second edition. Pp. xii+307. (London: Edward Arnold and Co., 1938.) 15*s*. net.

(2) Applied Thermodynamics

By Prof. Virgil Moring Faires. (Engineering Science Series.) Pp. xvii+374. (New York: The Macmillan Company, 1938.) 17*s*. net.

(3) Elementary Thermodynamics

By Prof. Virgil Moring Faires. (Engineering Science Series.) Pp. xiii+225. (New York: The Macmillan Company, 1938.) 12*s*. net.

(1) DR. HOARE'S book, which deals with pure thermodynamics, is one of the most readable treatises yet published on a subject which is too frequently dealt with in a somewhat formidable manner. No attempt is made to evade difficulties, since although starting with comparatively elementary work, the final chapters work up to the use of the quantum theory and statistical mechanics. As an instance of the human touch, the author allows himself in connexion with Callendar's equations for steam the use of the word "surprising" when conducting the reader along the interlocking paths of this fascinating piece of work. A little more of this spirit in the past might have shortened the twenty years which elapsed between its enunciation and acceptance.

Rather more than the first half of the book is taken up with the development of the usual theorems, including change of phase, equilibrium of systems, and the Nernst heat theorem. The kinetic theory first appears in a formal manner in Chapter vi, necessitating a reference forward from Chapter ii to some of its results. Though rarely adopted, a more logical procedure would seem to be to introduce it at an early stage: an additional advantage would be that it renders so much elementary work self-evident.

The applications which follow, to solutions, electrical phenomena including the magneto-caloric effect, radiation and specific heats according to the quantum theory, at times naturally make rather heavier reading. Numerous very recent references to original work are supplied for those who wish to go into each subject more deeply than is possible in the 300 pages of this book.

That this, a second edition, has b
is an indication of the usefulness of
value of which has been enhanced b
of examples at the end, with hints
them out.

(2) As its title implies, the secon
a very different type, and while n
theory, deals largely with applications
Half-tone illustrations form a featu
nearly a quarter of the 200 figures,
exception of the section giving exam
and their auxiliaries, which is up
fairly comprehensive, in a few ot
better choice might perhaps have
even allowing for differences in pra
America and Great Britain.

The theoretical side is by no
elementary character and includes s
variable specific heats in internal
engines, regenerative heating (or blee
plant with a section on the use of me
and various types of refrigerators
transmission is not neglected.

In addition, it is difficult to t
auxiliary apparatus connected with t
of engineering which is not mentione
in the form of a short piece of analy
others as a practical note. Here a
may not agree with the author; f
statement concerning the possible eff
Still engine is certainly open to ques

A number of examples are worke
text. Altogether a useful book, li
and practice.

(3) Prof. Faires' other book is sh
lines of (2) above, but with less a
practice: for example, most of
blocks have disappeared, and the re
in vain for details of boilers and turb
feature of the latter dealt with b
through nozzles.

The author has resisted the tempt
dense his larger book, and has had t
deal with a few subjects chosen f
complete a form as possible: in fact
chapters are transferred *en bloc*. Curi
it includes at the end a set of examp
not included in the larger book.

ENVIRONMENTAL CONDITIONS AND PHYSICAL CHARACTERS

Migration and Environment
A Study of the Physical Characteristics of the Japanese Immigrants to Hawaii and the Effects of Environment on their Descendants. By Prof. H. L. Shapiro, with the field assistance of Frederick S. Hulse. (Issued under the auspices of the University of Hawaii.) Pp. xi + 594. (London, New York and Toronto: Oxford University Press, 1939.) 32*s*. 6*d*. net.

EVER since 1912, when Boas published his studies upon the changes in bodily form of descendants of immigrants to the United States, speculations concerning the power of environmental conditions to affect the physical characters of man have been rife. At times these speculations have had but slender foundation in ascertained facts derived from proper anthropological investigation, and we have become accustomed to somewhat random statements concerning the differences in appearance between the migrants in their new environment and the parental stock in their homeland. It is obvious that the investigation of this problem is surrounded by pitfalls, and that no mere generalizations are of the least value in attempting its solution. Even when the problem is investigated by the standardized methods of anthropometry, there are still abundant sources of error that are difficult to eliminate but which will naturally invalidate the ultimate findings. It has been the first task of the reviewer to attempt the detection of any possible sources of error in the work under notice, and he freely owns that here he has failed.

The problem that Dr. Shapiro and his co-workers set for themselves was a threefold one. In the first place, they conducted an anthropometrical survey of the first generation of Japanese born in the Hawaiian Islands; in the second, of the Japanese who had come to the islands as migrants from Japan; and in the third, of the Japanese living in Japan representative of the stock from which the migrants came; this last class are termed by Dr. Shapiro 'sedentes'. We are therefore concerned with three classes: sedentes, immigrants and Hawaiian-born. It should first be made clear that all the measurements of more than three thousand individuals, whether made in Hawaii or in Japan, were recorded by the same observer. In the next place, it is important to note that the sedentes measured in Japan were inhabitants of the villages from which the immigrants were derived, and in a great many cases were actual relatives of the migrants. Of this large series of individuals there were recorded 43 measurements, 21 indexes and 41 observations.

From the enormous mass of data thus gathered together a simple and expected finding emerges, for it was found that the Hawaiian-born differed significantly from the migrant, mainly in a quantitative direction, by greater stature, increased length of limb and increased width and height of head among other things. So far, the finding seems to be the very natural one that change of total environment, often accompanied by change in social status and of occupation, has produced a quantitative change in the physical form of the Hawaiian-born Japanese. But the remarkable fact emerges that when the immigrants are in their turn compared with the sedentes, it is found that "in 18 out of 35 traits the immigrants diverged distinctively from the sedentes. In practically all the characters in which the immigrants deviate, no additional modification of noteworthy magnitude appeared among the Hawaiian-born".

Shapiro sums up this puzzling finding as follows:

> "These results lead to the conclusion that in both qualitative as well as in measurable characters the immigrants display significant departures from the means and percental distributions of the sedentes. The Hawaiian-born, however, fail to show any tendency to develop further modification in their qualitative characters, although in their quantitative traits they undergo considerable modifications."

How comes it that the men and women who left Japan as adults to migrate to Hawaii differ in physical characters so notably from the kin they left behind? It would naturally be suggested that some form of selection was exercised by the emigration officers in Japan or by the plantation owners in Hawaii; but this possibility seems clearly to be ruled out. It may be suggested that migrant groups are a naturally selected strain of the parent stock, but such a hypothesis is difficult to maintain. Whatever the underlying factor may happen to be, there is no doubt that this exhaustive piece of work has opened up a new field—a field concerning which the reviewer is in agreement with the author when he sums up his conclusions in saying, "We are thus reduced to the position of suspended judgment".

F. WOOD JONES.

STORAGE OF TROPICAL FRUITS

BY DR. C. W. WARDLAW,
IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD

WHEN work was begun at the Trinidad Low Temperature Research Station in 1928*, the immediate problem was to ascertain the keeping and carrying quality of the several banana varieties and hybrids which might be used as substitutes for the Gros Michel (the principal variety of commerce), then threatened by the epidemic spread of Panama disease. Within a few years, however, the very general use to which the Station could be put was recognized both by local agricultural administrations and by shipping companies operating in the Caribbean region, and by request work was in turn extended to tomatoes, limes, grapefruit, oranges, avocados, mangoes, papaws, pineapples, melongenes, cucurbits of various kinds, and to the assortment of vegetables that can be grown in the tropics. To some of these commodities a considerable amount of study has been devoted, and their general cold-storage requirements have now been ascertained with a sufficient degree of precision for practical purposes.

Success in transporting fruits and vegetables does not depend on refrigeration alone, and to a large extent it has fallen to those engaged on storage problems in the tropics to investigate, at least in part, related biological aspects such as the physiological behaviour of different varieties, questions of harvesting maturity, optimum conditions for harvesting, pre-storage and disinfectant treatments, the effect of different methods of wrapping and packing, post-storage treatments including ripening technique, and wastage problems in general. In the following notes some account is given of results obtained in Trinidad and of the varied botanical problems encountered in investigating the storage requirements of tropical fruits.

If not held at suitably low temperatures, the ripening of tropical fruits and the onset of wastage take place very rapidly. The practical problem, accordingly, is primarily one of arresting or retarding ripening without injuring the fruit. To do this satisfactorily, it is essential that rapid cooling to the required storage temperature should be undertaken as soon after harvesting as possible.

If an arbitrary and incomplete distinction may be drawn between 'cool' storage and 'cold' storage, it will be found that the greater number of tropical fruits require to be carried in 'cool' storage (for example, avocados, 45° F.; mangoes and tomatoes, 47·5° F.; grapefruit, oranges and limes, 45° to 50° F.; Gros Michel bananas, 53° F.
Lacatan bananas, 56° to 58° F.; pa
etc.), if chilling injuries are to be avoi
exposure to too low a temperature n
physiological injuries such as superfi
ing, failure to ripen, and loss of resista
pathogens already present in the tiss
or dormant infections, it will be appa
temperatures selected for the storage a
of tropical fruits should allow of a suff
of safety to avoid the danger of chill
of recent years there has been a grow
to raise the storage temperatures re
this having been especially marked i
grapefruit, where 'pitting' (chill blemi
the past constituted a large propo
wastage; thus whereas formerly t
below 40° F. were generally employed
tendency is to store fruit at 45° to 50°
higher temperatures have been advoc

Both in respect of the normal phys
fruit and the biology of its pathogen
tenance of correct humidity relation
storage rooms or holds is of very
importance. This conclusion is dr
number of instances in which the
humidity and water-relations hav
themselves for consideration; it must
however, that no final statement o
conditions required in different insta
be made. But, in general, it may
relative humidity (*a*) that it should n
as to allow of serious loss in weight o
appearance and maturation of the
the storage period; (*b*) that it shoul
high as to promote the superficial grov
hyphæ; and (*c*) that localized
within the cargo stack must be av
question of the need for improve
control is now being urged on all s
logists; in its physical and manipul
it is also being closely studied by p
engineers, and there seems little dou
future will be marked by interesting
innovations.

BANANAS

During the past decade, the maj
banana investigations has centred arou
for a variety to replace the Gros Miche
banana. This variety, which suffe

---

* Funds were provided by the former Empire Marketing Board.

disadvantage of being highly susceptible to Panama disease, is in all other respects almost uniquely suited to the conditions of bulk stowage and transport required in the extensive Caribbean industry; symmetry of bunch, disposition and size of fingers, uniformity of growth, toughness of skin, resistance to disease and ability to be carried at a temperature sufficiently low to effect a substantial control of fungal wastage, combine to make it not easily replaceable by other varieties. Investigations on the keeping quality of possible substitutes have chiefly served to accentuate the collective advantages possessed by the Gros Michel and the difficulties of obtaining a comparable assemblage in an immune variety. A note of optimism may be sounded regarding certain hybrids which have been obtained in Trinidad by crossing a wild, seeded variety (***Musa acuminata***) with the Gros Michel. These combine resistance to Panama disease and to Cercospora leaf disease with a very considerable assemblage of the desirable qualities of the Gros Michel. The first hybrid obtained, known as *I.C.*1, is open to criticism because it yields occasional seeds. The second, known as *I.C.*2, is seedless; it possesses many of the desirable Gros Michel characters and has good texture and flavour, but the individual fruits tend to be rather short.

Several interesting results have accrued from recent bulk storage trials. When the *I.C.*2 banana is grown under favourable conditions, it is capable of yielding good bunches, as judged by the appearance, symmetry and weight of individual fingers, 9-, 8- and 7-hand bunches, suitable for export, being represented among the collection of fruit obtained from different parts of Trinidad. While the symmetry of the bunch as a whole and the disposition and shape of individual fingers are admittedly not so good as in the Gros Michel, nevertheless the hybrid *I.C.*2 possesses qualities which would make it commercially important in the event of any major failure of the Gros Michel. Its present value as a source of food among the local peasantry should not be overlooked. In relation to current storage and ripening procedure for bananas, the optimum harvesting maturity lies between '¾-full' and 'heavy ¾-full', using Gros Michel standards of grading. 'Thin' grade fruit is difficult to ripen; 'heavy ¾-full' fruit, which behaves well during cold storage at 53° F., ripens with an excessive odour of pear drops. The Gros Michel transport temperature of 53° F., with rapid cooling to that temperature, is well suited to this hybrid.

It is generally agreed that the ideal hybrid banana of the future is likely to be one derived from the Gros Michel as female parent. Whether or not the *I.C.*2 eventually becomes acceptable as a commercial banana, any data which can be collected on its growth in the field and physiology in storage will contribute materially towards the central object of this work, that is, the maintenance of supplies of fruit of good quality.

During recent years the epidemic spread of Cercospora leaf disease in the Caribbean region has necessitated a renewal of storage trials with the Gros Michel banana. As a result of this disease many bunches undergo premature ripening while they are still attached to the plant. In storage trials it has been ascertained that the behaviour of fruit obtained from plantations which have been more or less severely infected by *Cercospora musæ* is abnormal in several respects; the pulp is of a slight to well-marked buff or pale ochraceous-salmon colour, fruit tends to ripen prematurely, to chill during the period of refrigerated transport, and to ripen with undesirable rapidity when removed to a higher temperature. Moreover, as a result of the extensive leaf destruction caused by *C. musæ*, bunches tend to grow slowly and to remain of small size; hence fruit may actually be considerably more mature than is indicated by its appearance, and departures from the normal storage behaviour for that grade may be anticipated.

LIMES

The storage of limes exemplifies in particular the importance of the humidity factor. In general, limes are more difficult to handle than lemons, being less cold resistant and, because of their small size, more subject to wastage through shrivelling; the avoidance of desiccation, indeed, is one of the major problems in handling this fruit, a loss in weight of 12–14 per cent being accompanied by severe shrivelling. As loss in weight under tropical conditions may amount to 1·5–2·0 per cent per day, the commercial storage life, as limited by the onset of shrivelling, may be seriously curtailed by undue delay whilst fruit is waiting to be graded and packed. Speedy handling, protecting of fruits by suitable wrappers, and rapid cooling to 45° F. are essential to the successful storage of this commodity.

The susceptibility of the West Indian lime to wither-tip disease has necessitated the breeding of new varieties. By crossing the Philippine lime with the West Indian variety a number of hybrids highly resistant to wither-tip have been obtained. One of these, known as the *T.*1 lime, is a fruit of good appearance, juice and oil-content and is now being cultivated and marketed on a not inconsiderable scale. A second hybrid, *T.*6, possesses less favourable commercial qualities, but has proved of interest when studied with the *T.*1 hybrid and the parental types. Under identical storage conditions, all four exhibit considerable differences in respect of loss in weight; weight for weight and grade for grade, the two hybrids are subject to more rapid desiccation than either of the parents. With regard to cold-resistance, the Philippine lime proved most resistant and the hybrid *T*.6 least; the hybrid *T*.1, on the other hand, is apparently more cold-resistant than the West Indian lime. Such variations are interesting in that they afford an indication of the rearrangement of physiological characters which may result from hybridization.

As with other kinds of citrus fruits, limes are very subject to the superficial blemishing known as oleocellosis which results from mechanical injury to turgid fruits. To avoid oleocellosis, fruits should not be picked too early in the morning or too soon after the fruits have been covered with dew or rain water.

GRAPEFRUITS

Because of the rapidly increasing importance of grapefruit as an orchard crop in the West Indies, an extensive programme of investigations has been carried out. Although data were available from experiments conducted in the United States, South Africa, and elsewhere, it was imperative, because of the relation between environment and keeping quality, to study Trinidad fruit entirely on its merits. In particular, attention has been directed to ascertaining the effect of time of harvesting, duration of the quailing or curing period prior to handling, the precise temperatures suitable for short or more prolonged periods in storage, the nature and incidence of chilling, the avoidance of excessive desiccation and the incidence and control of wastage. The behaviour of fruit derived from trees which has suffered from gummosis and root-rot also presented special problems of both practical and academic interest. Various commercial practices, for example, ethylene colouring, borax treatment, etc., which in some countries have now become standardized, when applied to Trinidad grapefruit have yielded results other than those expected. Thus when fruit is treated with borax solution before crating, as a means of controlling blue and green moulds—which, as a fact, are of minor importance in Trinidad—the effect of the fungicide is to promote the activities of the fungus *Colletortichum glœosporiodes*, which is already present within the tissues as latent infections, so that severe wastage may result. A similar effect is produced by the use of iodized wraps. Striking variations in the keeping quality, susceptibility to chilling and to fungal disease in fruit from different localities in Trinidad have also become apparent in studies conducted over a number of years.

AVOCADOS

The avocado, which is native to Central America, is represented in the West Indies by a very considerable range of types. The majority of trees are of seedling origin and so far only a few have been selected, named and used in the propagation of standard types. The influence of environment and genetical constitution on physiological behaviour during storage is well shown by the avocado, such information as was available from investigations undertaken in America being inapplicable to fruit grown under Trinidad conditions.

Cultivated avocados are generally referred to three horticultural races, the Mexican, the Guatemalan and the West Indian, useful types being fixed- and propagated by budding and grafting. Seedling avocados of the third group as grown under West Indian conditions are characterized by a low fat content, great variation in all fruiting characters, and by their comparative intolerance of cold-storage conditions (most varieties show chilling injury when held at temperatures below 50° F. (10° C.)). A distinctive feature of the avocado is its high fat content. It has been ascertained that fruit grown in Trinidad, and presumably elsewhere under moist tropical conditions, has a considerably lower oil content than that produced in Florida and California. In Trinidad, this low oil content, which is apparently largely determined by environmental factors, is characteristic of introduced as well as of local varieties.

Experimental observations indicate that the striking variability in fruiting characters of West Indian avocados is closely paralleled by the range in behaviour exhibited by fruits when subjected to refrigerated or gas storage or to a combination of both. In the avocado, maturation slowly continues even at relatively low temperatures, so that fruits ultimately become ripe. In varieties not sufficiently cold resistant, the metabolic trend is, however, abnormal, and chill effects in due course become apparent in a darkening of the vascular strands and storage parenchyma, the initiation of such changes being closely associated with the onset of ripening. As only a small number of varieties combine the requisite commercial qualities with adequate cold resistance, the practical problem is essentially one of selection.

MANGOES

In investigating the storage of mangoes, it has been necessary not only to select from the very considerable number of named and seedling varieties available for study, but also to consider such diverse aspects as criteria of harvesting maturity in the several varieties, and the effect of season and environment on keeping quality and liability to wastage. A finding of interest to horticulturists is the very marked effect that environment may exercise on the productivity and keeping quality of different varieties. Thus, whereas the Julie variety crops well and gives a fairly good storage life when grown under the moist conditions that prevail in Trinidad, the Peter's variety is of uncertain productivity and is very susceptible to fungal rotting; on the other hand, the Peter's (Pairi or Bombay) variety, as grown under the dry conditions found in certain areas in Jamaica, yields export fruit of excellent quality.

Like many other tropical fruits, mangoes are readily subject to low-temperature injury. Chilling may be manifested in several ways, including the production of definite skin blemishes, failure to develop normal colour on ripening, failure to ripen on removal from cold storage, and a notable decline in resistance to the inroads of pathogens. Susceptibility to chilling varies with variety, maturity at harvesting and season. Trinidad experience indicates that mango varieties in general are subject to chilling injury if exposed to temperatures below 48°–50° F., superficial blemishing being accentuated by partial desiccation.

The wastage problem in mango storage is serious. Apart from damage due to wound parasites (which is inconsiderable in carefully-handled fruit) the majority of fruits, though apparently free from disease, nevertheless carry latent infections of several important pathogens. Wastage attributable to such latent infections is greatly accentuated by chilling, slow ripening and tardy distribution of ripe fruit. The high incidence of field infections directs attention to the need for careful consideration of orchard sanitation, and it is evident that questions of spacing, pruning, spraying and upkeep generally should be made subjects of special study.

PAPAWS

The papaw (*Carica papaya*) may be cited as an example of a tropical crop where little progress can be made in the matter of commercial cold storage until standardized supplies of fruit are made available as a result of horticultural research. The papaw is well known as the source of the digestive substance papain, obtained by coagulating the latex exuded from green fruits on wounding. During recent years some attention has been paid to this fruit as a possible export crop notably in South Africa and the West Indies. An attempt has also been made to extend papaw cultivation in California and to breed varieties adapted to prolonged storage or transport. From the information available on the production and cold-storage behaviour of this fruit, it may be predicted that the organization and standardization of an export industry will be attended with serious difficulties.

The papaw shows great variety in its fruiting characters, some types producing small spherical fruits no larger than an orange, while others have elongated fruits as large as a watermelon and weighing up to 25 lb. In working towards an export trade, standardized production is a first essential; the basic problem is, therefore, to select and perpetuate good types from material which is notoriously variable. Again, as most varieties are diœcious, the liability to a low standard of production is accentuated by the number of male plants present in a sowing.

Storage trials carried out in Trinidad have shown that relatively immature papaws will not ripen after cold storage, and further, that most of the varieties tested show evidence of chilling if held at temperatures lower than 55°–60° F.

TOMATOES

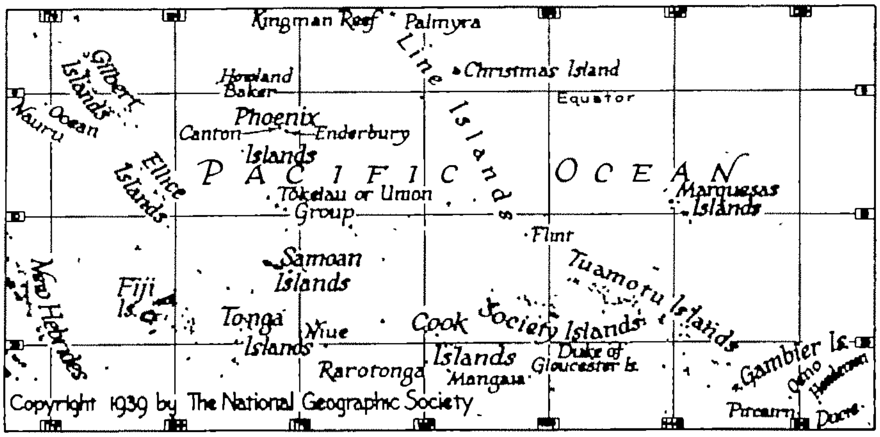
Tropically-grown tomatoes may be mentioned as illustrating the unexpected in storage investigations. Thus it has been ascertained that fruits of several varieties grown under Trinidad conditions have yielded storage records which compare very favourably with those obtained elsewhere. When picked full-grown but green, Trinidad fruit can be kept in cold storage at 40°–47° F. for twenty to thirty days, and on removal to a higher temperature remains in good condition for a further eight to ten days. These results have been confirmed over a number of years and are in marked contrast to the rapid degeneration recorded in comparable storage trials with fruit grown outside the tropics. In view of the disparity between Trinidad findings and previous English results, storage trials were undertaken at the Low Temperature Research Station, Cambridge, in which supplies of glasshouse fruit grown during summer and autumn respectively were used; the summer fruit gave results comparable to those obtained in Trinidad; the autumn fruit, on the other hand, was characterized by the poorer keeping quality already mentioned. As to why summer-grown fruit or that obtained under tropical conditions should be more tolerant of low temperatures is not understood.

During recent years the terms of the grant from the Colonial Development Fund by which this Station is maintained include a concentration on fundamental research with special reference to the banana.

UNITED STATES GEOPHYSICAL EXPEDITION TO THE PACIFIC OCEAN

BY PROF. S. CHAPMAN, F.R.S.

A NOTABLE expedition has been arranged by the National Geographic Society of America and the University of Virginia, with the co-operation of the United States Coast Guard, to undertake varied geophysical investigations in the Central and South Pacific Ocean. The expedition will start in September next, and its work will extend over a whole year. It will be transported by a 2,000-ton steel Coast Guard cutter, fitted with the latest type of sonic depth-finding apparatus, and carrying a two-seater scout observation seaplane which will be used in making aerial photographs and island maps. While the scientific work is proceeding, the Coast Guard will make a survey of present and future needs for navigational and radio aids to marine and air commerce.



Copyright 1939 by The National Geographic Society

The expedition will range over an area of 4½ million square miles, south of the Hawaiian Islands, east of Australia and New Guinea and north-east of New Zealand; most of its work will be done on the many islands scattered over this area. These islands are all owned or controlled by the United States of America, France, and Great Britain or the British Dominions; westernmost of those to be studied is Nauru, practically on the equator, about 800 miles north-east of Australia. Easternmost is Ducie Island, nearly in the longitude of San Francisco, almost on the tropic of Capricorn. The northern and southern limits of the area studied will be Kingman Reef (500 miles south of Honolulu) and Pitcairn Island. The expedition will sail from San Francisco, first visiting Canton Island, now under joint American and British control. During its twelve months in the field, the ship will put in at intervals at Honolulu and Auckland, New Zealand, for supplies and mail. From time to time the expedition will send out radio broadcasts describing its progress.

The expedition will set up major bases on twenty or more islands, and from each major base will visit from ten to fifty other islands. All the islands except those of the Fiji and Tonga groups (which are of the 'continental' type, with a foundation of very old granite) are of the 'pure Pacific' type, either of recent volcanic origin, or of coral resting on recent underwater volcanic outpourings.

Gravity determinations and magnetic observations, together with careful observations of latitude and longitude, will be made on the islands visited, and at the same time the geology of the islands will be studied: the region is virgin ground for the gravity survey, and of course magnetic observations everywhere need to be repeated every decade or so in order to keep up to date our knowledge of the earth's changing field. Artificial seismic waves will be set up by explosions on the ocean bed to indicate the types and depths of rock below; mud 'cores' will also be obtained, showing the composition, for a depth of several feet, of the top layer of the ocean floor. Observations on marine biology will be made, and radio engineers will accompany the expedition in order to investigate radio phenomena.

The expedition is thus one of the most important and extensive scientific exploration surveys undertaken by any country for many years: in several respects its programme coincides with that which was recently arranged, for work over a much more limited area (on or near the edge of the continental shelf off the British coasts), by the Royal Society with the co-operation of H.M. Navy—though the completion of that survey was prevented by the political crisis of last September. It is greatly to be hoped that the plans for the proposed United States expedition may be carried through fully and successfully.

OBITUARIES

Mr. H. Havelock Ellis

BY the death on July 8 of Henry Havelock Ellis, both science and literature have sustained a heavy loss. Havelock Ellis was born at Croydon eighty years ago. At sixteen years of age, owing to ill-health, he was sent to Australia, and later became an assistant schoolmaster in a suburb of Sydney. During a lonely adolescence he was greatly troubled by moral and spiritual difficulties, and decided to devote his life to systematic inquiries that should make clear to himself and to others the real nature of the problems of sex. With this in view he returned to London, and trained as a general practitioner at St. Thomas's Hospital.

After a few months in general practice, literary and scientific activities began to absorb all Havelock Ellis's time. He became editor of the "Contemporary Scientific Series" and co-editor of the "Mermaid Series" of old dramatists; and was soon widely known as a critic and essayist, and later as a popular philosopher and an interpreter of the national genius of France and Spain. His books on "The World of Dreams", "Man and Woman", "The Criminal", "A Study of British Genius", revealed his strong psychological interests and his gift for impartially collecting scientific observations and expounding scientific facts in a lucid and impartial way.

In a long list of publications, the most important work written by Havelock Ellis was that entitled "Studies in the Psychology of Sex". There is no need to repeat the oft-told story of the prosecution of its publisher, and the founding of a defence committee which included George Moore, William Sharp and Bernard Shaw. In spite of judicial condemnation, the volumes might have been seen on the shelves of most British psychologists at the beginning of this century; and his influence undoubtedly paved the way for the sympathetic interest aroused by Freud's more startling doctrines later on. Freud himself, indeed, has more than once acknowledged the value of Havelock Ellis's pioneer work.

Unlike Freud, Ellis was more interested in collecting data than in constructing theories. The results of psychological tests were duly reported in his pages whenever they were obtainable; but since experimental work was only in its infancy when he wrote, his books will remain a collection of suggestive observations rather than of experimentally verified facts. His views on crime, on genius, on the mental differences between the sexes, though still freely quoted, can no longer be regarded as representing the results of the latest researches. Nevertheless, his lucid and delightful style, and the charm of personality that shines through it, will keep his psychological writings alive and influential when the publications of the academic psychologists of his day lie dead and forgotten.

Dr. Henry Correvon

THOUGH better known as a horticulturist than as a botanist, Henry Correvon made considerable contributions by his numerous publications to botanical science. His death in his eighty-fifth year on May 11 leaves a notable gap among the devotees of alpine plants, whom he has done so much to encourage and assist by his own enthusiastic labours.

Born at Iverdon in 1854, Correvon was educated in this little Swiss town, and, losing his father at an early age, was sent to learn horticultural practice first to Geneva, then to Zurich, Frankfort, Erfurt and finally to the Jardin des Plantes in Paris, where he received botanical as well as horticultural training. Thus well equipped, he returned to Iverdon to take charge of the horticultural establishment founded by his grandfather, which had suffered greatly from the neglect of the tenant who had carried on the undertaking. Capable and energetic, Correvon commenced to work up this family heritage, but, alas, only to see most of his improvements totally destroyed by a devastating cyclone in July 1877. The low-growing alpine plants alone survived the ravages of the storm. He transferred his energies to Geneva, where he established a nursery for alpine plants, in the cultivation of which he was so successful that he ultimately purchased in 1902 a large vineyard at Chêne-Bourg high above Geneva. Here he created the wonderful garden "La Floraire" known to all cultivators of alpine gardens. To it he had transported limestone rocks from the Salève and the Jura and granite blocks from the Alps so as to have suitable surroundings for his pet plants.

Correvon's interest in these was not limited to those in his own garden. He was one of the originators of "La Linnea", the alpine garden at Bourg St. Pierre, now under the management of the University of Geneva. He was also concerned in the management of the alpine garden on the Rochers de Naye above Montreux and for a time with that above Saint-Cergue. His love for these, and other efforts for the preservation of the mountain plants, made him a prime mover in the formation of the Swiss Nature Protection Society.

Alphonse de Candolle persuaded Correvon to learn English, and for some years he acted as a correspondent of the *Garden*. In 1886 he visited England and wrote enthusiastically about some of the gardens he saw, and spoke with admiration particularly of the cultivation of the terrestrial orchids by various British horticulturists. This group of plants was particularly dear to him and led to his publication of a little book in 1893 on "Les Orchidées rustiques", followed in 1899 by his "Album des Orchidées", of which a second edition has appeared. His publications were, however, not limited to orchids. They included books on trees, ferns, flowers of fields and forests, water and marsh plants. His book on "Rock Garden and Alpine Plants", translated from the French edition, was published in New York. His "Alpine Flora", with its wonderfully artistic representations of the plants described, appeared in an English translation in London.

Correvon was an indefatigable worker and an excellent lecturer. Ten years ago, at the age of seventy-three years, he undertook a visit to the United States, where he gave some forty lectures and addresses in English to promote the interest in alpine gardens. He was an honorary member and correspondent of many horticultural societies and was awarded an honorary doctorate of the University of Geneva in 1931.

He retained his full powers of body and mind until the end, and his beloved garden at Chêne-Bourg is assured of its continuity in the hands of his son and his grandson, both trained gardeners and possessing Henry Correvon's devotion to alpine plants.

Sir Frederick Hobday, C.M.G.

THE veterinary profession has lost a pioneer of
bility with the passing of Sir Frederick Thomas
eorge Hobday at the age of sixty-nine years on
une 24.

Hobday graduated at the Royal Veterinary College
1892. His early contributions to veterinary science
ere on the applied side. He was responsible for the
iore general use of anaesthesia in veterinary surgery,
nd decreased the hazard of volatile narcosis by
eans of inhalers, which he designed to control the
pth of anaesthesia. In addition he developed
ethods of abdominal surgery in large animals, and
ccessfully applied the Williams technique for the
lief of roaring in horses.

Sir Frederick's real scientific achievements cannot
judged by his publications, but rather by his
tive and successful efforts in creating research
ilities at the Royal Veterinary College, and in
nging the medical and veterinary branches of
dicine into more intimate contact by the formation
the Section of Comparative Medicine in the Royal
iety of Medicine. He was the first veterinary
sident of this section (1924–26).

n 1927, Sir Frederick was made principal of the
yal Veterinary College. He took over a college
buildings of which were in danger of collapse
the financial position of which could not have
n worse. His enthusiasm enabled him to raise
voluntary subscription the sum of £135,000. This,
ther with a Treasury grant of £150,000, made it
ible for him to realize his ambition of rebuilding
College. The new main block, housing the long-
led research and teaching facilities, was formally
ed in 1937 by the King and Queen.

his ten years of strenuous endeavour drained
day's strength, and the unexpected termination of
rincipalship in 1936 came as a heavy blow both
n and to his many friends, though formal resigna-
was delayed until the opening ceremony. His
efforts, however, had received recognition by
conferment of knighthood in 1933. He was hono
Veterinary Surgeon to Queen Alexandra,
George V, King Edward VIII and King George

The Royal Veterinary College in London st
as a monument which will always be associated
his name, and those working there will be remi
that it was due to his unremitting energy that
excellent facilities are available.

J. YULE BOGU

Dr. W. H. Neale

DR. WILLIAM HENRY NEALE died on June 1
his eighty-third year. He was born in Batavia, w
his father, Dr. Richard Neale, was then in prac
He came to England as a boy and attended a pri
school at Hampstead. He studied medicine at Ki
College and University College, London, and
the degree of M.B. in 1879, proceeding to M.D. in 1

In 1880 Dr. Neale joined Mr. B. Leigh Smit
surgeon and naturalist on a sporting and explo
voyage in the steam yacht *Eira* to the then alr
unknown coast of Franz Josef Land, where discove
of considerable geographical importance were m
In 1881 Dr. Neale returned with Mr. Leigh S
in the *Eira* on a more ambitious summer expedi
to the same region, where the yacht was caugh
the ice-floes and sunk close to Cape Flora.

The disaster was so sudden that very little c
be saved from the wreck and the only hope of re
was in the power of the ship's company to
themselves. A hut large enough to house the twe
five men was built and Mr. Leigh Smith's skill
hunter secured an adequate supply of walrus
bear meat. Dr. Neale had charge of the rationin
the food so as to preserve the health of the
such tinned provisions as had been saved being
for the homeward boat voyage. He was trouble
the prospect of an outbreak of scurvy in the abs
of lime-juice, in which the British sailor
learned to trust as the only preventive. He fo
however, that the fresh meat diet was in fact
best possible antiscorbutic, and on his return he d
with the etiology of scurvy in several communicat
to the medical press, and he must be viewed as
of the first to recognize the value of fresh mea
a preventive.

The winter of 1881–82 was passed safely tho
the temperature sank to − 40°. When the
began to break up at the end of June a start
made to the south in four small open boats. T
were hardships in plenty and a baffling journe
more than 500 miles to be made through the shif
leads of the icefloes and in the open sea. After
weeks, the relief ship *Hope* was met on the c
of Novaya Zemlya, and the whole party were stil
sound health in spite of the trying experience.

Dr. Neale studied the natural history of the C
Flora region and described his collections in
Proceedings of the Zoological Society. He becan
valued fellow of the Royal Geographical Society
frequently spoke after polar papers.

For more than half a century, Dr. Neale lived as a general practitioner in the St. John's Wood district, endearing himself to an increasing circle of friends by his skill, devotion to duty and trust-begetting kindness.

HUGH ROBERT MILL.

WE regret to announce the following deaths:

Prof. H. H. Barnum, head of the Department of Mathematics in Robert College, Istanbul, aged sixty-one years.

Dr. W. A. Potts, a pioneer in the psychology of crime, on July 23, aged seventy-three years.

Prof. E. R. A. Seligman, McVickar professor of political economy and finance in Columbia University during 1904–31 and editor of the "Encyclopædia of Social Sciences", aged seventy-eight years.

Mr. J. M. Wood, formerly engineer of the New River Company and of the northern district of the Metropolitan Water Board, on July 21, aged eighty years.

Prof. Archibald Young, regius professor of surgery in the University of Glasgow, on July 23, aged sixty-five years.

NEWS AND VIEWS

Dr. Wilson Smith

DR. WILSON SMITH, who has just been appointed to the chair of bacteriology in the University of Sheffield, graduated in medicine at the University of Manchester in 1923, after War service in France and Belgium with a field ambulance during 1916–19. He obtained the diploma in bacteriology at Manchester in 1927 and was granted the M.D. degree in 1929. For the last ten years he has been a member of the scientific staff of the Medical Research Council and during this period he has made many valuable contributions to knowledge on bacteriological problems—such as the standardization and assay of pneumococcus antisera—and also on various virus diseases. Perhaps the most important of these latter contributions are the facts regarding the virus of epidemic influenza. As a member of a team, he was one of the discoverers of this virus and he helped to lay down criteria for its recognition; he did much of the pioneer work which has led to a renewed and intensive investigation of influenza throughout the world. Since 1934 he has been one of the editors of the *British Journal of Experimental Pathology*.

Mr. Hugh Main

THE council of the British Empire Naturalists' Association has elected Mr. Hugh Main as new national president in succession to Mr. Douglas English, who recently retired owing to ill-health. The presidency of the Association is not an annual affair and the choice of Mr. Hugh Main will meet with wide acclamation, for he is well known for his interest in nature photography and his insect studies. He spends much time in his private photographic studio at Woodford Wells in Essex, or in collecting insect specimens. He has long been a vice-president of the Association, and when the new Epping Forest Branch of the Association was formed, Mr. Main was elected its first president. He has made conspicuous contributions to nature photography and he has also been an active man in the field as well as on the lecture platform. He has also made some noteworthy experiments with his insectarium. Mr. Main has long been a keen and enthusiastic worker for the Association and has done much in various ways to promote its welfare. He is the Association's referee for beetles. The British Empire Naturalists Association now has twenty-four local branches each with separate meetings and officers, and thirty-five other natural history societies are affiliated to it.

Public Health and the Supply of Medicaments

THE address of Mr. J. Rutherford Hill, as chairman of the Pharmaceutical Conference, which met at Birmingham on July 17–21, was entitled "Public Health in relation to the Recognition, Definition, Standardisation and Controlled Supply of Medicaments", and he makes recommendations under all these heads. Lists of recognized drugs are supplied by the national pharmacopœias of many countries; it is hoped that these will eventually be replaced by an international pharmacopœia, but this would not solve the whole problem. Medicine is advancing rapidly and pharmacopœias soon get out of date. Some authority in Great Britain should publish a list, like the American list of New and Non-Official Remedies, which would be kept constantly up to date. The British Medical Association and the Pharmaceutical Society of Great Britain have recently been forced by considerations of cost to abandon the proposal to publish such a list jointly. The Government should undertake this important public service. Proper regulations for the definition of medicines would make it impossible for the manufacturers to confuse the public, and fill up the shelves in pharmacies, by selling the same simple chemical substance under a dozen synonyms. Mr. Hill also recommends that the present arrangements for the standardization of medicines should be extended, and that their retail sale should be confined to pharmacists. This would not mean a monopoly for one class of the community, but only that those firms which sell medicines should be compelled to employ salesmen who have been properly trained.

Marking of Patent Medicines

WHEN the question of withdrawing Medicine Stamp Duties was debated recently in the House of Commons, it was clear that there was a general feeling that proprietary medicines should not be freed from all restrictions, but should be subjected to effective control. Some of them are fraudulent, their advertisements encourage healthy people to think they are ill, and unhealthy people to postpone taking medical advice until it is too late, and some of them are poisons. The recent passing of effective legislation in the United States was largely due to the fact that seventy-three people were killed by an elixir containing diethylene glycol, just at the time when the matter was being debated in Congress. It would be unfortunate if another such accident were to occur in Great Britain before effective measures were introduced. Reforms of various kinds are being widely discussed. Prof. A. J. Clark, in a little tract published last year under the title "Patent Medicines" said: "The clearest line for the Government to take would be to say that it did not wish to tax any remedy that was beneficial to the health of the people, and wished to suppress all those that were useless and harmful." This would imply regulations such as those now enacted in the United States, where new remedies can only be sold when they have been officially approved. Lord Horder, in his speech in the House of Lords, stressed the harm that is done by misleading advertisements and recommended that measures for the control of quack medicines should form part of the campaign for national fitness.

Organization for War Emergency

EXTENSIVE preparations are in progress to meet a possible war emergency, not only in regard to defence, but also in other directions. On the medical side, the Ministry of Health has issued a "Statement Relating to the Emergency Hospital Organisation, First Aid Posts and Ambulances" (London: H.M. Stationery Office. 4*d.* net). This sets out, in the first place, emergency hospital requirements and organization, schemes for dealing with casualties and ambulance services. A summary is then given of supplies that are being provided. These include 200,000 beds with mattresses, 320,000 blankets, with a corresponding sufficiency of sheets, pillows, pillowslips and towels, and 226,000 stretchers with 400,000 coloured blankets. In addition, drugs and dressings to the value of £237,000 are on order, as well as surgical equipment and appliances sufficient for 75,000 casualty beds. On the food side, the Government has advised all who can to lay in a week's store of emergency food. In order to translate the Government's advice into practical terms, the British Medical Association has issued a booklet, which should be in the hands of every householder ("How to Stock your A.R.P. Larder". 2*d.*). This gives advice on the stores that should be purchased in order to provide a week's food supply for a family of five. The approximate cost of the articles suggested is given, together with hints for storage and use, a few sample recipes for one dinner, and the food values of the rations mentioned.

Nutrition and the Public Health

THE proceedings of one of the most useful conferences of recent years—the National Conference on the Wider Aspects of Nutrition organized by the British Medical Association and held in London at the end of April—have recently been published under the title "Nutrition and the Public Health" (B.M.A. House, W.C.1. Pp. 150. 2*s.* 6*d.* post paid). This conference, a report of which appeared in NATURE of May 6, p. 745, brought together representatives of medicine, agriculture, industry, administration and education to discuss in a comprehensive way the relation of human nutrition to the national welfare. It urged upon the Government the formulation of a long-term food policy in which the requirements of health, agriculture and industry should be considered in mutual relation, and recommended the inauguration of an educational campaign to make such a policy effective. The Conference ranged over a wide field, but as the published proceedings clearly indicate, there was the thread of the urgent need for an active, informed Government policy, which should take as its main objective the abolition of malnutrition, running through every discussion. The common benefit to the health of the individual citizen, to the prosperity of the home farmer (who would be largely responsible for the perishable 'protective' foods so essential to such a scheme) and to the efficiency of industry of such a policy forms the triple basis of what is undoubtedly one of the clearest and most influential appeals yet made for the early application of modern nutritional knowledge to national well-being.

Teachers on Modern Education

THE addresses delivered at sectional meetings arranged in connexion with the recent annual conference at Llandudno of the National Union of Teachers (Hamilton House, Mabledon Place, London, W.C.1) have been issued as a bound pamphlet. They include one by Mr. Kenneth M. Lindsay on the development of our educational system, in which he suggests that a commission is required on the whole financial relation between central and local government if the implications of the Spens Report are to be carried out. He also stresses the need for developing technical education, including the provision of improved premises and closer co-operation between technical education and industry and commerce. Emphasizing the importance of adult education, he pointed out the need for an effective survey of this field. Dr. C. F. Strong's address on the teaching of citizenship in central schools refers to the importance of including the civic aspects of science in a science syllabus, and urges the importance of history as laying the foundation for the teaching of citizenship and dispassionate thinking about political questions. Mr. E. R. J. Hussey's paper on aspects of education considered as a preparation for life in the modern world also emphasizes the importance of science, especially biology, from this point of view as well as the importance of character training and the formulation of ideals and a sense of values. Dr. G. H.

Green's address on the cinema and handicraft training directs attention to the need for investigation in the technique of using the film in schools.

The Hebrew University, Jerusalem

The Hebrew University, on the heights of Scopus in Jerusalem, is developing fast and well. Begun in 1923 with a Chemistry Research Institute, it is to-day a centre of research and instruction, with faculties in the main branches of learning, an academic staff, including research workers, of 125, and a students roll, under- and post-graduate, of 850. More than 30 per cent are women. Hebrew is the language of instruction. In some Departments are men pre-eminent in their own academic field. Prof. Bernhard Zondek, professor of gynæcology, is in charge of the Hormone Research Laboratory which is now attached to the new Medical Centre opened in May of this year. Prof. S. Adler, head of the Microbiology Department, has already achieved an international reputation for his pioneer work on tropical diseases transmitted by parasites, and has undertaken several expeditions on behalf of the Royal Society. Prof. A. E. Fraenkel, formerly of the Universities of Marburg and Kiel, is one of the professors in the Mathematics Department, with mathematical philosophy and foundations of theory of sets and of analysis as his special field. The Archæological Department, under Prof. L. A. Mayer, works in close association with the Department of Classics.

Two new faculties have been added this year, a medical faculty—it was formerly only a pre-faculty—and agriculture. The new professor of agriculture is Prof. E. Volcani, director of the Experimental Research Station at Rehovoth. The Hebrew University has played its part in enabling academic refugees to continue their work. Already nearly fifty exiled German scholars have been found positions at the University. These include Prof. H. Torczyner, the interpreter of the Lakhish Letters, Prof. J. Guttman, the authority on Jewish medieval philosophy, Prof. Martin Buber, the social philosopher, Prof. B. Zondek, the gynæcologist, Prof. Halberstadt, the radiologist, and the brothers Adelbert and Ladislaus Farkas, who are directing the Department of Physical Chemistry. The work already done gives promise that perhaps in the not-distant future Jerusalem will once again become the centre of learning in the Near and Middle East.

University and Professional Standards in the U.S.A.

The formulation of standards in respect of such matters as entrance and graduation requirements, staff, equipment and financial resources, and the accrediting of educational institutions with reference to them, are undertaken in the United States by voluntary national and regional associations and by State universities and departments of education. Lists of accredited institutions are published from time to time and the situation is reviewed by the United States Office of Education once in every four years. Bulletin No. 16, "Accredited Higher Institutions, 1938" (Supt. of Documents, Washington, D.C., pp. 212; 20 cents) brings together the latest available lists and standards of both voluntary and State accrediting agencies. The most noteworthy development of the past few years is the drawing up by the Engineers' Council for Professional Development of a statement of principles (reproduced in the Bulletin) for accrediting engineering curricula with the object of improving the status of the engineering profession. Other national associations have published lists of accredited professional and technical schools of law, theology, medicine, pharmacy, osteopathy, optometry, music, architecture, business, librarianship, journalism, forestry, social work and teaching. A National League of Nursing Education is conducting a survey with the intention of issuing a list of accredited schools on its completion. Of the university accrediting agencies, the chief and most exclusive is the Association of American Universities, which regards as the principal ground for the inclusion of a college in its approved list, evidence of success "in stimulating scholarly interest in its students and in preparing them for more advanced scholarly endeavour".

The Carnegie United Kingdom Trust

Twenty-five years have elapsed since Mr. Carnegie founded, with a capital of ten million dollars, his Trust "for the improvement of the well-being of the masses of the people of Great Britain and Ireland", and the Trustees preface their report for the year 1938 with a brief retrospect, in the course of which the allocation of their revenues since the Trust's foundation is summarized under the headings: libraries £1,393,000, physical welfare and playing fields and play centres £471,300, rural development and social service (including land settlement) £541,800, organs and other musical and dramatic activities £330,500, adult education £66,600, other activities £339,500. In pursuance of Mr. Carnegie's injunction to remember "that new needs are constantly arising as the masses advance" the Trustees aim at fulfilling the role of a pioneer body, financing no enterprise for more than a limited period, during which its sponsors are expected to contrive means for maintaining it, should its continuance appear expedient, without further recourse to the Trust. This principle plays a decisive part in the framing of the programmes of constructive experimental work which are drawn up by the Trustees once in five years and which pre-determine the bulk of the expenditure of each year's budget.

The current programme covers activities classified as: (*a*) cultural and æsthetic developments, including libraries, museums, music and drama, adult education; (*b*) social services, in many of which the National Council of Social Service collaborates, including village halls, community councils, shows and exhibitions, university settlements, village colleges, women's institutes, Zoological Society's films, national parks, youth services, etc.; and (*c*) land settlement. One of the notable events of the year was the publication of a report in furtherance of the policy inaugurated ten years ago for developing the educational function of museums of the British

Isles. The report, based on a two years survey by Mr. S. F. Markham, is accompanied by a short non-technical pamphlet, "Museums and the Public" for the use of museum committees.

Mycenean Athens

The discovery at Athens of a chamber-tomb of Mycenean age, which presumably had served for a royal burial, corroborates tradition, but at the same time necessitates a new orientation in assessing the importance of the settlement of Attica in early pre-classical times. The chamber was brought to light in the course of the present—the ninth—season of excavation on the Acropolis by the American School of Classical Studies. In a preliminary account of the discovery (*Illustrated London News*, July 22), Prof. T. L. Shear of Princeton University, field-director of the excavation, states that the tomb is situated in shallow accumulations of deposit on the northern slope of the Acropolis. It consists of a rectangular chamber, filled with splintered rock and approached by a dromos, or passage, some 45 ft. in length, but which originally may have been longer, as the outer end is cut by the Roman wall. The earth-filling of this passage contained a number of Mycenean pot-herds. Both passage and burial chamber had been cut from the rock; and the entrance to the chamber rom the passage is through a rock-cut doorway. This doorway was closed by carefully packed stones, which clearly had not been disturbed since they were placed n position.

Inside the chamber on one of the rock-cut enches, which run along each side, were six vases nd a cylindrical ivory box in their original position. he vases had been crushed by the collapse of the oof, but the ivory box, which is described as "a asterpiece of artistic design and of technical execuon", was intact. East of the doorway were two large ses standing on the floor by a copper ladle. The ave was cut in the rock to a depth of four feet. had been covered by a stone slab; but this had en removed, and lay diagonally by the grave. either bones nor offerings were found in the grave, though there was one small disk of gold in the earth d stones which filled the grave. On the floor beside e slab lay a group of small toilet articles—a bronze rror, a small ivory box, and ivory pins; and th of the grave, also on the floor, were three piles gold ornaments. The pottery is of a single period d is characteristically Mycenean in form and coration. Exact parallels can be found in Mycenean ttery from the Argive Heraeum and elsewhere longing to the third Late Helladic period of the t half of the fourteenth century B.C. The state in ich the tomb was found and the character of the rings lead Prof. Shear to the conclusion that this the burial place of a lady, probably belonging to royal house of Erechtheus, the legendary king of hens, whose body was removed when the roof of chamber collapsed; while the wealth of the rings—overlooked when the body was removed—es rise to a completely different conception of the gdom of Erechtheus in the fourteenth century B.C. from that conveyed by the fragmentary remains the walls of his palace, which have been discove on the Acropolis, and the unimportant part pla by Athens in the Trojan War five generations la as recorded in the Homeric poems.

Industry and Agriculture in Belgium

In a pamphlet on the National Foundation Scientific Research and Industry, the contribution this body to industry and agriculture in Belgium d ing the last ten years is reviewed by P. Beghin, secretary of the Foundation (Pp. ix + 408. Bruxell Fonds National de la Recherche scientifique). Si the Foundation gave its first grant in July 1928, persons have received grants, 75 of whom are s receiving them, while 35 fresh grants are made ea year. In subsidies of all kinds, 25,000,000 francs been distributed amongst 1,350 research worke The annual budget of the Department of Industr Science of the Foundation is limited to 1,000, francs. Taken by industries, the distribution research effort is concentrated mainly in agricult and horticulture (1,532,460 francs), metallur (1,299,000 francs), electrical engineering (1,209,4 francs), out of a total of 7,166,810 francs, chemist coming next with 730,750 francs and civil engineeri with 630,100 francs. The report includes more or l detailed accounts of work in progress in metallur welding, the thermodynamics of heavy-oil moto electrical apparatus, including incandescent elect lamps, radio reception, civil engineering, includi the action of wind on buildings, chemistry, includi synthetic lubricating oils, copal gum, synthe resins for the electrical industry, vulcanization rubber, the charcoal industry, glass industry, ceme industry, optical industry, as well as in agricultu including the disinfection of plants and the cultivati of the beetroot, the brewing industry and the tanni of leather.

British Museum (Natural History): Recent Acquisitio

An interesting acquisition in the Department Zoology is a series of the golden mole, *Eremital granti*, presented by Captain G. C. Shortridge of t Kaffrarian Museum, King William's Town, Sou Africa. The gift comprises seventeen skins and sku of this insectivore, and forms a valuable addition the study collections. Mr. F. N. Ashcroft has p sented to the Department of Mineralogy a furt selection of well-crystallized minerals from for seven carefully recorded localities in Switzerla The Ashcroft collection of Swiss minerals is unrivall in the excellence of the specimens and the care w which the localities have been recorded. This lat gift brings the number of specimens added to t Museum's collection from this source in the last t years to a total of 3,654. Another interesting g comes from the McGregor Museum, Kimberl through Miss M. Wilman, the curator, and consi of three specimens of the doubly refracting Icela spar found in Cape Province, South Africa. collection comprising about 4,900 gatherings plants has been brought back from South Amer by Mr. A. H. G. Alston, assistant keeper in t

Department of Botany. Of these about 1,900 are vascular cryptogams. The collection is rich in duplicates and there are about 20,000 specimens in all. Mr. Alston represented the Museum at the first South American Botanical Assembly at Rio de Janeiro last October, and later made an expedition across the north western corner of the South American continent from La Guayra in Venezuela to Bartacoas in southern Colombia, near the frontier of Ecuador. He studied the phytogeography of the area and collected specimens of the plants found.

Anthropology and Ethnology in Switzerland

The *Bulletin der Schweizerischen Gesellschaft für Anthropologie und Ethnologie*, 1938–39, in addition to the annual report, obituary and other affairs of domestic concern, contains matter of wider interest for anthropologists in a contribution by the editor, Dr. O. Schlaginhaufen, "Untersuchungen uber die Gesichtsform der Schweizer" which was presented to the International Congress of Anthropological and Ethnological Sciences at Copenhagen in August last, and summaries of the anthropological communications to the annual meeting of the Société Helvétique des Sciences Naturelles at Coire, August 28, 1938, from the *Actes* of that Society. Among these, a group of papers by Prof. E. Pittard deals comparatively with various lesser known physical characters of the Bushman and other peoples of South Africa, upon which the author's promised further interpretations will be awaited with considerable interest.

Students of the skeletal remains of man may be directed particularly to the study by Dr. Albert L. Périer of a remarkable postmortem deformation of the mandible in six out of a collection of twelve Griqua skulls. In these six specimens, the bicondylar diameter of the mandible is by so far less than the corresponding basio-cranial diameter that it is impossible to articulate the jaw to the skull; and indeed, if it were not for the correspondence of other characters, it would be difficult to believe that their attribution to these crania is correct. In three of the skulls the discrepancy in diameter is ten millimetres or more. It is to be noted that the bone of the jaw is exceptionally thick, and the shrinkage absolutely symmetrical. No acceptable explanation of the change presents itself, especially as no other example is found in one hundred and fifty South African skulls in the collection to which the Griqua skulls belong. The author points the moral that caution must be exercised in drawing conclusions from isolated specimens in human palæontology.

Tests of Materials

Numbers 726 and 727 of Hermann's "Actualités scientifique et industrielle" (Paris) deal with tests of materials and are entitled "La Structure et la Déformation des Solides" and "Essais des Métaux", respectively, the former of fifty pages (18 francs), the latter of seventy pages (25 francs), both well illustrated. They are written by M. R. L'Hermite, assistant director of the Laboratory for Buildings and Public Works, Paris, and represent his lectures delivered at the Laboratory in 1937 and 1938. He emphasizes the influence of the fine structure of materials on their elastic properties and devotes half the first volume to microscopic and X-ray methods and their results. In the section on the deformations produced by applied forces he makes use of the Mohr-Caquot diagrams and theory, and ascribes deviations of experimental results from the theory to want of isotropy. In the second volume many of the newer forms of machines for testing metals under tension, compression, shear, bending and shock are described, as well as methods of testing hardness, wear and fatigue. The principal results obtained are given and are related to the Mohr theory.

Bibliography of Seismology

This bibliography, by E. A. Hodgson, published by the Dominion Observatory, Ottawa, for the period October–December 1938 has just been received. It contains 120 items from fourteen collaborators residing in eight countries, and it is noticeable that the United States and Holland are well represented and that Spain has a collaborator. Italy, the Balkan States, the U.S.S.R. and South America are this time not represented although it is known that seismological work is being done in all these places. One of the more recently studied branches of the subject is well illustrated by a paper by A. Belluigi ("Seismisch-electrische Wirkungen und neu mogliche seismische Anwendungen", *Bei. Angew. Geoph.*, 7, Heft 3, 260–264, bib., Leipzig, 1938). It concerns the new seismic-electric effect pointed out by American authors, and the author suggests that its probable cause consists in electrochemical alterations produced by elastic waves as Thyssen, Hummel and Rülke have demonstrated. It is further suggested that new electro-elastic seismometers be planned, as these should afford advantages over the present seismometers in exactness of reproduction of impulses, owing to the absence of inertia masses, and they should measure at the same time the electrical resistivity. Following the bibliography is a very valuable double index for the whole year, arranged first by subjects and then by names

Journal of the Royal Agricultural Society

The *Journal of the Royal Agricultural Society of England* has reached its hundredth volume, and with this issue certain changes of format are being made. In place of the single annual volume, a periodical appearing three times a year is to be published. The first part, issued in June, consists mainly of the usual reviews of agricultural research under the familiar title, "The Farmer's Guide", but also includes the annual financial statement. Part 2 will appear in November and will contain a number of contributed articles and the various reports on the Show. Part 3 will be published in March and will also contain a number of contributed articles, the report of the Council to the annual general meeting, the annual reviews of agricultural law and agricultural statistics, and the annual report of the Society's scientific officers and of its research committees. Each part will include a summary of the proceedings of the Council at its meetings in the previous two or three months and will be separately indexed. The June issue for 1939 (100, Part 1) is now available and can be obtained from the Society, 16 Bedford Square, W.C.1, price 5*s*.

The Grid System

THE Association of Engineering and Shipbuilding Draughtsmen publishes (Draughtsman Publishing Co., Ltd., 96 St. George's Square, London, S.W.1) a series of pamphlets containing much useful information. A recent issue, entitled "The Grid System", contains a historical survey of electricity supply in Great Britain from the formation of the Edison Light Co. in London in 1881, through the troublous years when various Acts of Parliament were passed which in some cases hampered the industry; the first contracts for the 'grid-iron' or grid system were placed in the year 1928, and this was followed by the growth in the space of six years of 4,000 miles of transmission lines and the placing of 26,000 steel pylons. The advantages of standardizing frequency are discussed and the systems adopted for grid tariffs and trading. Much of the information is not readily obtainable elsewhere. A list is included of A.E.S.D. printed pamphlets and other publications written specially for engineering and shipbuilding draughtsmen.

Dutch Colonial Institute

THE "Acht en Twintigste Jaarverslag van het Koloniaal Instituut" gives a brief account of the work of the Dutch Colonial Institute at Amsterdam during the year 1938. Its activities have included public lectures, courses of instruction in tropical hygiene, researches on tropical diseases such as yellow fever and psittacosis, studies in mosquito control and the chemical examination of more than four thousand samples. The valuable work recorded in this year-book gives ample evidence that the Dutch Colonial Institute continues actively to serve the interests of Holland and its oversea possessions

The Scientific Films Committee

ABOUT two years ago the Association of Scientific Workers set up a Scientific Films Committee, to act as a clearing-house of information on scientific films. During this time it has seen and appraised some 150 films, and has produced a graded list of these films with particulars of length, availability, subject-matter, distributor, etc. This list is available to anyone interested at a cost of 1*s*. If desired, the Committee will undertake, for a small charge, to choose a programme to suit any particular requirements. In addition, the Committee has compiled an index of scientific and film experts willing to be put in touch with people requiring advice on the making of films. Full particulars of the services offered can be obtained from the Secretary, Scientific Films Committee, 30 Bedford Row, London, W.C.1.

Apparatus for the Physical Laboratory

THE twenty-fifth edition of the catalogue of physical laboratory apparatus and equipment recently issued by Messrs. W. and J. George, Ltd., proprietors of F. E. Becker and Co., London and Birmingham, is an impressive volume of 824 pages. The contents cover the whole of the equipment needed for the teaching of physics in all types of educational institution from elementary school to university. For convenience of reference, the catalogue is classified into thirteen sections within which the items are arranged in the usual text-book order of treatment of the subject. Physics is divided into ten sections. The remaining three deal with laboratory fittings, equipment and materials, with lantern slides, ciné films and with text-books. Out-of-date items have been entirely replaced by new apparatus, and the designs of many standard instruments have been improved. In addition to the well-known series of Nivoc products made by Messrs. George, other British and foreign items are included so that every normal requirement in physics teaching is to be found within the covers. But it is more than a mere catalogue. Each item dealing with less well-known apparatus has a brief description of the method of use, together with the necessary theory, supplemented in some of the entries by typical numerical results obtained with the apparatus in the laboratory. Some of these descriptions cover a page or two. The specially drawn illustrations are very clear and project well in the epidiascope. Altogether the catalogue, with its detailed index, corner page headings and numerous cross-references, makes a noteworthy addition to the library of any educational or industrial physics laboratory.

Book Reviews

SIDE by side with the increase in numbers of scientific papers which has been referred to repeatedly in this journal in recent years, there has been a steady if smaller growth of scientific and technical text-books, monographs and other books of interest to readers of NATURE, and the task of presenting to the scientific reader a reasoned survey of such literature has become increasingly difficult in the limited space available. Following the customary practice, longer notices of books have been printed under appropriate titles, while shorter notices have been brought together without a special heading; in addition, a classified list of recent scientific and technical books, whether received for notice in NATURE or not, is printed every month as a supplement to the journal. In the present issue, the shorter notices, which used to appear in the body of the journal immediately after the longer reviews, have been placed in the supplement with the books list. By publishing these shorter notices once a month in this way, it is possible to arrange them according to subject and it is also hoped to increase the total amount of space given to such notices. For the convenience of those who wish to bring the books lists together when binding up a volume, the list

(*Continued on page 199*).

NATURE

SUPPLEMENT

Vol. 144 SATURDAY, JULY 29, 1939 No. 3639

SHORT REVIEWS

BIOLOGY

Everyday Biology:
an Introduction to the Study of Life. By Dr. G. Pugh Smith. Pp. xii+283. (London: G. Bell and Sons, Ltd., 1939.) 3*s.* 6*d.*

HERE is a very useful and readable introduction to biology written for young beginners who need a general survey of the subject prior to going into it more deeply for the School Certificate examination. The author has taken the point of view—unfortunately all too rare among authors and teachers of biology—that the subject should relate itself to life and thus teach the reader something about himself. Again, the author takes the refreshing course of opening up with a general review of the plant and animal kingdoms. So many biologies begin with a germinating seed or the detailed study of a plant, which more often bewilders rather than captivates the young beginner. To begin with a general survey of what is already known (at any rate, in part) is undoubtedly the best means of approaching a difficult subject.

The author has broken new ground, even in many of his illustrations, though here he is not so successful. Many are novel and look well, but they teach little. For example, the skeleton is illustrated by three photographs. One is of the "Transparent Woman", which, according to the legend, shows the "skeleton, organs and blood vessels and their relationship to each other". The actual model does this, of course; but the very much reduced photograph shows very little. The other two illustrations are X-ray photographs which will certainly intrigue the young beginner, but will tell him little of the actual anatomy of the skeleton. In the next edition, these photographs should be accompanied by a line drawing. Another excellent, though scarcely helpful, illustration is the photograph of the head of an earthworm which, without the help of the legend, would puzzle many a trained biologist.

In the second edition, the author would be well advised to reconsider certain of the illustrations (so important to any work on biology), and then it would be difficult to better this book for the standard for which it is intended.

Medical Entomology
A Survey of Insects and Allied Forms which Affect the Health of Man and Animals. By Dr. William A. Riley and Dr. Oskar A. Johannsen. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xiii+483. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 25*s.*

WE welcome the appearance of a second edition of this text-book. After an interval of six years much new knowledge has accumulated while older theories and facts have undergone modification. While only seven additional pages are incorporated in this volume, careful reading will show that the revision has been adequate and conscientious. Thus, the account of Latrodectus (or the 'black widow' spider) has been brought well up to date with new illustrations. The role of Phlebotomus in relation to the transmission of kala azar is well discussed, and the conclusion is reached that the insect-vector theory of the transmission of this disease is not borne out as being a major factor in the process.

In the account of mosquitoes an adequate statement of recent work on the biological and other races of these insects seems to be an omission of importance. In dealing with dipterous larvæ as agents in the treatment of osteomyelitis, reference is made to the newest aspect of this method. This involves the use of sterile larval extracts and the isolation therefrom of allantoin or the urea split off during allantoin treatment. In this way a definite advance seems to have been made in overcoming the repulsion aroused by the application of living larvæ to wounds.

In connexion with yellow fever a guarded account is given and a not too optimistic view taken as to its entire elimination from the American continent, owing to the prevalence of the disease in an endemic jungle form. In the great forests of Africa and South America, monkeys and maybe other non-human reservoirs have to be contended with, while various little-suspected species of mosquitoes are probable vectors. At the end of the book there is a supplementary list of literature which brings this aspect of the subject reasonably up to date.

Études et recherches sur les phytohormones

Première réunion organisée en collaboration avec l'Union Internationale des Sciences biologiques, Paris, 1 et 2 octobre 1937. Pp. xiv+126. (Paris: Institut International de Coopération Intellectuelle, 1938.) 35 francs.

IN spite of the great interest in the phytohormones which has been aroused in recent years, their mode of operation and full significance are still far from being fully understood. In the hope of clearing up some of the problems concerning them, and in order to discuss them generally, an international conference of experts who have specialized in the study of phytohomones was held at Paris in 1937. The conference was under the auspices of the International Union of Biological Sciences in collaboration with the International Institute for Intellectual Co-operation. Papers were read by each of the following: Prof. M. J. Sirks (introduction); Prof. F. Kögl (chemistry of phytohormones and other plant growth substances); Prof. Niels Nielsen (phytohormones in different groups of plants); Prof. V. J. Koningsberger (phytohormones and metabolism); Prof. G. S. Avery, jun. (the concept of phytohormones and their relationship to plant irritants); Prof. R. Bouillene (the action of phytohormones on growth, cell division and the genesis of organs); Prof. R. Boysen Jensen (phytohormones and plant movements); Mlle. C. Zollikofer (the influence of animal hormones on plants); Prof. R. Dostal (correlations and phytohormones). The report under review contains each of these papers in full, with an account of the discussions which followed. It is worthy of careful study by all those who are interested in this aspect of plant physiology.

C. R. M.

Methodik der Hormonforschung

Von Dr. Christian Bomskov. Band 2: Ovar (Follikehormone, Gelbkörperhormon), Hoden, Hypophysenvorderlappen. Pp. xxix+1016. (Leipzig: Georg Thieme, 1939.) 89 gold marks.

THE second volume of Bomskov's work on the methods used in research on hormones deals with the sex glands and the anterior lobe of the pituitary. A third volume dealing with the posterior lobe of the pituitary, the anti-pernicious anæmia factor and vasodilator substances is in preparation. This second volume has been produced in a year and a half, and it is easy to believe the author when he says in his preface that it has meant a great sacrifice of personal freedom. The book sets out to describe all the surgical, histological, biological and chemical methods used in the study of hormones. The details are usually given in the form of a direct translation from the original description, so that it is often unnecessary to refer to the original work. There are about 3,000 references, 274 beautifully reproduced figures and 276 tables.

This book will be an invaluable source of information to all workers in this field. It can be criticized on the ground that it contains too many facts. The full description of a number of different ways of doing the same thing necessarily involves a certain amount of repetition but increases the usefulness of the book. The writings of Dr. Bomskov have covered a very wide field (he has written a similar book on vitamins) and it is natural that those whose expert knowledge is deeper, but narrower, should find matter for criticism. Such general reviews do for scientific workers, however, what Baedeker has done for tourists: the traveller finds them very useful, and the settler prefers other sources of information, so long as he is in his own small field.

A Textbook of Pharmacognosy

By T. C. Denston. Third edition. Pp. xvi+583. (London: Sir Isaac Pitman and Sons, Ltd., 1939.) 20*s*. net.

THIS text-book is primarily intended for the use of students preparing for the chemist and druggist qualifying examination of the Pharmaceutical Society of Great Britain. The subject-matter covers the syllabus for this examination, and is arranged in a systematized, concise manner so that the student can readily grasp it. The drugs dealt with are classified according to their morphological nature under barks, roots, seeds, fruits, etc. This enables the student to compare and contrast similar morphological structures by their macroscopic characters. Microscopy is limited, so as to fulfil the above examination requirements, to starches, calcium oxalate crystals, epidermal trichomes, hairs and fibres used in surgical dressings, and filtering materials. Attention is given to recent work on the identifying and evaluation of drugs, the use of the ultra-violet lamp, methods of cultivation, collection, stabilization, drying, preservation and the detection of adulteration and of insect invasion. Reasons are given for the standards of purity laid down by the British Pharmacopœia.

The illustrations are numerous and of a high order. The drawings set a standard which students would do well to emulate. Both author and publishers have collaborated to produce a volume of which they may justly be proud, and which can be recommended with confidence to those for whom it is written.

W. O. Howarth.

An Introduction to Vertebrate Anatomy

By Harold Madison Messer. Pp. xvi+406. (New York: The Macmillan Company, 1938.) 16*s*. net.

IT is often profitable to present old knowledge in new ways, and this Prof. Messer has done by rejecting the method of teaching zoology by means of selected types and treating the systems of organs from a comparative point of view. The book is a compilation, and makes no claim to originality of knowledge or treatment. But the author maintains that the 'systemic method' is more satisfactory than the 'type-study method' both in the lecture room and the laboratory. The American student taking a one-year course is taught the comparative embryological, histological and anatomical aspects of each system of organs from cyclostomes to man, without, so far as can be ascertained from the book, studying a system in detail in any one animal or relating that system to the body as a whole. Herein, in the reviewer's opinion, lies the weakness of the method, since the elementary student has no standard or basis for comparison.

The book is well produced and contains some good photographs of stuffed and living animals from museums and zoos. The anatomical figures, however, are of variable quality, many being too small or too faintly drawn, or even so poor as to be misleading. The text, though on the whole well done, is at times inaccurate, perhaps as the result of pushing comparisons too far. A bibliography and glossary are appended.

N. B. Eales.

The Molluscs of South Australia

By Bernard C. Cotton and Frank K. Godfrey. Part 1: The Pelecypoda. (Handbooks of the Flora and Fauna of South Australia.) Pp. 314. (Adelaide: Government Printer, 1938.) 7*s*. 6*d*.

This book is the tenth in the series "Handbooks of the Flora and Fauna of South Australia". It is purely conchological and deals with the Pelecypoda. There is an introductory chapter on distribution and methods of collecting, and an account is given of the structure of a typical bivalve mollusc. Keys are used for tracing specimens to families, genera and species; but these are based on conchological characters only. The descriptive text is illustrated with good figures of the shells.

The object of this series is to provide Australian naturalists with inexpensive but accurate handbooks dealing with the indigenous flora and fauna. Many of the volumes are pioneer efforts, none more so than this one, for although great collectors like Angas, Tate and Verco have made lists or deposited specimens in the South Australian Museum, no comprehensive account of the bivalves has hitherto been published. The work of these two Adelaide city men deserves the highest praise from every naturalist, and we hope that it will inspire the production of a more scientific treatise on the group, for a bivalve without a body is a mere shell.

N. B. Eales.

Population: To-day's Question

By G. F. McCleary. Pp. 222. (London: George Allen and Unwin, Ltd., 1938.) 6*s*. net.

The author, who as former principal medical officer of the National Health Insurance Commission and medical officer of health of two London boroughs had ample opportunities of studying the various problems of population, has given a lively and lucid exposition of this subject in this little work. The historical aspects are first set forth, special attention, of course, being given to the work of Malthus, followed by an account of the modern methods of measuring the growth of the population. The author then discusses the causes of the great increase in population which began in the eighteenth century and continued until about sixty years ago, when a marked decline in the birth-rate began. Finally, the important subject of birth control receives full consideration, including its social, economic and political results.

Chemistry

The Chemical Formulary

A Collection of Valuable, Timely, Practical Commercial Formulæ and Recipes for making Thousands of Products in Many Fields of Industry. Vol. 4. Editor-in-Chief, H. Bennett. Pp. x+632. (London: Chapman and Hall, Ltd., 1939.) 25*s*. net.

To the three volumes of the "Chemical Formulary" there has now been added a fourth, in which are to be found many formulæ and recipes gathered together during the past year by members of a large editorial board. This American assembly of useful compounding information, obtained variously from commercial practice and from patent and general literature, covers a very wide range of products ranging from lipstick to lubricants, from concrete to cold cream, from solutions that entice an oyster open to a method for preparing a sulphuric acid catalyst.

In view of the wide application and use of compounded materials of all kinds, the value of a register such as this needs no emphasis. Intelligently used, it conveys a great deal of interesting information, and while it may not in every conceivable case specify the best possible admixture of ingredients for a particular purpose, it will nevertheless save the experimenter much time by presenting him with a reasonable starting point for his trials. The amateur researcher, endowed with that degree of skill, curiosity, and courage requisite for the purpose, will find much to interest him in the sections devoted to cosmetics, to beverages, liquors and flavours, to photography, and to the farm and garden. Engineers and chemists will find particularly valuable such sections as those on materials of construction, paints, soaps, emulsions, adhesives, and inks. The layman who has no intention of putting any of the recipes to a practical test will discover that with the aid of this book he can spend a profitable hour learning something of the composition and application of materials in everyday use.

A. A. E.

Lehrbuch der chemischen Physik

Von Prof. Arnold Eucken. Zweite vollkommen neubearbeitete Auflage. Band 1: Die korpuskularen Bausteine der Materie. Pp. xix+717. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 40 gold marks.

The new edition of Eucken's "Lehrbuch der chemischen Physik" is to be in two parts, of which this is the first. It deals with corpuscles and radiation, and the treatment is on the whole theoretical and mathematical. Several specialists have co-operated in the preparation of sections, some of which are more detailed and difficult than others. The basis is quantum-mechanical. Since the treatment includes molecules, there is a long account of valency. There are also detailed accounts of various types of spectra. The range of subjects is very large, so that a detailed account of the contents can scarcely be given, but the main object is to provide an account of the modern theories of atomic and molecular structure. The mathematics is, on the whole, of a standard which is within the capacity of an advanced student of physical chemistry, and the book contains a large amount of well-digested information. References to literature are given.

Annual Reports on the Progress of Chemistry for 1938

Vol. 35. Pp. xviii + 447. (London: Chemical Society, 1939.) 13*s*. net.

THE present issue of the "Annual Reports on the Progress of Chemistry", issued by the Chemical Society, contains sections on radioactivity and sub-atomic phenomena, general and physical chemistry, inorganic chemistry, crystallography, organic chemistry, biochemistry, and analytical chemistry. The plan of dealing with selected topics in some detail is adopted and the reports are interesting and valuable. Of the 410 pages of text, more than 100 are devoted to organic chemistry. This seems a very high proportion as compared with the other six parts of the book, and those responsible for the reports might well consider whether a better balance is not desirable. Some 50 pages on general and physical chemistry cannot be said to reflect the great importance of this branch of the subject.

Kurzes Lehrbuch der physikalischen Chemie

Von Prof. Dr. Hermann Ulich. Unter Mitarbeit von Dr. Kurt Cruse. Pp. xvi + 315. (Dresden und Leipzig: Theodor Steinkopff, 1938.) 12 gold marks.

THE distinguishing features of this book are the omission of material which belongs specially to physics and the illustration of the theory by numerical examples. A detailed consideration of the laws of thermodynamics, for example, is replaced by a brief but very clear and instructive discussion of the entropy as a measure of internal disorder, and the formulæ for maximum work and entropy changes are given in a very practical form. The calculations deal with systems of practical interest and are most instructive and helpful. Although the book is short it is in no way superficial or too elementary, and the emphasis is modern throughout. The brief biographical and historical notes add interest to the text. Particular care is taken to include English and American work, and the English names of functions, etc., are given. The bibliography is very well chosen, and for those students who can read German the book cannot fail to be helpful and stimulating.

The Chemical Analysis of Foods and Food Products

By Dr. Morris B. Jacobs. Pp. xxii + 537. (London: Macmillan and Co., Ltd., 1938.) 25*s*. net.

A GOOD book, full of details which the ordinary inquirer is not likely to find in the usual text-books. It should be on the shelves of every public analyst, and will be found of great use for purposes of reference.

Engineering

Testing Television Sets

By J. H. Reyner. Pp. viii + 128 + 12 plates. (London: Chapman and Hall, Ltd., 1938.) 9*s*. 6*d*. net.

THE inauguration of a television service in Great Britain has brought forth a number of text-books, not so much on the theory of the subject as on the very practical question of keeping receivers in effective operation. The complexity in a television receiving set might suggest that the liability to failure is high in comparison with normal broadcasting receivers. The fact is, however, that television sets are much better made, and the anticipated mass-faulting has not matured. The present text-book gives some indication how faults may be chased and put right, but we should not be doing the book justice if we stopped at that, because in illustrating the way in which the elementary parts might misfunction, the author does give much insight into the working of the several parts, so that a technician in a hurry to grasp a formidable subject can get some basic knowledge as well. The text is illustrated with rasters exhibiting typical faults and many clear diagrams.

L. E. C. H.

River Engineering: Principles and Practice

By F. Johnstone-Taylor. Second edition enlarged. Pp. xxii + 119. (London: The Technical Press, Ltd., 1938.) 4*s*. 6*d*. net.

TO deal with a subject such as river engineering within the limits of a small-sized text-book necessarily involves a considerable degree of compression, so that the author has only been able to touch lightly on certain aspects, which might with advantage have been treated at greater length. The explanation of the action of flow at river bends, for example, is rather too superficial to be altogether satisfactory. As a fairly representative outline of the various methods of treatment adopted for the regulation of river channels, the book may serve as a useful introduction to a more detailed study of a difficult science.

B. C.

Medicine

Recent Advances in Chemotherapy

By Dr. G. M. Findlay. Second edition. Pp. x + 523. (London: J. and A. Churchill, Ltd., 1939.) 21*s*.

THE series of books published by Messrs. J. and A. Churchill dealing with recent advances in the medical sciences has served a useful purpose and been deservedly popular, but they vary much in form. Some of them contain full reviews on selected topics, giving a readable and connected account of certain aspects of the science with which they deal; others tend rather to consist of abstracts of all the papers published on the subject in the last ten years, and give the impression of having been printed directly from a card index. The latter method of writing provides more information per page but less pleasure for the reader.

The information available on chemotherapy is fragmentary, though extensive, and few generalizations are possible, and the book under notice suffers from fragmentation and compression. Since the first edition appeared, the discovery of the action of sulphonamide derivatives on bacterial infections has opened up great possibilities and caused the appearance of a spate of literature. A new chapter with more than 150 pages which is devoted to this absorbing topic contains an enormous amount of information and greatly enhances the usefulness of the book.

Books on chemotherapy are few, and this one will be almost indispensable to those working on the subject. It contains a large number of references, many of them to papers written in 1938. It is a pity that several of the chemical formulæ are incorrectly printed.

The Extra Pharmacopoeia

By Martindale. Twenty-first edition. In 2 vols. Vol. 2. Pp. xxxvi+1148. (London: The Pharmaceutical Press, 1938.) 22*s.* 6*d.*

THE "Extra Pharmacopoeia" has been produced by the Pharmaceutical Society since the death of Dr. W. H. Martindale in 1933. The twenty-first edition is the first to be completely produced in this way and it is now completed by the issue of volume 2, which is considerably larger than the last volume 2. This volume contains 330 pages of analytical addenda to volume 1; comprehensive information about proprietary medicines, a new section on the nomenclature of organic compounds which contains information not readily available elsewhere; 70 pages of tests on blood and urine; sections on vitamins, milk, margarine, jam and various other foods; preservatives; 135 pages of clinical notes on various diseases; articles on chemotherapy, radium, X-rays, electrotherapy, and much information about chemical tests of all kinds. The book contains a vast amount of information and numerous references to recent medical literature. It has been brought thoroughly up to date and the revision must have involved much work. It will be useful not only to pharmacists but also to biochemists, medical men and analysts.

Classic Descriptions of Disease

With Biographical Sketches of the Authors. By Prof. Ralph H. Major. Second edition. Pp. xxx+727. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1939.) 27*s.*

THE second edition of this fine volume contains nearly a hundred more pages than the first, which was published in 1932 (see NATURE, 131, 895; 1933). In addition to a general revision, new sections have been added on malaria, containing extracts from the works of Hippocrates, Aristophanes, Varro, Celsus, Pliny the Elder, Martial, A. F. A. King and Ronald Ross, and on yellow fever, to the knowledge of which Mathew Carey, Benjamin Rush, Carlos Finlay and Walter Reed, from whose works several passages have been selected, made such valuable contributions.

MISCELLANY

The Science of Society

An Introduction to Sociology. By Dr. J. Rumney. Pp. 125. (London: Gerald Duckworth and Co., Ltd., 1938.) 3*s.* 6*d.* net.

IN these days, few scientific workers can afford to be indifferent to sociology, whether or not they are convinced as to the possibility of a science of society. Even if they are concerned merely in planning in its narrowest technical sense, planning presupposes some understanding of the structure of society and the intimate interrelation between social life and material techniques, and the inability to realize the importance of a sociological approach lies behind many of the gravest difficulties of our time, such as unemployment, the revolt against democracy, mechanized or commercialized leisure, and blind resentment towards science because the benefits it was expected to bring have either not materialized or largely been missed. In this volume, Dr. Rumney indicates for the general reader not only the content of sociology, but also its possibilities as a practical instrument no less than for theoretical purposes.

The sociologist firmly believes that the scientific study of human affairs will ultimately provide a body of knowledge and principles that will facilitate the control and improvement of social conditions. His first task is to determine the range and structure of human society and of social institutions; the second is to investigate the nature of the interdependence of the structures that function in social life; and the third to establish empirical generalizations, or laws of change and growth in social life, and if possible to interpret them in the light of more ultimate laws. Dr. Rumney does not disguise the difficulties in the methods and technique of social study, and he stresses the importance of objectivity and the elimination of bias, as well as the absurdity of expecting the methods of social science to conform exactly to those of the abstract sciences. This brief account is eminently readable, not only for its avoidance of jargon, but also for the admirable way in which it discusses some of the biological aspects of sociology, such as the absurd racial claims sometimes advanced to-day, and the biology of war. Dr. Rumney gives a clear but brief account of the limitations no less than the opportunities of social study, and his book can be heartily recommended to the scientific worker. R. B.

The Consumer-Buyer and the Market

By Jessie V. Coles. Pp. xviii+596. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 17*s.* 6*d.* net.

UP to the time of the great depression in the United States, the average wage-earner there was more concerned with increasing his money income than his real income. During the depression millions of families were forced, in the attempt to maintain customary standards of living on falling incomes, to search for 100 cents' value in every dollar spent. As a result, there has been a steady growth of interest in the problems of the consumer, and the present volume is a comprehensive study of the difficulties that beset him (or her, as the case may be) in obtaining the desired goods at the lowest price.

The author deals first with the buying habits of the consumer and the structure of the retail market, in which connexion some interesting statistics are given of the comparative costs of marketing commodities by various methods and through various types of shop. Sections on instalment buying and retailers' price policy lead up to the most valuable part of the book, the section on "Market Devices as Aids to Consumer-buyers". After reading this account of the salesmanship, labelling, packaging, guaranteeing, branding and advertising of goods, one is forced to the conclusion that the main purpose of all these 'market devices' is the deception of the consumer. The inadequacy of legislative protection has given rise to such organizations as Consumers' Research, which seeks to provide confidential information on the relative merits of advertised or branded goods. R. W.

A Short History of Science

By Dr. F. Sherwood Taylor. Pp. xiv+320+14 plates. (London and Toronto: William Heinemann, Ltd., n.d.) 8*s.* 6*d.* net.

AN attempt to cover the history of science in some three hundred pages is bound to produce a result which can be criticized from one angle or another. The present book is probably as good an account as is possible in the space. The earlier chapters are of a more general character and will perhaps appeal most to the general reader, but even in the account of the later period, when the material is overwhelming, the author has managed to select with good judgment and to convey the story in a connected fashion. The book is one which should have a wide appeal. The interesting illustrations require special praise.

PHILOSOPHY

On Understanding Physics

By Prof. W. H. Watson. Pp. xii+146. (Cambridge: At the University Press, 1938.) 7*s.* 6*d.* net.

IN this work, Prof. Watson thinks aloud about some fundamental concepts and theories of modern physics. He uses for this purpose the analytical method favoured and practised by Dr. Wittgenstein, with the result that many questions, such as those of atomic mechanics and electricity, regarded mainly as mathematical or physical, resolve themselves into logical problems. There is no doubt that science does benefit from a systematic clarification of its language. But is it not going beyond this achievement to separate science entirely from philosophy? Language and symbols cannot go beyond themselves, so to speak, in representing the world of the physicist; but that should be no reason for denying value to *what* is represented. Such a value, of course, cannot be found within the restricted world of linguistic expression, especially in so far as it is applied to technically physical concepts. That is why Prof. Watson's conclusions from his discussion of the idea of substance (ch. v) seem to be beside the point. Nevertheless, the new ground broken in his book makes it a most useful contribution to the philosophy of Nature. T. G.

Symbolism and Belief

By Edwyn Bevan. (Gifford Lectures.) Pp. 391. (London: George Allen and Unwin, Ltd., 1938.) 15*s.* net.

THE philosophy of symbols has become prominent lately through the efforts of mathematical logicians. But it is not with that aspect of the subject which the book under review deals. The author is concerned with the relations between symbolism and religious beliefs. The very character of the data of revelation makes it necessary for man to use symbols for their interpretation and communication. In this respect Mr. Bevan performs a very useful task in explaining, with the support of an amazing amount of scholarship, the purpose of symbolism in these matters. His points would have been strengthened, however, by a bolder theory of analogy. As it is, his book enlightens us, but has little drive in it to guide us towards those truths which underlie his theme. T. G.

PHYSICS

Heat and Thermodynamics

An Intermediate Textbook for Students of Physics, Chemistry and Engineering. By Prof. Mark W. Zemansky. Pp. xii+388. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 24*s.*

THIS text is well suited to the needs of first-year honours students in physics and to students taking a graduate course in engineering. Experimental methods are cut down to the shortest possible presentation consistent with clearness, and modern methods are in most instances selected. Thus, the description of the time-honoured experiments of Joule and of Rowlands for the determination of J is cut down to a few words, and Callendar and Barnes, Jaeger and Steinwehr, and Laby and Hercus appear in their place. Forbes and Angström disappear, and a short account of the modern simple methods for conductivity determinations reigns instead.

Of the two partners in the title, thermodynamics has the lion's share of the space. The treatment is elementary, detailed and satisfactory; unavailable energy is correlated with entropy, and a number of special problems are discussed, including the phase rule. Applications of the Helmholtz and Gibbs functions are made, and a special chapter is devoted to the steam-engine and the refrigerator. Newton's law of cooling is deduced from the fourth power law as holding for small temperature excesses. The fact is, that Newton's law, in the circumstances in which it was established by Newton (*forced* convection), holds, as he showed it to hold, for temperature excesses of some hundreds of degrees.

Each of the nineteen chapters of the book is followed by a comprehensive set of numerical exercises, and the book may be commended as a careful and scholarly introduction to the subject, providing a solid foundation for further knowledge.

Demonstration Experiments in Physics

(Prepared under the Auspices of the American Association of Physics Teachers.) Edited by Prof. Richard Manliffe Sutton. Pp. viii+545. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 25*s*. net.

THERE are some books that can be reviewed at first reading, others that require only a glance. But sometimes the value of a book can only be appreciated when it has been used for some time, and then comes to be appreciated more and more. The author modestly claims "Demonstration Experiments in Physics" as a 'cookbook' for teachers of physics, and in its 500-odd pages it certainly contains an enormous variety of recipes. Among them we find many already familiar to teachers of physics in Great Britain, but the majority are new, or improved variants of existing experiments. They cover all branches of physics and all stages of lectures; but, naturally for demonstration experiments, the general emphasis is on the first and second years' lectures. Here dramatic nature of the action and simplicity of construction are the chief requirements. The reviewer can vouch for the feasibility of construction and the satisfactory performance of a considerable number of the experiments in this book.

The author and his collaborators have considered very carefully the principles underlying demonstration experiments, and their statement, which starts with the elementary fact so often forgotten that demonstrations are for the student and not for the instructor, is in itself a very useful contribution to the teaching of physics. Any physics teacher who buys this book is likely to find it of ever-increasing use in his lecture preparations.

The Flow of Homogeneous Fluids through Porous Media

By Dr. M. Muskat. With an Introductory Chapter by R. D. Wyckoff. (International Series in Physics.) Pp. xix+763. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 45*s*.

DR. M. MUSKAT'S book is an important contribution to technical literature and will be useful not only to workers in the oil and gas industries, but also to those who have to deal with problems of fluid flow through refractories and through ceramic materials and with problems of well and dam construction.

The eleven chapters which comprise the book are collected under four main headings. Part 1, which deals with fundamentals, is concerned chiefly with a discussion of Darcy's law connecting the rate of flow of water through a filter bed with the area of the sand, the thickness of the bed, and the difference between the fluid heads at the inlet and outlet faces of the bed. The law and its implications are very fully discussed, and the hydrodynamical equations for flow through porous media established. Part 2 deals with steady-state flow of liquids and contains discussions of two- and three-dimensional flow problems, of gravity-flow systems, of systems of non-uniform permeability, of two-fluid and of multiple-well systems. Part 3 is concerned with the flow of compressible liquids through porous media, and Part 4 with the flow of gases through porous media.

The treatment throughout is clear and detailed, and the whole work forms a most useful and praiseworthy contribution to a subject which had, until its appearance, scarcely been explored systematically.

An Introduction to Industrial Rheology

By Dr. G. W. Scott Blair. Pp. xiii+143. (London: J. and A. Churchill, Ltd., 1938.) 7*s*. 6*d*.

DR. SCOTT BLAIR deals mainly with the flow of non-Newtonian liquids: that is, those whose apparent viscosity varies with the rate of shear. We may regard these cases of anomalous viscosity from either of two points of view: that the anomaly is the interference with the normal hydrodynamical flow of the solvent by the solute particles; or, we may treat the system as a close-packed 'pudding' of particles separated by the dispersion medium. The latter, which is followed in this book, automatically becomes the method of approach of many industrial problems, since these are problems of the 'body' of systems in which the concentration of disperse phase is large. It is certain that, for dilute systems, the coaxial cylinder viscometer is preferable for theoretical reasons which are fundamental and well known.

That this is not made clear in this book is almost inevitable from the treatment followed. Viscosity is described from consideration of flow of liquids through tubes. This leads to Bingham's work on anomalous systems and to the subsequent modifications of his equation. Commercial viscometers are described, but the coaxial cylinder instrument is misnamed 'concentric' throughout the book. Although attention is mainly concentrated on paste type systems, the book contains a wide survey of all the types of anomalous liquid which have been investigated. It should be of value to industrial chemists faced with problems of anomalous viscosity, the number of which increases every day.

A. S. C. L.

The Amplification and Distribution of Sound

By A. E. Greenlees. Pp. 254. (London: Chapman and Hall, Ltd., 1938.) 10*s*. 6*d*. net.

THIS is the first comprehensive text to appear on a subject which the public is rather apt to take very much for granted, the microphone-amplifier-loudspeaker combination, the correct and original description of which is the public-address system. There is little theory which can be said to belong to the subject, except the simple calculations associated with decibels, transformers, and the power-handling capacity of power-valves. The author concentrates on the practical side, perhaps too much, with rather crude descriptions of standard types of microphones and loudspeakers. Nevertheless, he does give a very good picture of the importance of the subject and the extent of its applications.

L. E. C. H.

TECHNOLOGY

An Introduction to the Study of Spinning

By Prof. W. E. Morton. Pp. viii+267. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 12*s*. 6*d*. net.

THE application of the exact sciences to problems of the textile industries has received special attention during this century. The research associations established in connexion with the industry and the Textile Institute, the professional institution of the industry, have contributed much to new methods of thought on textile problems. These organizations, together with the technical institutions responsible for the training of textile students, have created a demand that, as Prof. Morton puts it, the teaching of spinning should be developed on a broader basis.

In his excellent treatise under notice, Prof. Morton has adopted an entirely new method of approach. The book is divided into two parts. In the first part he gives a general survey of the various natural and synthetic fibres, while in the second part he deals with general spinning principles, and points out the modifications in method which the different types of material entail. The book is described by the author as primarily intended as a text-book for use during the first year or two of spinning courses. There is little doubt that in this direction it will have supplied a real need. It is, however, likely to have a much wider appeal, and it will be read by many engaged in the different branches of the textile industry. Its originality of conception and the skill with which it deals with a difficult and extensive subject make it a useful contribution to textile literature.

The Structure of Steel Simply Explained

By Eric N. Simons and Dr. Edwin Gregory. Pp. xi+115+7 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1938.) 3*s*. 6*d*. net.

THE subject of the structures of steels is one of very considerable importance from many points of view, and the present volume will be welcomed by many readers. It gives a very clear and intelligible account of the subject and is well illustrated. The treatment is both physico-chemical and practical, the properties of interest to engineers being fully explained as well as the effects of heat-treatment, and many difficult points are elucidated. The book may be warmly recommended. The treatment is 'simple' only in the respect that the authors have taken pains to remove difficulties, and the standard is high. The plates of microstructure are very good, and the properties of special steels receive adequate treatment.

TRAVEL

Saga of the *Discovery*

By L. C. Bernacchi. Pp. xv+240+48 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1938.) 10*s*. 6*d*. net.

THIS book is of particular interest since it is written by one of the few whose experiences date from the time when there were no vitamins or radio and when British polar explorers were expected to man-haul their sledges in the way so vividly described. One can well understand the wonder of an expedition to a region which, except for the merest fringe, was new and contained so much of the entirely unknown.

Commander Bernacchi has written of his companions with a sympathetic and notably unbiased pen—a gratifying characteristic—and in spite of his frank recognition of idiosyncrasy one is pleased to observe that he can still write that *Discovery* was a "happy ship". The prejudice against dog-haulage is dealt with, and it is easy to see that it made inevitable the tragedy which involved *Terra Nova's* polar party. It is a dreadful example of the destructiveness of the preconceived idea.

There are a few minor inaccuracies; for example, one may be permitted to doubt whether Killer whales attack adult Blues, since precisely similar stories are told with reference to the Greenland whale.

This is a very readable book and the author is to be congratulated not only for a history of a ship now withdrawn beyond the possibility of further work in the ice, but also for the record of his own experiences in the 'heroic age' of Antarctic exploration.

Siberian Man and Mammoth

By E. W. Pfizenmeyer. Translated from the German by Muriel D. Simpson. Pp. xii+256+24 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 12*s*. 6*d*. net.

DR. PFIZENMEYER here gives an account of two expeditions, of which he was a member, one in 1901–2 and one in 1908, that were sent to Siberia by the Russian Academy of Sciences to excavate the carcasses of mammoths, of which the discovery in a frozen state had been reported. Of these expeditions the first recovered the Bereskova specimen, the most complete hitherto known, and the second the Sanga-Yurakh mammoth, which determined previously uncertain details in the characters of the trunk and tail. The author reviews the history of discoveries of the mammoth since the first recorded report in 1698 down to his own expeditions.

It is somewhat remarkable that these discoveries aroused little scientific interest, and it was not until 1806 that anything like a complete specimen reached St. Petersburg. The character of the tusks was still uncertain, as the native tribesmen usually made a practice, when a carcass was discovered, of hacking out and cutting up the tusks for the sake of the ivory.

The narrative is not confined to the purely scientific objective of the expeditions; and the author gives a vivid picture of travel on horseback and by sledge in pre-Soviet Siberia. He had a sharp eye for the idiosyncrasies of the exiles and tribesmen with whom he came into contact, and gives an interesting account of shamanistic ceremonies and practices. His acute estimate of the potentialities of a country of great natural wealth seems on the way to be realized.

has been arranged as usual in the middle of the supplement, the pagination of which will be unaffected by its removal.

American Geographical Society Awards

According to *Science*, the American Geographical Society has made the following awards: Cullum Geographical Medal for 1938 to Emmanuel de Martonne, professor of geography at the University of Paris; Charles P. Daly Medal for 1939 to Prof. H. J. Fleure, professor of geography in the University of Manchester; David Livingstone Centenary Medal for 1939 to John R. Rymill, in recognition of his scientific achievement and exploration in the southern hemisphere. The following have been made honorary members of the Society: Sir Wilfred Grenfell, for his contributions to geographical knowledge concerning the Labrador Peninsula; Prof. H. Baulig, professor of geography in the University of Strasbourg, and Prof. G. Dainelli, professor of geology and physical geography in the University of Florence. The following have been made corresponding members of the Society: E. Antevs, research associate of the Carnegie Institution of Washington; Prof. L. L. Mecking, professor of geography at the University of Münster; W. E. Rudolph, a civil engineer who has carried out extensive explorations in South America; P. G. Schott, retired section chief of the Deutsche Seewarte and honorary professor in the University of Hamburg, and Dr. L. Dudley Stamp, reader in economic geography in the University of London and director of the Land Utilization Survey of Great Britain.

The Night Sky in August

The moon is new on August 15 at 3·9h. U.T. and full on August 29 at 22·1h. On August 25, ρ Sagittarii (magnitude 4·0) is occulted, the disappearance as seen from Greenwich taking place at 23h. 48·9m. at position angle 77° from the north point of the moon's disk. Conjunctions between moon and planets occur as follows: August 5d. 14h. with Jupiter; 7d. 9h. with Saturn; 26d. 14h. with Mars. On August 25 at 20h. Venus is in conjunction with Regulus, the geocentric distance between the planet and the star being 0·9°. Mars, Jupiter and Saturn rise in the evening, the respective times of southing on August 1 being 23h. 23m., 3h. 55m., and 5h. 20m.; by August 25 these times have changed to 21h. 35m., 2h. 17m. and 3h. 46m. Mars, a conspicuous object low in the evening sky, declines in brightness during the month from mag. −2·5 to −1·8; Jupiter increases slightly from mag. −2·3 to −2·4. Mercury reaches its greatest western elongation (18°) on August 28 and should be looked for in the early morning at about this date. Venus continues as a morning star rising in the dawn at 3h. 26m. on August 1 and at 4h. 38m. on August 25. Saturn reaches a stationary point on August 14, Mercury on August 20, Mars on August 24 and Uranus on August 28. The minor planet Juno is in opposition on August 19, when its magnitude is 8·3; on August 1 it is about 50′ south of α Aquarii. The Perseids reach their maximum frequency on or about August 9, their radiant point being near η Persei. In the late evenings of mid-August, with the moon absent, the region of the Milky Way near the southern meridian offers interesting 'sweeps' with binoculars or telescope.

Announcements

Prof. S. Timoshenko, professor of mechanics at Stanford University, California, has been elected *correspondant* for the Section of Mechanics of the Paris Academy of Sciences.

Mr. R. H. Whitby, City and Guilds College, London, has been awarded the Busk studentship in aeronautics for the year 1939–40 tenable at the Aeronautics Department, Engineering Laboratory, Cambridge.

The following awards for 1939–40 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Salters' Company. Fellowships have been renewed in the case of Messrs. A. Cameron (University of Cambridge), H. S. Corran (University of Cambridge) and J. L. Tuck (University of Oxford). Fellowships have been awarded to R. Scarisbrick (University of Cambridge), T. W. Walker (University of London) and J. A. Berriman (University of Cambridge). The Salters' Institute has also awarded forty-four grants-in-aid to young men employed in chemical works in or near London to assist them in their studies.

Prof. Otto Grossern, director of the Anatomical Institute of the German University of Prague, has been awarded the Silver Medal of 1939 by the Jena Society of Medicine and Natural Sciences.

Prof. Esmond R. Long, director of the Henry Phipps Institute and professor of pathology in the University of Pennsylvania, has been elected president of the Wistar Institute of Anatomy and Biology. Dr. Edmond J. Farris, associate in anatomy, in charge of operations at the Wistar Institute, is to be executive director.

The twelfth International Congress of the History of Medicine will be held in Berlin on September 22–28, 1940, when the chief subjects for discussion will be the evolution of medicine in different countries from Harvey to Haller (epoch of medical philosophers) introduced by Dr. Laignel-Lavastine, professor of the history of medicine in the Paris faculty, and the history of typhus, introduced by Prof. Zeiss, director of the Institute of Hygiene of the University of Berlin.

An account of the chemical composition of 'Volpar' contraceptive products recently published (*Eugenics Rev.*, 31, No. 1) gives many details about the nature and action of these substances. They are in the form of gels and pastes and are weakly alkaline, containing phenyl mercuric acetate in aqueous solution. The gels contain also glyceryl monoricinoleate together with a fungicide to prevent the action of bacteria and moulds. The paste contains a basis of arrowroot starch and can be used in the tropics. Numerous tests of their efficiency and other effects have been made on animals.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 208.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nuclear Reactions in the Continuous Energy Region

IT is typical for nuclear reactions initiated by collisions or radiation that they may, to a large extent, be considered as taking place in two steps: the formation of a highly excited compound system and its subsequent disintegration or radiative transition to a less excited state. We denote by A, B, . . . the possible alternative products of the reaction, specified by the nature, internal quantum state, and spin direction both of the emitted particle or photon and of the residual nucleus and the orbital momentum. Further, we call P_A, P_B . . . the probabilities, per unit time, of transitions to A, B, . . . respectively, from the compound state.

The cross-section for the reaction $A \rightarrow B$ is then evidently

$$\sigma^A_B = \sigma^A \frac{P_B}{P_A + P_B + \cdots}, \qquad (1)$$

where σ^A is the cross-section for a collision in which, starting from the state A, a compound nucleus is produced. This formula implies, of course, that we are dealing with energies for which the compound nucleus can actually exist, that is, that we are either in a region of continuous energy values or, if the levels are discrete, that we are at optimum resonance. Moreover, it is assumed that all possible reactions, including scattering, proceed by way of the compound state, neglecting, in particular, the influence of the so-called 'potential scattering', where the particle is deflected without actually getting into close interaction with the individual constituents of the original nucleus.

On these assumptions a very general conservation theorem of wave mechanics[1] yields the relation

$$\sigma^A = \frac{\lambda^2}{\pi}(2l+1)\frac{P_A}{P_A + P_B + \cdots}, \qquad (2)$$

where λ is the wave-length of the incident particle and l is the angular momentum.

In the case of discrete levels, (1) and (2) give the same cross-section as the usual dispersion formula, if one applies it to the centre of a resonance level and neglects the influence of all other levels. In this case we have for each resonance level a well-defined quantum state of the compound nucleus, and its properties, in particular the probabilities P_A, P_B, . . . then cannot depend on the kind of collision by which it has been formed, that is, they would be the same if we had started from the fragments B, or C, . . . instead of A.

In the case of the continuum, however, where there are many quantum states with energies that are indistinguishable within the life-time of the compound nucleus, the actual state of the system is a superposition of several quantum states and its properties depend on their phase relations, and hence on the process by which the compound nucleus has been produced.

This dependence is made particularly obvious if we consider the formula

$$\overline{\sigma^A} = \frac{\hbar}{2}\rho\lambda^2(2l+1)P^0_A, \qquad (3)$$

for the mean value of the cross-section over an interval containing many levels, which follows from the well-known considerations of detailed balancing. Here ρ is the density per unit energy of levels (of suitable angular momentum and symmetry) of the compound nucleus. P^0_A is the probability for process A in statistical equilibrium and thus refers to a microcanonical ensemble of compound states built up from the fragments A, B . . . respectively, with proper statistical weights.

In the case of discrete levels, where formula (3) can also be derived directly from the dispersion formula, P^0_A is simply an average over the individual levels of the probability P_A, which in this case is well defined.

In the continuum, (3) must be identical with (2), since the cross-section does not vary appreciably over an energy interval containing many levels, and hence, comparing (2) and (3)

$$\frac{P^{(A)}_A}{P^0_A} = \frac{\pi}{2}\bar{\lambda}\rho\,(P^{(A)}_A + P^{(A)}_B + \ldots) = \frac{\pi}{2}\frac{\Gamma^{(A)}}{d}, \qquad (4)$$

where the superscript A has been added to the probabilities occurring in (1) in order to show explicitly the dependence on the mode of formation, and where $\Gamma^{(A)}$ is the total energy width of the compound state concerned and $d = \frac{1}{\rho}$ the average level distance. In the continuum, where $\Gamma^{(A)} \gg d$, the probability $P^{(A)}_A$ of re-emitting the incident particle without change of state of the nucleus will thus be much larger than the probability of the same process in a compound nucleus produced in other ways.

While the arguments used so far are of a very general character, more detailed considerations of the mechanism of nuclear excitation are required for a discussion of the dependence $P^{(A)}_B$ of the mode A of the compound nucleus provided $A = B$.

One can think of cases in which such a dependence must obviously be expected; in fact, if a large system be hit by a fast particle, the energy of excitation might be localized in the neighbourhood of the point of impact, and the escape of fast particles from this neighbourhood may be more probable than in statistical equilibrium. Further, if the system had modes of vibration very loosely coupled, the excitation of one of them, for example by radiation, would be unlikely to lead to the excitation of a state of vibration made up of very different normal modes, even though the state may be quite strongly represented in statistical equilibrium.

In actual nuclei, however, the motion cannot be described in terms of loosely coupled vibrations, nor would one expect localization of the excitation energy to be of importance in nuclear reactions of moderate energy. If we suppose that there are no other special circumstances which would lead to a dependence of $P^{(A)}_{B}$ on A, it is thus a reasonable idealization to assume that, even in the continuum, all $P^{(A)}_{B}$ are equal to P^{0}_{B}, except, of course, for $A = B$, where we have seen in (4) that the phases are necessarily such as to favour the re-emission of the incident particle.

A typical case of a reaction in the continuum is the nuclear photo-effect in heavy elements, produced by γ-rays of about 17 mv. In the first experiments of Bothe and Gentner, there seemed to be marked differences between the cross-sections of different elements, but the continuation of their investigations[2] indicated that these differences can be accounted for by the different radioactive properties of the residual nuclei, and that the cross-sections of all heavy nuclei for photo-effect are of the order of 5×10^{-26} cm.^{2}.

In previous discussions, based on formulæ (1) and (2), where the distinction between $P^{(A)}_{A}$ and P^{0}_{A} was not clearly recognized, it was found difficult, however, to account for photo-effect cross-sections of this magnitude. In fact, if one estimates the probability of neutron escape P_B at about 10^{17} sec.$^{-1}$, one should have for P_A 10^{15} sec.$^{-1}$, and as long as this was taken as P^{0}_{A} it seemed much too large, since it evidently must be much smaller than the total radiation probability, estimated at about 10^{16}, which included transitions to many more final levels besides the ground state.

We see now, however, that $P^{(A)}_{A}$ is here considerably larger than P^{0}_{A}, since the level distance at the high excitations concerned is probably of the order of 1 volt, whereas the level width corresponding to the above value of P_B is about 100 volts. From (4), or more directly from (3), P^{0}_{A} is thus seen to be only about 10^{13} sec.$^{-1}$, which would appear quite reasonable.

N. BOHR.
R. PEIERLS.
G. PLACZEK.

Institute of Theoretical Physics,
Copenhagen.
July 4.

---

[1] The details of this and of the other arguments of this note will be published in the *Proceedings of the Copenhagen Academy*.

[2] Bothe, W., and Gentner, W., *Z. Phys.*, **106**, 236 (1937); **112**, 45 (1939).

The Scattering by Uranium Nuclei of Fast Neutrons and the Possible Neutron Emission Resulting from Fission

THIS work to be described concerns only fast neutrons, and its object is the study of their scattering by uranium and the possible neutron emission which accompanies the fission of the nucleus.

The experiments were performed with a polonium plus beryllium source equivalent to 3mC. of radon plus beryllium. An ionization chamber surrounded with 2·5 cm. lead, filled with hydrogen at a pressure of 35 atm., was used as a neutron detector. The insulated electrode was connected to a compensated electrometer valve[1], the grid leak being 10^{11} ohms and the sensitivity $1{\cdot}2 \times 10^{-15}$ amp./div. on the scale.

We have employed two experimental arrangements in which the source was placed (1) between the chamber and the substance used as scatterer, the nature and the thickness of which were variable; (2) in the centre of a cube of 16 cm. side, alternately filled with uranium oxide (specific gravity, $d = 4{\cdot}0$) and lead oxide (compressed to $d = 3{\cdot}8$).

The first type of experiment gave us the total scattering cross-section, which is, as can be shown, $\sigma_t = \sigma_e + k_i\sigma_i$; for uranium oxide $\sigma_t = \sigma_e + k_i\sigma_i + k_r\nu_r\sigma_r$, where σ_e, σ_i, σ_r are respectively the average cross-sections of elastic and inelastic scattering and of fission; ν_r is the average number of neutrons produced per fission; k_i and k_r are the average efficiency factors of the chamber for the neutrons having undergone an inelastic collision or for the neutrons resulting from fission. The efficiency for the direct neutrons was taken to be unity, $k = 1$. For neutrons elastically scattered by nuclei of sufficiently high mass, $k_e = k = 1$. We have calculated k, taking into account the size of the chamber, the cross-section for proton projection, etc. The spectrum of polonium plus beryllium neutrons has been considered[2] to contain 50 per cent of neutrons of W_n less than 10^6 ev. We thus obtain:

$10^{-6}\,W_n$	0·1	0·5	2	5	10 ev.
k	0·3	1	1·9	1·7	1·2

In view of a possible extrapolation that would give $\sigma_e + k_i\sigma_i$ for uranium, we have in the same way experimented with scattering by lead oxide, lead, copper and zinc.

The results of the first experiment were as follows:

Substance	Cu	Zn	Pb	PbO_2	UO_2	$(O)_{calc.}$	$(U)_{calc.}$
$\sigma_t \times 10^{-24}$ cm.^{2} ($\pm$ 10%)	2·2	2·3	5·4	9·5	14·4	2	10·3

The values for uranium and oxygen are calculated on the assumption of the additivity of the cross-sections in lead oxide and uranium oxide.

The second experiment gives us, in the first approximation, the absorption coefficient $(1-k_i)\sigma_i + (1-k_r\nu_r)\sigma_r$, the value of σ_e being only as a correction term in the determination of the mean free path λ and the average distance L travelled by the neutrons before they escape from the whole mass, which is supposed spherical, the radius being r and $L = r\left(1 + \frac{1}{2}\frac{r}{\lambda}\right)$. This experiment, taking into account the results of the previous experiments, gives for lead, $(1-k_i)\sigma_i \simeq 2 \times 10^{-24}$ cm.^{2}. Assuming that σ_i can reach 30 per cent of σ_e[3], this gives k_i ($\simeq$) 0.

With the exception of uranium, for which one must consider not only σ_i, but also $\nu_r\sigma_r$, it is probable that σ_t is not very different from σ_e because of the small value of k_i.

In the case of uranium, however, we have,

$$(1-k_i)\sigma_i + (1-k_r\nu_r)\sigma_r \simeq 0{\cdot}9 \times 10^{-24}\ \text{cm.}^2 \quad (1),$$

or, by adding to σ_t, thus eliminating k_i and k_r,

$$\sigma_e + \sigma_i + \sigma_r \simeq 11{\cdot}2 \times 10^{-24}\ \text{cm.}^2. \quad (2).$$

If it is supposed that each fission produces radio-elements, the cross-section measured by Joliot, and by Anderson *et al.*[4] would be identical with σ_r, which they found to be $\sigma_r \simeq 10^{-25}$ cm.^{2}. In this case we see that $(\sigma_e + \sigma_i)$ is much greater ($\simeq 11{\cdot}1 \times 10^{-24}$ cm.^{2}) than that given by an extrapolation ($\simeq 6 \times 10^{-24}$ cm.^{2}).

On the other hand, it results from (1) that, if the value of σ_i is comparable to that of the next elements (1 to 2×10^{-24} cm.^{2}), ν_r can, with plausible assumptions as to the coefficients k_i and k_r, take variable values, for example, from 1 to 5, or even more.

One can see that, so long as σ_i is not determined separately, the experiments of the type described do not allow us to determine ν_r and σ_r (characteristics of the fission), or to conclude that neutrons are liberated; or, *a fortiori*, to form a conclusion as to the possibility of chain reactions, contrary to the results of similar experiments[4].

The only suitable case for showing with certainty, by means of an ionization chamber, the production of neutrons, would be that in which, by the use of a sufficient quantity of uranium, the chain mechanism would give multiplication of neutrons, if such chain is realizable[6].

In conclusion, it results from these experiments with neutrons of polonium plus beryllium that the sum of the cross-sections $\sigma_e + \sigma_i + \sigma_r$ for the uranium nucleus is $(11\cdot2 \pm 1\cdot5)10^{-24}$ cm.[1]. This value implies a mean path in uranium much shorter than that usually admitted; this suggests that smaller masses than those hitherto expected might be used to show chain fission.

LA. GOLDSTEIN.
A. ROGOZINSKI.
R. J. WALEN.

Laboratoire Curie,
Institut du Radium,
Paris, 5.
July 13.

---

[1] Rogozinski, A., *C.R.*, 208, 427 (1939).

[2] Auger, P., *J. Phys. Radium*, 4, 719 (1933).

[3] Seaborg, G. T., Gibson, G. E., and Graham, D. C., *Phys. Rev.*, 52, 408 (1937).

[4] Joliot, F., *J. Phys. Radium*, 10, 159 (1939). Anderson, H. L., Booth, E. T., Dunning, J. R., Fermi, E., Glasoe, G. N., and Slack, F. G., *Phys. Rev.*, 55, 511 (1939).

[5] Haenny, C., and Rosenberg, A., *C.R.*, 208, 898 (1939).

[6] v. Halban, H., Joliot, F., and Kowarski, L., NATURE, 143, 680 (1939). Perrin, F., *C.R.*, 208, 1394, 1573 (1939).

Possible Delay in the Emission of Neutrons from Uranium

ROBERTS[1] and others have reported the emission of delayed neutrons with a period of 12 sec. from uranium under neutron bombardment, but the effect seems to be a small one[2], the main body of neutrons being produced in a much shorter period. Green and Alvarez have shown that there is no delay exceeding 3×10^{-9} sec. in the actual production of fission, but it seemed possible that the neutrons might not be produced at the moment of fission but rather as the products of rapid disintegration of the primary fission particles.

Following on a conversation with Prof. N. Bohr, we have made experiments to see if there is any appreciable delay (approximately 0·01 sec.) in the emission of the bulk of the fission neutrons. For this purpose we have used the intermittent neutron source described by Moon and others[3]. In this device, neutrons emitted by the intermittent bombardment of a target of heavy ice with deuterons are detected on a cathode ray oscillograph, the time-scale of which is interrupted by marks produced by the intermittent beam of ions. For the present experiment, the detecting chamber was shielded with cadmium and placed nearer the source (about 2 metres instead of 5 metres), thus increasing the intensity and diminishing the lag due to the time of flight of any slow neutrons present. The period of intermittence was 0·005 sec. and delays exceeding 0·001 sec. could have been detected. Delays larger than 0·005 sec. would have resulted in an approximately uniform distribution of the fission particles over the time-scale. Experiments were made by surrounding the source with a considerable thickness (approximately 10 cm.) of uranium oxide (U_3O_8). Check experiments were made without the uranium, and also without the source but with the uranium.

Two complete sets of experiments were made, one with the source surrounded with wax inside the uranium, the other with it bare. The second experiment showed a slight positive effect corresponding to a cross-section of about 5×10^{-26} cm., about that found by Roberts, but this is of the order of the experimental error. We can, however, say that the effect is less than corresponds to a cross-section of 10^{-25} cm., so that it is unlikely that the bulk of the emission is due to effects having a delay of more than 10^{-3} sec. in the case of the primary neutrons from the D—D process. The experiment with the wax gave a negative result, and assuming that the number of 'slow' neutrons emitted from the source, which was surrounded by about 5 cm. wax, is a quarter that of the fast neutrons emitted under the same conditions, we should have detected a cross-section for the production of a delayed neutron of 5×10^{-25} cm. The value given by Anderson and others for fission is 2×10^{-24} cm., and according to Szilard about two neutrons are produced per fission.

D. F. GIBBS.
G. P. THOMSON.

Imperial College of Science
and Technology,
London, S.W.7.
July 17.

---

[1] Roberts, Meyer and Wang, *Phys. Rev.*, 55, 510 (1939).

[2] Szilard and Zinn, *Phys. Rev.*, 55, 799–800 (1939).

[3] Fertel, Moon, Thomson and Wynn-Williams, NATURE, 142, 829 (Nov. 5, 1938).

Evaluation of the Beta Upper Energy Limits with Simple Absorption Data

OF late, several methods have been suggested by different workers[1,2,3,4] for estimating the β upper energy limits of radio-elements (especially those produced in artificial disintegrations) from absorption measurements made with aluminium foils. One great drawback of these methods is that most of them are too empirical and without a theoretical basis, and are limited to cases of simple spectra.

A new method is now proposed, which enables one not only to obtain good results, but also to analyse complex spectra into simple ones, from the ordinary absorption data. It consists essentially in utilizing the absorption measurements to construct the Fermi and Konopinski-Uhlenbeck theoretical curves and deduce the upper limit by extrapolation.

As is well known, the Fermi and Konopinski-Uhlenbeck[5] curves have been used for magnetic spectrograph and cloud chamber data. Kurie, Richardson and Paxton[6] first pointed out a practical way of doing this, and many workers have applied it to several cases with success. To plot these curves, two quantities are required, namely, the number N of β-particles in successive small momentum (or energy) intervals, and the average momentum M (or average energy E) for each of those intervals, all along the distribution curve, chiefly in the high-energy portion. Certain simple considerations make it possible to derive these two factors N and M (or E) to a good approximation even from simple absorption measurements. In consequence, absorption data can be used to draw the Fermi and Konopinski-Uhlenbeck curves.

This new method has been applied with interesting results to radiorhodium and radiosilver obtained with slow neutron activation. The two periods of rhodium are supposed to be isomeric, while those of silver are not.

Method	Rhodium	
	45 sec.	4·2 min.
Konopinski-Uhlenbeck	2·70 ± 0·05 Mev.	2·75 ± 0·05 Mev.
Fermi	2·62 ± 0·05 „	2·66 ± 0 05 „

Method	Silver	
	24 sec	2 5 min
Konopinski-Uhlenbeck	2·81 ± 0·08 Mev.	1 72 ± 0·05 Mev.
Fermi	2·60 ± 0 10 „	1 67 ± 0·07 „

The following points are worth noting:

(1) The above values are in good agreement with those obtained by different methods[7].

(2) The upper energy limits of the two periods of rhodium are the same within the limits of experimental error, an important result which confirms Pontecorvo's simple scheme[8] for the isomers of rhodium.

(3) For rhodium, besides the above-mentioned two upper limits, a third one is obtained of about 3·8 Mev., which is found always linked with the 45 sec. period. A close comparative study of the curves of rhodium and silver clearly shows that this value cannot be referred to either of the isomeric periods. Various hypotheses, such as 'group' spectra, radioactive rhodium (102), secondary electrons, etc., have been tried to explain it.

The new method has the following advantages over others: (*a*) it has a theoretical basis, namely, Fermi's theory of β-disintegration; (*b*) it enables a complex spectrum to be split up into simple spectra; (*c*) measurements very close to the limiting thickness of absorber are not necessary; (*d*) it is impersonal and objective at the same time, since the upper limit is given by a definite point of intersection of the curve with the X-axis.

J. B. R. RAJAM.
P. C. CAPRON
(Associé F.N.R.S.).
M. DE HEMPTINNE.

Institute of Physics,
University, Louvain.

---

[1] Beschwitz, *J. Phys.*, 8, 120 (1938).

[2] Nahmias and Schiff, *J. Phys.*, 4, 140 (1938).

[3] Widdowson and Champion, *Proc. Phys. Soc.*, 50, 185 (1938).

[4] Feather, *Proc. Camb. Phil. Soc.*, 34, 599 (1938).

[5] Konopinski and Uhlenbeck, *Phys. Rev.*, 48, 7 (1935).

[6] Kurie, Richardson and Paxton, *Phys. Rev.*, 48, 167 (1935); 49, 368 (1936).

[7] Crittenden and Bacher, *Phys. Rev.*, 54, 862 (1938).

[8] Pontecorvo, *Phys. Rev.*, 54, 542 (1938).

A New Method of Determining *e*/*m* for Medium High Velocities

CONSIDER the motion of an electron moving in an electric field between two charged co-axial cylinders. If the electrons are emitted from S (Fig. 1) with velocity v, they can be refocused at a point S' on the circle r_0 if

$$(1)\quad \Theta = \frac{\pi\gamma}{\sqrt{1+\gamma^2}} \text{ where } \gamma = \frac{1}{\sqrt{1-v^2/c^2}}\ ;$$

and further, if the field at the circle of radius r_0 satisfies the relation

$$(2)\quad eF = \frac{m_0\gamma v^2}{r_0}.$$

From (1) and (2) we get

$$(3)\quad \frac{e}{m_0} = \frac{c^2}{Fr_0}\sqrt{\frac{(2\Theta^2-\pi^2)^2}{(\pi^2-\Theta^2)\Theta^2}}\ \text{e.s.u.gm.}^{-1}.$$

Thus a simultaneous measurement of the two quantities Θ and F would give a value for e/m_0.

The method becomes much more convenient when a radioactive source is used at S emitting a continuous velocity spectrum of electrons. The angle Θ can then be fixed and it is only necessary to vary the field until a maximum of intensity is observed at S'. The best way of doing this in practice would appear to be to have just a slit at S' and to place the detecting counter at C, approximately a further angle Θ round the centre. This will always be possible, since Θ must lie between $\pi/\sqrt{2}$ and π.

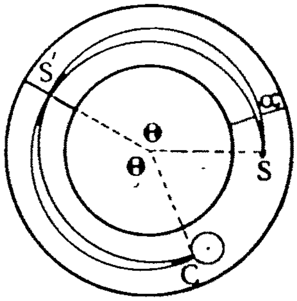


Fig. 1.

In effect, the choice of a definite angle Θ specifies the energy of the electrons for which e/m_0 is to be found:

$$(4)\quad E = \frac{m_0c^2}{e}\left(\sqrt{\frac{\Theta^2}{\pi^2-\Theta^2}}-1\right)300 \text{ ev.};$$

and so only one deflection measurement is necessary.

The increase of the angle of refocusing Θ with the velocity is a pure relativistic effect and also takes place in a Coulomb field, where the dependence of Θ on the velocity can be found readily from the precession of the ellipse, $\Theta = \pi\gamma$. Owing to the stronger focusing properties of the inverse r field, slow electrons are refocused in this field earlier than in a Coulomb field, and the increase of Θ with the velocity is slower.

The accuracy of the method will depend mainly on the determination of the angle Θ, since

$$(5)\quad \frac{d(e/m_0)}{e/m_0} = \frac{\pi^4}{(2\Theta^2-\pi^2)(\pi^2-\Theta^2)}\,\frac{d\Theta}{\Theta}\ ;$$

and this is very large both at small and high velocities. The error is a minimum for $v/c = \frac{1}{3}\sqrt{6} \doteq 0{\cdot}81$, corresponding to an energy of nearly 10^6 ev., which is certainly an interesting region. The angle Θ is then $\frac{\pi}{2}\sqrt{3} = 155{\cdot}88°$, and under this condition,

$$\frac{d(e/m_0)}{e/m_0} = 8\,\frac{d\Theta}{\Theta}$$

It does not seem at all impossible ultimately to have the angle Θ measured to 1 part in 10,000, which would lead to an accuracy of 1 in 1,000 for e/m_0. Using an apparatus with $r_0 = 25$ cm. and a gap between the two cylinders of 0·5 cm., 10,000 volts would be required to refocus electrons of this energy.

Apart from the question of measuring the voltage, the error in fixing the exact value of the field to give focusing is determined by the resolving power of the apparatus. If this is too high, other errors would be introduced due to lack of intensity. With a source of 1 mc. on a 0·1 mm. wire, ample intensity should be obtained with an angular spread of $\alpha = 2 \times 10^{-2}$ radians. With these values the uncertainty in dF/F should not exceed 10^{-4}.

Apart from the question whether an accuracy could in fact be realized comparable with that attained already for slower electrons, this method is interesting in so far as it is peculiarly adapted for use with the electrons or positrons forming the continuous spectrum from radioactive bodies.

An interesting analogy exists between this method and that developed by Henneberg[1], Bartky and Dempster[2] and Shaw[3]. They also use a field between two co-axial cylinders, but since their electrons are very slow, the angle of refocusing is practically $\pi/\sqrt{2}$ and quite insensitive to changes in velocity. An artificial precession is then introduced by a magnetic field parallel to the axis of the cylinders, when the method becomes formally similar to that described here.

J. AHARONI.

Wheatstone Laboratory,
King's College,
London, W.C.2.
June 20.

---

[1] Henneberg, W., *Ann. Phys.*, 19, 335 (1934).
[2] Bartky, W., and Dempster, A. J., *Phys. Rev.*, 33, 1019 (1929).
[3] Shaw, A. E., *Phys. Rev.*, 44, 1006 (1933).

Phosphatide Exchange between Plasma and Organs

THE blood plasma of rabbits contains about 80 mgm. phosphatides. What is the average time a phosphatide molecule spends in the plasma?

To answer this question we administered labelled sodium phosphate of an activity of 0·01 millicurie to rabbit *A*. The active phosphate was kindly presented us by Prof. Lawrence. After the lapse of a day the plasma contained phosphatides of an appreciable activity. We added this plasma to the corpuscles from rabbit *B* and reintroduced the blood obtained, composed of non-active corpuscles and active plasma, into the rabbit *B*. Blood samples were taken at intervals from the ear vein of rabbit *B* and the disappearance of the active phosphatides from the plasma was followed. As seen in Table 1, about one half of the labelled phosphatide molecules disappeared in the course of 1½ hours. To find what happened to the molecules which disappeared we killed the rabbit after 4 hours, extracted the phosphatides from the organs with ether-alcohol, determined the phosphatide phosphorus content of the extracts by the colorimetric method and their activity by making use of a Geiger counter. The results are seen in Table 1. Nearly one third of the labelled phosphatide molecules introduced into the plasma were after the lapse of four hours present in the liver; the muscles contained about 3 per cent, the other organs less. Though intestinal tract, bones and skin were not investigated, about 60 per cent of the labelled phosphatides introduced into the plasma could be recovered in the organs.

TABLE 1.

EXCHANGE OF LABELLED PHOSPHATIDES BETWEEN PLASMA AND ORGANS.
(Active inorganic P is only present in negligible amount).

Time	Organ	Phosphatide P content in mgm.	Percentage labelled phosphatides introduced into the plasma present in the organ	Percentage organ phosphatides replaced by plasma phosphatides
0 min.	Plasma	3·08	100	—
26 "	"	3·08	78·4	—
78 "	"	3·08	47·6	—
116 "	"	3·08	33·0	—
243 "	"	3·08	20·9	—
	Corpuscles	2·48	0·94	2·35
	Liver	41·3	31·7	4·76
	Muscles	164·2	3·42	0·13
	Lungs	6·0	1·13	1·14
	Kidneys	5·82	0·96	1·00
	Heart	6·5	0·23	0·20
	Brain	13·4	0·06	0·27

TABLE 2.

FORMATION OF LABELLED PHOSPHATIDES

Organ	Percentage of organ phosphatide synthesized in the course of 3½ hours (obtained by comparing the specific activities of the inorg. P and phosphatide P of the organs)
Plasma	0·7
Liver	7·4
Muscles	1·2
Lungs	2·9
Kidneys	4·8
Heart	1·6
Brain	0·9
Spleen	2·4
Intestinal mucosa	4·1
Stomach	10·0

Radioactive phosphorus as an indicator has been used in numerous cases[1] to determine the relative rate and the place of formation of phosphatide molecules. The line of attack described above differs, however, entirely from that pursued in the references given above. We are following the exchange of phosphatide molecules between the plasma and the organs and not their formation from components. How these two entirely different magnitudes compare is seen in Tables 1 and 2. During the period in which 7 per cent of all the phosphatide molecules present in the liver are renewed by synthesis, 5 per cent of the phosphatide molecules of the liver are replaced by phosphatide molecules previously present in the plasma. The amount of newly synthesized phosphatides present, for example in the liver, was determined by comparing the specific activity of the liver phosphatide phosphorus with that of the liver inorganic phosphorus in experiments in which labelled sodium phosphate was injected into the vein of a rabbit drop by drop. The amount of labelled phosphatide synthesized from labelled inorganic phosphate and other components in the course of the exchange experiment can be entirely disregarded. Due to the intense interaction of the plasma phosphate with that of the organs, the amount of active inorganic phosphorus present in the plasma of rabbit *A* was only one third of that of the active phosphatide phosphorus at the end of the twenty-four hours. This ratio was further shifted in favour of the phosphatide phosphorus after injecting the plasma into rabbit *B*; 10 minutes later it was 1/50, and four hours later 1/150.

As seen in Tables 1 and 2, liver, in which a high phosphatide turnover takes place, exchanges easily its phosphatide molecules with those present in the plasma, while muscles, in which phosphatides are synthesized slowly, also exchange phosphatide molecules at a very slow rate. The kidneys show a different behaviour. There is a fast new-formation of phosphatides, while the rate at which the phosphatide molecules are carried into the plasma is slow.

Though the individual phosphatide molecules, as seen above, leave the plasma at a fairly fast rate, the speed with which they penetrate the walls of the capillaries and reach the lymph is much smaller than in the case of electrolytes. We introduced 1 c.c. plasma containing labelled sodium chloride into a rabbit; after the lapse of a few minutes we found the labelled sodium chloride to be diluted 590 times, showing that the labelled sodium is now distributed in 590 c.c. fluid. We carried out similar experiments with plasma containing labelled phosphatides and after the lapse of ten minutes found a dilution, in rabbits weighing 2·3–2·4 kgm. of 105–130. The phosphatides are, thus, distributed in a volume of

105–130 c.c. liquid, which is not very appreciably more than the total plasma volume. The latter amounts, in the case of a rabbit weighing 2·3 kgm., to about 90 c.c.

All data given in this note relate to those phosphatide molecules which are soluble in petrol ether. We found great differences in the turnover of the different types of phosphatides and this induced us to carry out similar experiments as described above with each of the different types.

L. Hahn.
G. Hevesy.

Institute of Theoretical Physics,
University, Copenhagen.

[1] Artom *et alia*, *Archiv. internat. de Physiol.*, 45, 32 (1937), 47, 245 (1938); Hahn and Hevesy, *Skandin. Archiv. Physiol.*, 77, 148 (1937); *Kgl. Dansk. Vid. Selsk. Medd.*, 2, 14 (1938). Hevesy and Aten, *Kgl. Dansk. Vid. Selsk. Medd.*, 14, 5 (1939). Chaikoff *et alia*, *J. Biol. Chem.*, 122, 169 (1937); 128, 493 (1939). Dols *et alia*, NATURE, 77, 141 (1938).

Preparation of Thyroxine from Casein treated with Iodine

In a recent paper by Ludwig and Mutzenbecher[1] experiments are described in which treatment of casein with iodine under carefully defined conditions is stated to yield a physiologically active product from which thyroxine can be isolated.

In view of the existing knowledge of the chemistry of thyroxine, these results are so surprising that it appeared to us to be desirable to repeat the experiments. We have therefore carried out three preparations under the conditions laid down by the German workers and we have confirmed the findings of the latter in every respect.

The casein employed in our experiments was a commercial preparation (B.D.H. acetic-precipitated, soluble). Three separate lots of 100 gm. of this material gave, under Ludwig and Mutzenbecher's conditions of iodination, products containing 7·7, 7·7 and 8·7 per cent of iodine respectively; a physiological test on one of these products indicated an activity (as measured by the effect on the basal metabolic rate of the rat) of the order of 1/300 of that of thyroxine.

Hydrolysis of the iodinated casein preparations with barium hydroxide as described by the German workers led to iodine-rich fractions, containing 37–45 per cent iodine, solutions of which in 0·1 *N* sodium carbonate solution slowly deposited small amounts of a crystalline sodium salt; the latter could be converted in the usual manner into a compound indistinguishable in chemical properties from thyroxine and showing the full physiological activity of the latter; the chemical identification was completed by the catalytic deiodination of the product isolated to give a characteristic preparation of thyronine. The yields of crystalline thyroxine which we have isolated have been of the order of 100 mgm. from 100 gm. of iodinated casein.

There seems, therefore, to be no doubt as to the correctness of the results obtained by Ludwig and Mutzenbecher, and it becomes a matter of great interest to consider the possible mechanisms by which the formation of thyroxine in these experiments may be brought about.

The first point which seems to us to be significant is that the conditions employed by Ludwig and Mutzenbecher for the iodination of the casein, and which according to them must be closely observed, are not such as to bring about maximum substitution of iodine in the casein molecule but are rather such as to favour the oxidizing action of iodine. Now the hypothesis has been previously advanced by one of us that the biological synthesis of thyroxine may occur from tyrosine through the stage of diiodotyrosine, two molecules of which may undergo oxidative coupling with elimination of one side-chain; it has been supposed that an enzymic mechanism may exist in the thyroid gland by means of which this reaction could be brought about. In the experiments of Ludwig and Mutzenbecher the participation of oxidizing enzymes which might be present in the casein preparation could not be completely excluded owing to the conditions of the iodination (maintenance for about four hours at 37° and *p*H 8·5); we have found, however, that initial boiling of the casein in aqueous suspension does not affect the result, so that enzymic action cannot be involved.

There appear, therefore, to be two possibilities remaining: (1) iodine itself, under the conditions employed, may be able to effect the oxidative coupling of two molecules of diiodotyrosine which is postulated as a stage in the biogenesis of thyroxine; (2) casein may contain preformed thyronine as one of its constituent amino-acids and this may be iodinated to thyroxine.

The first of these explanations is favoured by Ludwig and Mutzenbecher; the difficulties in the way of its acceptance are (*a*) the inherent unlikelihood that iodine should bring about such a drastic oxidation and (*b*) the still greater improbability that a reaction of the type required should occur between two tyrosine residues within the protein molecule. On the other hand, although the presence of a small amount of thyronine in casein (and indeed in other tyrosine-containing proteins) might well have escaped detection hitherto, all attempts which have been made in the past to convert thyronine into thyroxine have failed.

We are at present engaged in experiments which it is hoped may throw further light on the chemical basis of the very interesting phenomena which the work of Ludwig and Mutzenbecher has revealed.

C. R. Harington.
Rosalind V. Pitt Rivers.
University College Hospital Medical School,
University Street, W.C.1.

July 7.

[1] *Hoppe-Seyl. Z.*, 258, 195 (1939).

The Cromer Forest Bed Implements

Researches I have carried out recently, by means of grants from the Royal Society, relating to the artefacts found in the basal layer of the Cromer Forest Bed, have shown that some six periods of flaking are recognizable on these specimens. I conclude, therefore, that the deposit containing them is composed, in part, of the wreckage of a land surface, or surfaces, on which the makers of the flint implements lived prior to the laying down of the Forest Bed. The various groups of artefacts from the base of this deposit differ not only in their patination and condition, but also, it seems, in their forms and flaking. One of the assemblages of specimens referable, apparently, to the earlier part of the Cromer Forest Bed, is that composed of the well-known ochreous-yellow implements, and flakes found upon the foreshore site at Cromer.

Since 1919, I have made periodical examinations of the large spreads of flint, exposed at low tide, along the shore from Sheringham to Mundesley, and it is beyond dispute that it is only at Cromer that the ochreous specimens are, or rather were, present in any quantity. They are exceedingly rare at Sheringham, West and East Runton, while to the south-east of Cromer, though stone beds are present upon the foreshore, no ochreous artefacts, so far as I have been able to observe, occur at these sites. These facts are of considerable significance when the question of the origin of the flaking of the ochreous specimens comes up for consideration. For example, they make it very difficult to believe that wave-action has been responsible for this flaking, as, apart from the lack of evidence that such action could produce the required effect, it is incredible that it would be confined, to all intents and purposes, to only one spot on the north-east coast of Norfolk. Moreover, the ochreous artefacts are not made from the flint which is being eroded from the chalk on the foreshore, but from another variety; while the ever-lessening number of the ochreous specimens on the Cromer site—a reduction brought about by their removal by archæologists and others—indicates that these flints are not being produced at the present time.

As is known, the ochreous artefacts generally exhibit a thick and ancient patination, while the flakes very often show flat striking platforms, prominent cones and bulbs of percussion and the usual characteristics of human workmanship.

J. Reid Moir.

Hedges,
One House Lane,
Ipswich.
July 1.

Reduction of the Ctenidia in the Lamellibranchia

The ctenidia of a typical lamellibranch are each composed of two demibranchs arranged one on each side of the ctenidial axis. In three families, however, the Lucinidæ, the Montacutidæ and the Teredinidæ, the ctenidium is composed of one demibranch only. A list of such lamellibranchs found in British waters is given by Atkins[1], type G. It is reproduced below.

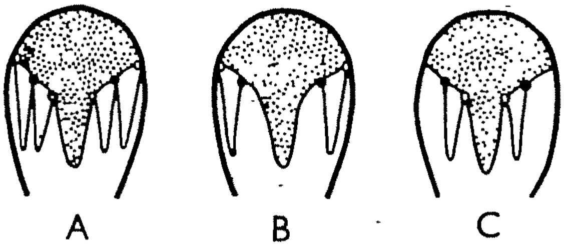
Lucinidæ.
  Myrtea (Lucina) spinifera.
  Phacoides (Lucina) borealis.
Montacutidæ.
  Montacuta ferruginosa.
  Montacuta substriata.
  Mysella (Montacuta) bidentata
Teredinidæ.
  Teredo norvegica.
  Teredo navalis.
  Teredo megotara.
  **Xylophaga dorsalis.*

A similar condition obtains in the American genus *Bankia*, as shown by Sigerfoos[2] who examined *B.* (*Xylotrya*) *gouldi*.

It has generally been assumed, on little definite evidence, that in all these cases it is the outer demibranch which has been lost[1,2,3,4]. The question can only be definitely decided by determining the positions of the afferent and efferent branchial veins. The afferent vein invariably runs in the ctenidial axis. It receives blood from the kidney and passes it down the descending lamellæ of the ctenidium. The typical lamellibranch possesses two pairs of efferent veins which run along the dorsal margins of the ascending lamellæ of each ctenidium. They convey blood from the ctenidia to the auricles. This normal arrangement is indicated in *A*.

Where one demibranch has been lost, the relative positions of the afferent and efferent branchial veins remain unchanged (*B*, *C*). By the examination of serial sections it is possible to trace the connexion between the afferent vein and the kidney, or between the efferent vein and the auricle, and thus (by identifying the veins) to determine the position of the ctenidial axis.

Menegaux[3] discusses the position of the afferent and efferent veins in *Lucina*, and his description leaves no doubt that in the Lucinidæ the single demibranch is the *outer* one (*B*).



Diagrammatic transverse sections to show reduction of the ctenidia in certain lamellibranchs. A, typical lamellibranch. B, Lucinidæ and Teredinidæ. C, Montacutidæ.
The afferent branchial vein at the ctenidial axis is figured black, and the efferent branchial veins at the dorsal borders of the ascending lamellæ are figured white.

In the Montacutidæ, I have been able to examine one species only, *Montacuta ferruginosa*, in which it is clear that it is the *inner* demibranch which is retained (*C*). This is in accordance with the views of Miss M. L. Popham, who has sectioned all the species of the Montacutidæ found in British waters.

Examination of the illustrations of *Teredo* and *Bankia* given by Ridewood[4] and Sigerfoos[2] respectively make it abundantly clear that in these genera it is the *outer* demibranch which is retained. My own investigations on *Xylophaga dorsalis* establish that a similar condition obtains in this species.

In the Lucinidæ and Teredinidæ, therefore, the ctenidium is composed of the *outer* demibranch only; whereas in the Montacutidæ the single demibranch is the *inner* one.

R. D. Purchon.

Department of Zoology,
University, Bristol.
May 27.

---

* Evidence has been produced which justifies placing *Xylophaga* in the Teredinidæ. This will be published elsewhere in due course.

[1] Atkins, D., *Quart. J. Micr. Sci.*, 79, 375 (1937).

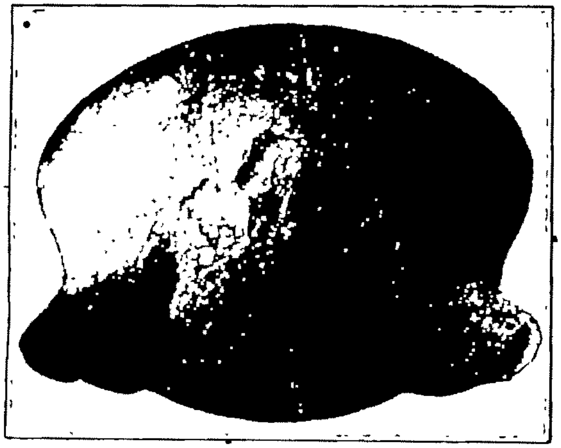
[2] Sigerfoos, C. P., *Bull. U.S. Bur. Fish.*, 27, 191 (1908).

[3] Menegaux, A., Academic Thesis, Besançon (1890).

[4] Ridewood, W. G., *Phil. Trans.*, B, 195, 147 (1903).

Cranidial Muscle Scars of '*Illænus*' *proles* var. *shelvensis* Whittard

From the core of the Walsall boring[1] which was put down in 1935, Dr. and Mrs. A. J. Butler collected a large number of Silurian fossils. Among those from the Purple Shales of the Upper Llandovery there are internal casts of two trilobite middle-shields referable respectively to *Phacops* (*Portlockia*) *elegans* Sars and Boeck, obtained at a depth of 1,050–1,055 feet, and to '*Illænus*' *proles* var. *shelvensis* Whittard, from 982–987 feet down. The illænid, as shown in the accompanying figure, though rather larger than the individuals upon which Prof. Whittard founded the variety[2], differs from these only in the remarkable preservation of the impressions of what seem to be muscular platforms. The pair of these which occur at the front of the glabella are expanded anteriorly, and are covered with small depressions like those occurring at points of muscular attachment in modern Crustacea. About 0·6 mm. behind these well-marked muscular platforms under the posterior part of the glabella we find another pair that are poorly defined with small raised areas sometimes isolated, irregularly arranged, and not so high as those in front.



INTERNAL CAST OF MIDDLE-SHIELD OF "*Illænus*" *proles* VAR. *shelvensis* WHITTARD, SHOWING IMPRESSIONS OF PAIRED MUSCLE-PLATFORMS UNDER FRONT PART OF GLABELLA, WITH A PAIR OF FAINTER AND LESS REGULAR MUSCULAR AREAS BEHIND. ×1¾.

Birmingham University Geological Museum, Figured Collection T. 215.

In cranidia areas of muscular insertion have been previously described by von Volborth and Prof. Öpik. In his *Illænus crassicauda* var. *dalmanni*, von Volborth[3] found four paired areas under the glabella —the illustration is copied by Salter[4]—and clearly distinguished these from a pair of elongate oval depressions in the axial furrows. None of von Volborth's scars, we note, is relatively as large as the front pair in '*I.*' *proles* var. *shelvensis*. Under the frontal lobe of the glabella of several species of *Chasmops* Öpik[5] has discovered small elevations in two rows converging in front and behind, which he regards as points of attachment for the muscles which served to dilate the œsophagus.

In explaining the novel musculature of '*Illænus*' *proles* var. *shelvensis*, the easiest supposition is that it may have arisen through fusion of muscle impressions like those seen in *I. crassicauda* var. *dalmanni*, probably three pairs going to the making of the large anterior muscle scars of the Walsall form. This development may have been connected with change in feeding habits, for example, evolution of a sucking mouth, as it is unlikely that an enlarged pair of mandibular appendages ever appeared in the Illænidæ.

The genotype of Illænus is *I. crassicauda* (Wahlenberg). Von Volborth's variety certainly seems to come close to this. It would, therefore, be justifiable at once to separate '*I.*' *proles* var. *shelvensis* as the representative of a new genus. It has been thought better, however, to delay placing the Shelve and Walsall specimens in a new systematic position, since re-examination of collections of illænids may in the near future give additional information about the condition of cranidial muscle platforms and the possible value of these features in taxonomy.

ARCHIE LAMONT.

Department of Geology,
University, Edgbaston,
Birmingham 15.
June 14.

---

[1] "On Silurian and Cambrian Rocks encountered in a Deep Boring at Walsall, South Staffordshire", *Geol. Mag.*, 74, 241–257 (1937).

[2] "The Upper Valentian Trilobite Fauna of Shropshire", *Ann. Mag. Nat. Hist.*, Ser. 11, 1, 93–94, Pl. II, Figs. 7–8 (1938).

[3] "Über die mit glatten Rumpfgliedern versehenen russischen Trilobiten, nebst einem Anhange über die Bewegungsorgane und über das Herz derselben", *Mém. Imp. Acad. Sci. St.-Pétersbourg*, VIIe Sér., 6, No. 2, 9, 13, 15, Taf. II, Fig. 8 (1863).

[4] "British Trilobites from the Cambrian, Silurian, and Devonian Formations", *Mon. Palæont. Soc.*, 192, Fig. 50*B* (1866).

[5] "Trilobiten aus Estland", *Publ. Geol. Inst. Univ. Tartu*, No. 52 Pl. IX, Figs. 1–3, etc (1937).

'Auto-parasitism' by *Nemeritis canescens* (Grav.) (Ichneumonidæ)

THERE appears to be no published record of oviposition by an insect in the body of another of its own species. This interesting phenomenon, however, occurs in *Nemeritis canescens* (Grav.) (Hymenoptera: Ichneumonidæ), a parasite of the Mediterranean flour moth (*Ephestia kühniella* Zeller) in certain circumstances.

Nemeritis canescens breeds parthenogenetically and is ready to oviposit within half an hour after its emergence from the pupa. In a jar containing fully grown host larvæ, the parasites which develop from them do not emerge simultaneously. Those that emerge first try to oviposit in those that will emerge in a day or two. The parasite succeeds in laying one or more eggs if its ovipositor pierces the soft ventral side of the abdomen of the imprisoned parasite in the silken cocoon. The egg hatches into a larva which undergoes a part of its development in the abdomen of its host, which, nevertheless, develops into an imago and may live for some days afterwards.

Experiments corroborated the above observations. Two parasites were released for six hours in a small jar containing about forty advanced parasite pupæ from which the imagines were expected to emerge in a day or two. As each imago emerged, it was at once transferred to a tube and fed on sucrose solution until it died. Twenty-five such parasites were fed in this way, and inside the abdomen of two of them partly developed parasitic larvæ were found. They were both dead.

In cultures where 80–100 parasites are reared in a jar the percentage is found to be much higher. For batches of 10–20 parasites emerge at intervals of 12–24 hours, and when two batches of about forty parasites have emerged the chance of some of these successfully ovipositing in those that are yet to emerge is high.

Another interesting fact observed was that in Ephestia larvæ, where superparasitism by *Nemeritis* is a common occurrence, all parasitic larvæ in one host, except one, die in the first instar. Nevertheless, in the abdomen of an adult parasite that was dissected two larvæ were found, one well advanced in the third instar and the other in the second instar.

E. S. NARAYANAN.

Department of Zoology and Applied Entomology,
Imperial College of Science and Technology,
London, S.W.7.
June 9.

Pure Ethyl Alcohol for Absorption Spectrophotometry

ETHYL alcohol which has been dehydrated by an azeotropic process is liable to contain traces of absorbent impurities, for example, benzene[1], which make it more difficult to purify for absorption spectrophotometry. Alcohol known to have been produced by one of the above methods was subjected to the following processes:

(1) To each litre of alcohol 20 c.c. of water and 4 c.c. of sulphuric acid were added and the mixture refluxed for 2–3 hours, after which it was distilled, rejecting the first and last 10 per cent.

(2) 1·5 gm. of silver nitrate was dissolved in the minimum quantity of water and added to the alcohol in a tall vessel. To this was then added drop by drop and without shaking a solution of 3 gm. potassium hydroxide in 10–15 c.c. alcohol. This allows the silver oxide to precipitate in a finely divided form, and the vessel is left until all the precipitate has settled. The silver oxide is either filtered off or the liquid decanted and distilled, rejecting the first and last fractions as before[2].

(3) To remove the water, the alcohol was refluxed with calcium oxide in an atmosphere of nitrogen, the oxide itself having been prepared in an atmosphere of nitrogen.

(4) The purification was completed by distilling the product from (3) in an atmosphere of nitrogen.

Of the various methods which have been suggested for the purification of ethyl alcohol, the above sequence was found to be the most satisfactory, each step extending the transmission farther into the ultra-violet, the absorption curve for the final product being almost identical with that found by Harris[3] and superior to that found by Leighton, Crary, and Schipp[4] and Bielecki and Henri[5]. A final distillation from aluminium amalgam did not increase the transmission in the ultra-violet.

ARCHIBALD CLOW.
GAVIN PEARSON.

Department of Chemistry,
Marischal College,
University of Aberdeen.

[1] Fritzweiler and Dietrich, *Z. Spiritusind.*, 53, 27 (1930).

[2] Dunlop, *J. Amer. Chem. Soc.*, 28, 395 (1906).

[3] Harris, *J. Amer. Chem. Soc.*, 55, 1940 (1933).

[4] Leighton, Crary and Schipp, *J. Amer. Chem. Soc.*, 53, 3017 (1931).

[5] Bielecki and Henri, *Ber.*, 45, 2819 (1912).

Points from Foregoing Letters

N. Bohr, R. Peierls and G. Placzek discuss the typical difference between nuclear reactions in the regions of discrete and continuous level distributions of the compound nucleus. The argument developed is used to clear up an apparent difficulty as regards the order of magnitude of the cross-sections of heavy nuclei for the photo-effect with ejection of neutrons.

La. Goldstein, A. Rogozinski and R. J. Walen have studied the diffusion of fast neutrons by uranium nuclei and the possibility of showing the emission of neutrons when this nucleus explodes. The sum of the cross-sections for elastic and inelastic scattering and for fission found implies that a chain reaction of fission, if such chain is possible, may be observed in a smaller mass than was hitherto thought necessary.

D. F. Gibbs and G. P. Thomson describe experiments with an intermittent source which show that the majority of the neutrons produced in the fission of uranium appear with a delay of less than 10^{-3} sec.

J. B. R. Rajam, P. C. Capron and M. de Hemptinne describe a method of determining the beta upper energy limits of radio-elements. The ordinary absorption data are used to construct the Fermi and Konopinski-Uhlenbeck curves, from which the upper limit is deduced by extrapolation. Results are given for radio-rhodium and radio-silver.

J. Aharoni suggests a new method for determining e/m for electrons of about a million volts energy. It is particularly applicable to electrons and positrons forming the continuous spectrum from radioactive bodies.

The exchange of phosphatide molecules between plasma and organs is compared by L. Hahn and G. Hevesy with the turnover of phosphatides in the latter.

C. R. Harington and R. V. Pitt Rivers report experiments confirming the recent observation of Ludwig and Mutzenbecher that treatment of casein with iodine under carefully controlled conditions yields a product which has physiological activity similar to that of thyroglobulin and from which thyroxine can be isolated. The mechanism of the formation of thyroxine under these conditions is discussed.

Some six periods of flaking have been recognized by J. Reid Moir upon the artefacts from the basal layer of the Cromer Forest Bed. One of the assemblages of specimens referred to is composed of the well-known yellow implements and flakes found upon the foreshore site at Cromer. The conditions existing at this site make it improbable that these specimens have been flaked by wave action.

R. D. Purchon states that in three families of Lamellibranchia the ctenidia are reduced to one demibranch on each side. This has always been assumed to be the inner one. By determining the position of the afferent and efferent veins, the former always running through the axis, it has been shown that in the Lucinidæ and Teredinidæ the inner demibranch has been lost; only in the Montacutidæ has the outer one been lost.

A. Lamont records an unexpected reduction in the number of cranidial muscle-scars in '*Illænus*' *proles* var. *shelvensis*, and points to the possible use of these features in the systematic subdivision of a difficult family.

An interesting phenomenon of one insect ovipositing in the body of another of its own species was observed in *Nemeritis canescens* (Grav.), by E. S. Narayanan. In Ephestia larvæ superparasitism by Nemeritis is a common occurrence, but all except one die in the first instar. In the abdomen of an adult parasite two larvæ were found, one in the third instar and the other in the second instar.

RESEARCH ITEMS

Artificial Parthenogenesis and Chromosome Constitution

An extensive study of the effects of artificial parthenogenesis upon the chromosome constitution of the cells resulting from the subsequent cleavages in the eggs of the frog *Rana nigromaculata* is reported by T. Kawamura (*J. Sci. Hirosima Univ.*, Series B, 1939). In most instances the successive cleavages occurred at the normal times, but in about 18 per cent they were delayed. The histories of 1,073 eggs were followed and in 413 that lived longer than seven days the chromosome number was determined; 49 per cent of these were haploid, 21 per cent were diploid, 23 per cent were triploid. The remainder were divided among tetraploid, hexaploid, hyperploid, haploid-diploid, haploid-triploid, haploid-pentaploid and triploid-hexaploid. In each instance an attempt is made to explain how the particular condition originated. The most viable type is the diploid. Some of the external characters of the parthenogenetic larvæ are described. The paper is provided with numerous tables and illustrations of the various chromosome conditions.

Properties of Renin

O. M. Helmer and I. H. Page (*J. Biol. Chem.*, **127**, 757; 1939) describe a method for purification of renin, a pressor substance from the renal cortex first described and so named by Tigerstedt and Bergman in 1898. The purest preparations raised arterial blood pressure 30 mm. mercury in dogs when injected in amounts representing 0·027 mgm. of nitrogen per kilo of body weight. In cats it was three times as active; 0·009 mgm. of nitrogen-containing extract produced the same rise. Colour tests for guanidin groups and for pentose were found to be especially strong in renin solutions, while those for adrenin were negative. Crystalline precipitates were formed on addition of flavianic acid or picric acid to hydrolysates of renin. The pressor action of renin in cats and dogs was not abolished by ergotamine or potentiated by cocaine, as is adrenin. Cats anæsthetized with pentobarbital supply suitable preparations for assay purposes.

Origin of Dahlia Varieties

A paper by A. J. Cobb (*J. Roy. Hort. Soc.*, **64**, Pt. 5, May 1939) gives a clear description of the origins of several types of garden dahlias. Vicente Cervantes, director of the Mexico Botanical Gardens, sent seeds and roots of *Dahlia pinnata* to Madrid, for the Abbé Cavanilles, in 1785, though the plant had been known in Mexico as early as 1575. *D. coccinea* and *D. rosea* were also described by Cavanilles in 1791. These three species were the parents of all the garden and show varieties until the appearance of the cactus dahlia. This last type was introduced by Henry Cannell in 1879, and was named *D. Juarezii*. Still another form, *D. Merckii*, was used as a parent in 1903, and thereby the forms with dark central disks and light ray florets were brought within horticultural practice. The dwarf 'Coltness Gems' are selections from progeny of this stock crossed with other garden varieties. The paper under review also gives detailed accounts of the practical cultivation of dahlias.

Triploid Red Alga

Kathleen M. Drew (*Ann. Bot.*, N.S., **3**, 347–368; 1939) has studied populations of *Plumaria elegans*. Plants bearing sexual organs have 31 chromosomes and plants bearing tetrasporangia have 62 chromosomes. A cystocarp results from fertilization, and reduction division takes place in the tetrasporangium. In addition, several plants bearing parasporangia and an occasional tetrasporangium had 93 chromosomes. These triploids form triploid paraspores. The development of the parasporangia is shown to be distinct from that of tetrasporangia, and the relationship between the triploid plants and the diplobiontic life-history of the species is as yet unknown.

Fruit Flies of China

We have received a copy of *Sinensia* (Contributions from the National Institute of Zoology and Botany, Academia Sinica, vol. 8, No. 2, April 1937). This journal is a bi-monthly publication and each volume comprises six parts with a total of 500–800 pages. It is to be obtained from the director of the Institute, 68 Ching Hsien Street, Nanking, price 6 dollars (Chinese) for foreign subscribers. The present issue is largely occupied by an important paper on the Trypetidæ or fruit flies of China, by Y. Zia, (pp. 103–226). Altogether 101 species are recognized, including one genus and 16 species that are described as new. This memoir is of special interest to workers on oriental Diptera and is a carefully executed and well-illustrated contribution. The remainder of the present issue of the journal is occupied by a paper entitled "Additional Fungi from China", (6), by S. C. Teng and S. H. Ou (pp. 227–297).

Fruit Breeding in the U.S.A.

The *American Fruit Grower* of March contains articles on the breeding of new varieties of fruits. M. A. Blake summarizes some of the results of the breeding programme started at the New Jersey experiment station in 1914 to determine facts about the inheritance of characters in the peach and to develop varieties of higher quality than those existing at the time. It takes at least five or six years to make a cross and obtain the first good crop of fruit. The following facts have been established during the past twenty-five years. When a variety with pure white-fleshed fruit was crossed with another white-fleshed variety, the progeny all gave pure white-fleshed fruit. Crosses between two heterozygous white-fleshed varieties gave progeny 75 per cent of which gave white-fleshed and 25 per cent yellow-fleshed fruit. A variety with pure white-fleshed fruit crossed with a yellow-fleshed variety gave an all white F_1 generation. Red flesh around the pit was found to be dominant over absence of red, whilst heavy pubescence was dominant over light or absence of pubescence. Small size of fruit was dominant over large. J. C. Miller contributes an article on strawberry breeding at the Louisiana experiment station. The variety Klondike accounts for 95 per cent of the total plantings in this area. Breeding experiments aim at raising varieties sweeter than Klondike, but with the same shipping qualities and resistant to leaf spot (*Mycosphærella fragariæ*) and scorch (*Diplocarpon earliana*). Crosses have been made between varieties which show any resistance to these diseases. The resulting fruit is fermented to free the seeds, which are then dried and cold-stored until December. They are germinated in a greenhouse and the best plants planted outdoors in May; 20 to 40 of the 250 to 600 plants produced by each seedling are transplanted and sprayed every ten days with spore suspensions of the leaf spot and scorch diseases. All except 2–5 per cent of the seedlings are eliminated in the first year, the remainder being studied further for yield and quality.

Lime Sulphur Injury

LIME sulphur has been used as a fungicide for more than a hundred years and is still the most effective agent known for the control of apple scab. In certain conditions, however, it causes considerable damage to foliage and fruit. Scorching of the leaves and shedding of fruit are the most obvious symptoms, but recent work (summarized by Norman F. Childers, *American Fruit Grower*, April) has shown that less obvious but equally serious damage may result. Trunk growth of trees sprayed with lime sulphur may be much reduced, and reductions in the leaf growth of apples and cherries have been demonstrated. Heinicke and Hoffmann have recently shown that spraying may seriously reduce the rate of photosynthesis, especially at high temperatures. These reductions persisted for seven days or longer, with no apparent external injury to the leaves. Preparations of elementary sulphur are generally much less damaging in this respect, but on the other hand are less effective against bad attacks of scab.

The Smut Fungi

PROGRESS of knowledge about the life-cycles of the smut fungi has gradually revealed a bewildering though fascinating variety, which Miss Kathleen Sampson described in her presidential address to the British Mycological Society (*Trans. Brit. Mycol. Soc.*, 23, No. 1, 1–23, May 1939). The Ustilaginales show a general similarity of life-history to the larger Hymenomycetes, but each species appears to have its own characteristics. Fusions of nuclei appear at different stages, but are often associated with the young chlamydospore. Meiosis often follows close after fertilization. Heterothallism is common but is occasionally a complex organization, with four factors instead of two. Smut fungi appear readily to adopt a saprophytic mode of life, a fact which should not be forgotten when economic measures of control are being planned. The plus and minus strains of simple heterothallic forms can often be separated by growth upon selective media. Genetic implications of heterothallism are also discussed, whilst the frequency of specific hybrids and the ever-increasing number of physiological forms raise considerable anxiety as to the validity of species concepts. An examination of the available evidence leads Miss Sampson to the conclusion that the parasitic mycelium of smut fungi has two types of nuclei associated in a loose partnership which is more typical of the Hymenomycetes than the Uredinales. The paper provides a wealth of information for the teacher in mycology, and is an authoritative stocktaking of extant knowledge about a very difficult group of fungi.

A Fungus upon the Liverwort *Riccia Himalayensis*

LIVERWORTS are occasionally attacked by fungi. The Jungermanniales provide the most numerou hosts but an increasing number of the Marchantiales are now known to be subject to fungal attack K. S. Srinivasan has recently described a furthe parasite on *Riccia himalayensis*, a liverwort growing in Madras (*Trans. Brit. Mycol. Soc.*, 23, No. 1, 55–62 May 1939). The fungus is *Phærosphærella Riccia* and it appears to be limited to the gametophyte stage of its host. Spermogonia and perithecia are formed with numerous asci, but the oogonia are non-functional and rapidly disintegrate. The spermogonia liberate spermatia which, however, are of no use by themselves. Asci are produced from ordinary vegetative hyphæ. Sclerotia are formed in the liverwort thallus and serve to perpetuate the fungus from year to year

Movement of Water in the Soil

IN his presidential address to the Royal Meteorological Society, B. A. Keen gave an account of how a theory of the movement of water in the soil that has long been generally accepted, and which provides a simple and plausible explanation of certain traditional cultivation practices such as rolling, harrowing and hoeing, has had to be abandoned in recent years and to be replaced by a new theory developed and experimentally verified mainly by Haines and Schofield (*Quart. J. Roy. Meteor. Soc.*, April 1939.) The old theory is the capillary theory of soil water movement according to which the rain that percolates to some depth into the soil forms a reservoir that can be drawn on by plants in drought, the water ascending by capillary tubes, built up from the spaces between the soil particles, from saturated levels many feet below the surface to supply the roots of the plants at higher levels. According to this theory, harrowing and hoeing conserve moisture by destroying the top few inches of the capillary tubes and so checking evaporation from the surface, while rolling crops in spring reverses the process by diminishing the space between soil particles near the surface and so allowing the capillary tubes to bring water to the upper layers of the soil. It was found at Rothamsted from observations on the water level in cylinders closed at the bottom and filled with various soils, the top being kept free of weeds, that capillary rise actually does not exceed 3 or 4 feet even in such a drought as that of 1921. Haines showed, moreover, that the pore space in soil is essentially cellular, not capillary, and that with both increasing and decreasing moisture content the movement of water takes place through sudden changes corresponding with the abrupt emptying and filling of the cells. Schofield investigated the marked hysteresis in moisture content according as the soil is being moistened or dried. Under the new theory, it may be noted, the value of cultivation lies in the encouragement of soil crumb formation, while its control of soil moisture is confined to the removal of weeds that are competing for moisture and nutriment.

The Central Core of the Earth

Gutenberg and Richter, in their fourth paper "on seismic waves" (*Gerlands Beiträge zur Geophysik*, 54, 94–136; 1939) revise the travel times and velocities of such waves as have been given previously by them, using for the purpose observational data from deep focus earthquakes. The new tables contain calculated travel times for zero focal depth for the important phases of earthquake waves, and a re-interpretation of the observations of the waves *P′* and *SKS*. In this connexion the authors give a diagram showing the passage of longitudinal waves through the earth's core and exhibiting the refraction which, from their observations, appears to amount almost to total reflection for a wave approaching an inner core. A table is also given of the velocities of seismic waves and the calculated elastic constants of the materials through which the waves pass, all given as functions of the depth within the earth.

Preparation of *l*-Tartaric Acid

THE resolution of the mirror-image hemihedral crystals of sodium ammonium tartrate by Pasteur is the classical example of the resolution of racemic tartaric acid. Later, Pasteur observed that the mould *Penicillium glaucum* would consume ammonium *d*-tartrate from a solution of the racemate, thus effecting a preparation of ammonium *l*-tartrate. The third method of Pasteur was by salt formation with an optically active base, cinchonine. The latter was the only method of practical significance and was the usual procedure for the preparation of *l*-tartaric acid. The procedure is tedious and the yield poor. W. T. Haskins and C. S. Hudson (*J. Amer. Chem. Soc.*, 61, 1266; 1939) have now described an improved method of obtaining *l*-tartaric acid which gives an overall yield of more than 90 per cent. It depends on the resolution of racemic acid with 2[*d*-gluco-*d*-gulo-hexahydroxyl]-benzimidazole. In the same paper a new method of preparation of benzimidazoles substituted in the [2] position with sugar residues is described which is based on the reaction of aldonic acids or lactones with *o*-phenylenediamine, and the properties of a number of these substituted benzimidazoles are described. In the resolution, the racemic acid and base were dissolved in hot water, alcohol was added, and crystallization induced by scratching. The crystalline acid-*l*-tartrate salt which separated was washed with alcohol and could be recrystallized with negligible loss. The *l*-tartaric acid was obtained by precipitating the base with ammonia, precipitating the acid in the filtrate as the lead salt, and decomposing this with hydrogen sulphide.

Electrical Interference

WE have received from the British Thomson-Houston Company, Ltd., a pamphlet containing two papers by T. H. Kinman of its research laboratory entitled "Radio Interference Measurements" and "Electrical Interference in Flying" respectively. Considerable progress has now been made in producing 'radio-interference-free' electrical appliances, and in many cases troublesome 'interference' with radio can be very satisfactorily suppressed. The British Standards Institution now issues to manufacturers a special mark which they can stamp on their radio apparatus when it satisfies the limits of the disturbance tolerated in the B.S.I. specification. Measurements are at present mainly limited to the medium and long-wave broadcast frequencies between 1,500 and 200 kilocycles. In aeroplanes which have radio communication with the earth, great pains are taken to prevent interference produced by the ignition apparatus on board by waves of almost any frequency. In some aeroplanes, particularly those owned privately, where no devices for suppression are employed, the interference they produce with the radio apparatus of other aircraft or of television sets on the ground is very serious. If this aeroplane move parallel to other aeroplanes, it may cause danger as well as annoyance to them by preventing them from landing during fogs, etc. The low audible frequency which is heard after rectification in the receiver is characteristic of spark frequency and can be used to distinguish whether it comes from a magneto or a motor.

Catalogue of Double Star Orbits

A CATALOGUE of orbits for visual binaries is published from the Lund Observatory, Sweden, by B. Ekenberg. It supplements a preceding catalogue by Luplau Janssen, Fjeltofte and Lauritzen, who gave a list of all orbits computed up to 1926. Other catalogues by Finsen and by Baize have been published, but these usually select the best derived orbit for each pair. The catalogues from Lund give all computed orbits for any one star, and such a list will be found very useful by double-star observers and computers. The two Lund compilations contain 1051 orbits relating to some 197 systems. (The number of other pairs in which orbital motion, often very slow, is observable exceeds 1,500.) In addition, there are more than fifty orbits received after the printing of the Catalogue and given in an appendix. Among the interesting re-computed orbits included in the present list are: (1) γ Andromedæ BC with a period of from 55 to 56 years and a high eccentricity of 0·83 or 0·92 according to two separate computers. The present apparent separation of the component stars is about 0·43″. (2) α Centauri with a period of 80 years and eccentricity of orbit 0·52. (3) The spectroscopic binary *Aa*, comprising the brighter star of the well-known binary, ζ Ursæ Majoris (Mizar), with a period of 20·5305 days and eccentricity of orbit 0·53. The observations giving this orbit were made at Mt. Wilson with the 20-foot interferometer attached to the 100-inch reflector, the observed separation of the components being of the order 0·01″.

A Simple Wedge-Photometer

H. W. NEWTON has recently published a paper describing a simple wedge-photometer for observing bright chromospheric eruptions with a spectrohelioscope (*Mon. Not. Roy. Astro. Soc.*, 99, 5, March 1939). Within recent times there has been established a relationship between bright chromospheric eruptions and sudden ionic disturbances, and it has become necessary to obtain further data concerning the intensity of the solar eruptions. The simple wedge-photometer, described in the paper, is intended to make rapid measurements of the intensities of bright chromospheric eruptions observed with a spectrohelioscope. A secondary line shifter half the height of the primary one enables a comparison of the peak intensity of a flocculus to be made directly with the adjacent continuous spectrum. Each instrument requires certain corrections on account of its finite resolving power and also for scattered light. Uncorrected observations of bright eruptions will provide the order of magnitude and the time-intensity curve for any particular eruption. The instrument will fulfil its purpose—to make rapid observations in conditions where the phenomena under investigation are varying very quickly, and where speed rather than great accuracy is required.

RECENT EXPERIMENTAL RESULTS IN NUCLEAR ISOMERISM

By DR. B. PONTECORVO, LABORATORY OF NUCLEAR CHEMISTRY, COLLÈGE DE FRANCE, PARIS

THE hypothesis that two atomic nuclei indistinguishable in respect of atomic and mass number could nevertheless have different radioactive properties (the hypothesis of nuclear isomerism) was put forward for the first time by Soddy[1] in 1917. In 1921 uranium Z was discovered by Hahn[2]; by studying the chemical and radioactive properties of this element, Hahn deduced that uranium Z and uranium X_2 are isomeric nuclei. The problem of uranium Z has been taken up recently by Feather and Bretscher (*Proc. Roy. Soc.*, 165, 542; 1938). It should be noted that, for many years, uranium Z and uranium X_2 were the only known example of an isomeric pair.

After the discovery of artificial radioactivity, the study of isomerism received considerable impetus on account of the experimental material assembled in the course of research on artificial radio-elements. The first *certain* example of an isomeric pair to which it has been possible to attribute a mass number ($A = 80$) in the domain of the artificial radio-elements was furnished[3] by the study of the radioactivity produced in bromine by neutrons (slow and fast) and by γ-rays of great energy.

Then, as the experimental material on artificial radio-elements has increased, the number of pairs of nuclei which are undoubtedly isomeric has grown to such an extent that it is not possible to quote here all the investigations which have been published on the question. More than thirty such pairs are known and there is no doubt that the number still unknown is much greater. We can say, now, *that nuclear isomerism is by no means an exceptional phenomenon.*

It is natural to think that the physical difference between two isomeric nuclei is connected with two states of different excitation of the same nucleus (let us say ground state and first excited state). But in this case, how could the upper state be metastable, that is, how could it live for any length of time (greater than one day, in some cases)? By what mechanism would it be preserved from destruction in a very short time by the emission of an electromagnetic radiation? Weizsäcker has answered this question[4].

According to Weizsäcker's *hypothesis*, nuclear isomerism may be explained by assuming that *the lowest excited state of the nucleus has an angular momentum differing by several units from that of the ground state.* Selection rules may then be invoked to weaken considerably the probability per unit of time of the transition from the upper to the ground state of the nucleus. Of course, experiments which make it possible to test the truth of Weizsäcker's hypothesis are of great interest.

One of the most important points is the study of the γ-radiation eventually emitted in the transition from one isomeric state to another: I say "eventually emitted" because, the nucleus being radioactive, the upper state corresponding to one of the isomeric forms may be destroyed by an ordinary β transition. The γ-ray – β-ray branching ratio will depend on the relative life-times for the two modes of decay. The first researches made to observe this γ-radiation failed. But it should be noted[5] that the considerable difficulty in detecting this radiation might be due to the fact that transitions between isomeric nuclei can be strongly converted: in this case electrons of small energy would be emitted and not γ-rays.

The very complete theory of the internal conversion of radiations emitted in the transitions between isomeric states[6], given by Hebb and Uhlenbeck, Dancoff and Morrison, has shown that these radiations must have internal conversion coefficients of approximately 1. Since these calculations are based on Weizsäcker's hypothesis, it can be concluded that *experiments which prove that the conversion coefficient in question is very high would indicate, to a certain extent, that Weizsäcker's hypothesis is correct.*

Indeed, in the case of the isomerism of radio-rhodium, Pontecorvo[7] has observed a radiation of low-energy electrons, which he interpreted as an electron line emitted in the transition from the metastable state to the ground state of the nucleus.*

At the present time, after a number of recent experiments, *there is no longer any doubt as to the fact that these transitions are generally strongly converted.* In particular, in the cases of isomeric nuclei of radio-bromine[8] and of element 43[9], strong lines of conversion electrons have been photographed in the Wilson chamber or in the magnetic spectrograph. Of course, the internal conversion is accompanied by emission of X-rays: as a rule, the analysis of these rays is an invaluable test in the interpretation of these phenomena[8,10].

It is interesting to find possible genetic relations between isomeric states of the same nucleus (β-radioactive): in this direction an extremely brilliant method has been described by Segrè, Halford and Seaborg[11], who have succeeded in *separating*, one from the other, the two isomeric forms of radio-bromine. The principle of their method is as follows. Suppose the element, of which the isomeric states are being studied, can give compounds suitable for the application of the Szilard-Chalmers method of concentration. When the isomer in the upper state decays to the lower state, there is a γ-ray emission: corresponding recoil may be sufficient to knock the decayed atom out of the compound. The daughter activity can then be separated, as in the Szilard-Chalmers method.

---

* Note added in proof. A similar conclusion was independently obtained by Rusinow and Yusephovitch [*C. R. Acad. Sci. U.R.S.S.*, 20, 9 (1938)] who observed a soft electron radiation in the case of isomeric forms of radio-bromine.

This method, which has been successfully applied in several cases[12], can then be used (a) to separate known isomers in some cases; (b) to discover the existence of isomeric pairs, still unknown, in the study of artificial radioactivity.

Moreover, it has given a striking new proof that the transitions between isomeric states are strongly converted: in effect, the recoil due to the γ-emission is not sufficient to knock the decayed atom out of the compound, while the recoil of a conversion electron can be sufficient.

So far we have discussed radioactive isomers: the isomerism, in this case, implies a difference in the life-times of the isomers. It has been noticed by Pontecorvo[5] that β-stable nuclei with a metastable excited state ought not to be very rare and should be revealed by the study of the radiation emitted by this metastable state. These nuclei are interesting for the understanding of nuclear isomerism, because the radiation corresponding to the transition from one isomeric state to the other is not troubled by the presence of β- or γ-rays. It should be possible to obtain a β-stable nucleus in a metastable state, after a nuclear transmutation or a radioactive disintegration.

Dodé and Pontecorvo[13], by bombardment of cadmium with fast neutrons, have obtained an activity ($T = 50$ min.) which chemical proofs have shown to be due to an isotope of cadmium. On the other hand, there is no question of a reaction of simple neutron capture or of an $n,2n$ reaction. They interpreted the soft radiation emitted by cadmium (50 min.) as proceeding from a metastable state of an isotope of cadmium; the reaction of excitation without capture by fast neutrons (reaction n,n), having a considerable cross-section (some 10^{-24} cm.[8]), it is not impossible, indeed, that part of the nuclei so excited might fall into a metastable state.

Segré and Seaborg[9] have observed a metastable state of element 43, decaying (only a line spectrum of electrons) with a 6-hour period into the ground state, which is stable or perhaps radioactive with a long life: the 6-hour activity is daughter of a β-radioactive molybdenum.

A very interesting case has been observed and studied thoroughly by Goldhaber, Szilard and Hill[14]. They have obtained by the n,n reaction already quoted, a metastable state (^{115}In*) of ^{115}In, decaying with a period of 4·1 hours; moreover, the same state can be obtained after the disintegration of a radio-cadmium ($T = 2·5$ days). The radiation emitted by ^{115}In* has not yet been sufficiently studied; its properties are of the greatest interest both for the understanding of the nuclear isomerism and for that of isobaric pairs. In effect, ^{115}In and ^{115}Sn are one of the rare cases of stable neighbouring isobaric nuclei: ^{115}In* might then decay into ^{115}Sn (β-emission) or into ^{115}In, or into both together.

The same metastable state of ^{115}In has been obtained also by irradiating indium with 5·8 Mev. protons (reaction p,p), by Barnes and Aradine[15]. Nevertheless, it is not yet clear whether the mechanism of nuclear excitation is that discussed by Weisskopf, that is, excitation by the action of the electric field of the proton[16].

In all these cases and in others studied more recently[17], the metastable states of stable isotopes are obtained from *nuclear transmutations*.

Lazard and Pontecorvo[18] have tried a new method, by which *it would be impossible to transmute the nucleus* and, consequently, to obtain artificial radio-elements, the presence of which may interfere with the investigation.

This method consists of irradiating the target with a continuous spectrum of X-rays, the energy of which is less than the dissociation energy of the nuclei. Suppose the radiated nuclei have a metastable state; the X-rays may excite higher levels of the nuclei; a part of the nuclei thus excited can fall into the metastable state, and it is the radiation from this state which can be observed. The maximum energy of the continuous spectrum utilized was 1,850 kilo-volts: indium gives an activity of approximately 4 hours period, which is obviously due to the same metastable state ^{115}In*, of which we have already spoken. Similar results on the stable nuclear fluorescence of indium were obtained by Collins and others[19].

There is no doubt that new isomers of β-stable nuclei will be discovered, in the course of research undertaken in different laboratories; systematic research on the radiations emitted by metastable states will certainly be very useful for the understanding of nuclear isomerism.

In conclusion, we may remark that it is very probable, on account of the great number of known isomers, that the radiative transitions of life-times between, say, 10^{-7} sec. and 1 sec. are much more frequent than is generally supposed. These transitions, on the other hand, are strongly converted[6]. We would expect[20], consequently, that *transitions of this kind, with conversion coefficients approximately* 1, *may be found frequently*.

Indeed, in the radiation emitted in the capture of slow neutrons by gadolinium, a strong component of soft electrons has been observed by Amaldi and Rasetti[21] (life-time less than 10^{-3} sec.). Soft electronic components have also been observed in the capture of slow neutrons by other nuclei[12]. On the other hand, these strongly converted transitions may play a considerable part in the interpretation of γ- and X-spectra emitted by certain natural radio-elements[22].

[1] Soddy, *Proc. Roy. Inst.*, 22, 117 (1917).

[2] Hahn, *Ber. dtsch. Chem. Ges.*, B, 54, 1181 (1921).

[3] Kourtchatow, Myssowsky, Roussinow, *C.R.*, 200, 1201 (1935). Amaldi, d'Agostino, Fermi, Pontecorvo, Segrè, *Ric. Scient.*, 6, 581 (1935). Amaldi and Fermi, *Phys. Rev.*, 50, 899 (1936). Bothe and Gentner, *Z. Phys.*, 106, 236 (1937).

[4] Weizsäcker, *Naturwiss.*, 24, 813 (1936).

[5] Pontecorvo, *Congrès du Palais de la Découverte*, Paris, 1937, p. 118.

[6] Hebb and Uhlenbeck, *Physica*, 5, 606 (1938). Dancoff and Morrison, *Phys. Rev.*, 55, 122 (1939).

[7] Pontecorvo, *Phys. Rev.*, 54, 542 (1938).

[8] Valley and McCreary, *Phys. Rev.*, 55, 666 (1939). Sizoo, NATURE, 143, 681 (1939).

[9] Seaborg and Segrè, *Phys. Rev.*, 55, 808 (1939). Kalbfell, *Phys. Rev.*, 54, 543 (1938).

[10] Alvarez, *Phys. Rev.*, 54, 486 (1938). Roussinow, Yusephovitch, *Phys. Rev.*, 55, 979 (1939). Sizoo, ref. 8. Walke, Williams and Evans, *Proc. Roy. Soc.*, A, 171, 360 (1939).

[11] Segrè, Halford and Seaborg, *Phys. Rev.*, 55, 321 (1939).

[12] De Vault and Libby, *Phys. Rev.*, 55, 322 (1939). Le Roux, Lu and Sugden, NATURE, 143, 517 (1939). Seaborg and Kennedy, *Phys. Rev.*, 55, 410 (1939).

[13] Dodé and Pontecorvo, *C.R.*, 207, 287 (1938).

[14] Goldhaber, Hill and Szilard, *Phys. Rev.*, 55, 46 (1939).

[15] Barnes and Aradine, *Phys. Rev.*, 55, 50 (1939)

[16] Weisskopf, *Phys. Rev.*, 53, 1018 (1938).

[17] Delsasso, Ridenour, Sherr and White, *Phys. Rev.*, 55, 113.

[18] Pontecorvo and Lazard, *C.R.*, 208, 99 (1939).

[19] Collins, Waldman, Stubblefield and Goldhaber, *Phys. Rev.*, 55, 507 (1939).

[20] Pontecorvo, *C.R.*, 207, 230 (1938).

[21] Amaldi and Rasetti, *Ric. Scient.*, 10, 115 (1939).

[22] Hoffman and Bacher, *Phys. Rev.*, 54, 644 (1938). Pontecorvo, *C.R.*, 207, 856 (1938).

RECENT ADVANCES IN RADIO ENGINEERING

RADIO MEETING IN WASHINGTON

A JOINT meeting of the Institute of Radio Engineers and the International Scientific Radio Union (American Section) was held at Washington, D.C., during April 28–29, 1939. Twenty-four papers on the more fundamental aspects of radio communication were presented.

A paper of particular interest, by D. R. Goddard, RCA Communications, Inc., reported reception at Riverhead (Long Island), N.Y., of British television transmissions on 41·5 and 45·0 megacycles from Alexandra Palace, London. The British afternoon programmes, between 9.30 a.m. and 11.30 a.m. New York time, could be received at times during certain winter months with some clarity. The author showed motion picture reproductions of images received on a number of occasions, both clear and distorted. Multiple path transmission was believed to be responsible for some of the distortion. In the past few years, the latest date for which reception is possible has been steadily receding from March through February to January, and it seems probable that next winter no reception at Riverhead of these signals will be possible after December 31.

Prof. Leon Brillouin of the Collège de France presented a comprehensive theoretical discussion of the transmission of electromagnetic waves in hollow conductor pipes, and reported confirmatory experimental work. Pipes of elliptical cross-section have been investigated, as well as those of square cross-section. Acoustic analogies, as discussed by M. Brillouin (*J. Phys.*, 1906), have been found of material assistance in these studies. An application of this investigation is to the design of tuning units of small attentuation for very high frequencies.

W. E. Jackson, of the U.S. Civil Aeronautics Authority, described the use of ultra-high frequencies, as 63 megacycles, in radio aids to air navigation. These frequencies reduce multiple-course indications, and are particularly suitable for aircraft application where usual horizon limitations do not apply.

H. T. Stetson, of the Massachusetts Institute of Technology, reported corroboration of a lunar effect of radio transmission which he discovered and published several years ago. A large number of observations have been examined, and appear to yield fairly consistent results among themselves, indicating increased field strengths as the moon nears the meridian. Reference was made to a discussion of lunar effects by Appleton (NATURE, July 9, 1938, p. 71).

B. Trevor, of RCA Communications, Inc., reported measurements of attenuation at 500 megacycles and 250 megacycles through 500 feet of woods and underbrush, also over low scrub pines.

J. T. Henderson, J. W. Bell and H. R. Smyth, of the National Research Council of Canada, described a 12-inch cathode-ray direction finder and its application to determine the direction of atmospherics. A cathode-ray direction finder equipment, received some time ago from the Radio Research Board of Great Britain, was used at Ottawa. At Forrest, Manitoba, a newer direction finder, designed and constructed by the authors, was used, and avoided defects found in the older instrument. Observers in Florida and Puerto Rico co-operated, particularly in studies of hurricane disturbances. While it is not yet possible to locate storms by these directional observations of atmospherics, before the Weather Bureau locates them by aeroplane observations, such early location of storms is an object of the work.

S. S. Kirby and F. R. Gracely, of the U.S. National Bureau of Standards, reported comparisons of signals at broadcast frequencies received at Washington from Buenos Aires with signals received from Rennes, France, and other European stations. The measurements have usually been made from 1 to 3 a.m. Washington time. The South American path averages about twenty times as good as the European path, both as to average field intensity and as to range of night-to-night variations of field intensity. The observed transmitting conditions were compared with co-existing magnetic disturbances, and it appears that the poor transmitting conditions on the northern path (auroral zone) may persist several days after the magnetic disturbance has ceased, the day following cessation of the magnetic disturbance often being particularly bad.

Ralph Stair and W. W. Coblentz, of the U.S. National Bureau of Standards, described a precision instrument sent aloft with balloons for observing and reporting to the ground the distribution of ozone in the stratosphere. There is used a precision method of making such measurements by measuring the change in spectral distribution of ultra-violet solar radiation at different heights as the balloons rise. Measurements of intensity in the ultra-violet are made by a special cadmium photo-electric cell which covers the range from about 2800 A. to 3300 A., and these are transmitted to the ground by a small radio transmitter including a relaxation oscillator. The instrument has been described in the March 1939 *Bureau of Standards Journal of Research*. It has been sent up to heights of 27 km.; about two-thirds of the total ozone lies below this height. Maximum ozone content has been found at heights of about 25 km.

Andrew Alford, of Mackay Radio and Telegraph Co., reported studies at high frequencies of characteristics of antenna arrays. He described marked differences in the phase of signals received over relatively long distances from two similar transmitting antennæ, only a few hundred feet apart, operating at the same time on the same frequency. The keying of the two transmitters was interlocked, and the signals were received and compared at the receiving station as to phase and intensity on a cathode-ray oscillograph. It appears that the construction of a directive transmitting array to obtain gain may fail of its purpose if the signals from different antennæ arrive out of phase, due to transmission over different paths. Proper phasing of inputs at the transmitting array may be an effective control, to get proper co-operation between the different antennæ.

R. C. Colwell and A. W. Friend, of the University of West Virginia, reported studies of tropospheric flections at about 2,400 kc. Preliminary tests in njunction with data from simultaneous aeroplane ights indicate direct connexion with temperature d humidity variations in the troposphere, as flection at a temperature front. These reflections ay be susceptible of use for weather prediction, oth for primary data in localities where neither roplane flights nor *radio sonde* ascents are available, d also as secondary data to interpolate between ch regular flights and ascents at established ations (see NATURE, July 1, 1939, p. 31).

L. V. Berkner, of the Carnegie Institution of ashington, who has just returned from an extended isit to Australia, described foreign installations and chnique for ionospheric exploration. Observations t the Watheroo (Western Australia) station of the arnegie Institution were discussed in particular etail, especially with reference to the formation of he *E*-region, and there was pointed out the importnce of co-ordination of ionospheric measurements rom a number of stations widely separated over the arth, and the extensions of ionospheric knowledge lready so obtained.

N. Smith and A. S. Taylor, of the U.S. National ureau of Standards, described a project now under ay to predict monthly average ionospheric chareteristics and maximum usable frequencies for undisturbed days, for several months in advance. Such predictions are now being published each month in the *Proceedings of the Institute of Radio Engineers*. These predictions are related to sunspot numbers.

J. A. Pierce and H. R. Mimno, of Harvard University, reported on the reception of radio echoes from distant ionosphere irregularities. Studies of numerous reflection patterns strongly indicate that the delayed echoes are returned from regions where there is a marked curvature of the *F*-layer, as at the edge of the sunlit zone. There may be successive reflections between the *E* and *F* layers.

Other papers covered a comprehensive study of the characteristics of noise in radio reception, a field strength survey on 52·75 megacycles in the New York area, transmission on 7 megacycles between Los Angeles and San Francisco, a comparison of shunt and series excitation of a 0·55 wave-length uniform cross-section broadcast vertical radiator, inductive output tubes, shielding of radio-frequency ammeters, and additional ionosphere studies.

The meeting was preceded and followed by a number of informal round-table discussions of groups specialized in certain aspects of ionosphere and transmission phenomena. It is expected that a number of the papers presented will be published in the *Proceedings of the Institute of Radio Engineers*.

BEIT MEMORIAL FELLOWSHIPS FOR MEDICAL RESEARCH

A MEETING of the trustees of the Beit Memorial Fellowships for Medical Research, Sir Alfred Beit, the Earl of Onslow, Lord Harlech, Lord Rayleigh, Lord Macmillan of Aberfeldy, Prof. T. R. Elliott and Dr. H. L. Eason, was held on July 19, 1939. They received with regret the resignation from the advisory board of Sir F. Gowland Hopkins, who throughout the long period of twenty-five years has given wise counsel at the meetings of the Board and in his Biochemical Department at Cambridge has directed the research studies of perhaps a greater proportion of those elected to Beit Fellowships than any other head of a department has done. They also regretted the resignation of Sir Patrick Laidlaw after eight years of keenly attentive work. These vacancies were filled by the appointment to the Board of Prof. R. A. Peters, Whitley professor of biochemistry, University of Oxford, and of Mr. Paul Fildes, bacteriologist on the scientific staff of the Medical Research Council.

Former holders of fellowships have recently received appointments as follows: C. H. O'Donoghue (fellow 1912–13) to be professor of zoology at the University of Reading; J. T. Irving (fellow 1926–28), to be professor of physiology in the University of Cape Town, South Africa; G. F. Marrian (fellow 1927–30) to be professor of chemistry in relation to medicine in the University of Edinburgh; F. H. Smirk (fellow 1930–34), to be professor of medicine in the University of Otago, New Zealand; and H. P. Himsworth (fellow 1932–35), to be professor of medicine in the University of London and director of the Medical Unit at University College Hospital.

It was in 1910 that the first Beit fellow, now Sir Thomas Lewis, was elected, and last year's election in 1938 brought the total of all fellows elected to exactly 200. Women are eligible and have been elected from 1910 onwards, their total being 30 out of the 200. Of the 170 men, 6 have been elected to the fellowship of the Royal Society, and no fewer than 34 have already been appointed to university professorships, of which 5 were in physiology, 5 in pharmacology, 5 in medicine and 9 in chemistry or biochemistry. Eight of these past Beit fellows hold professorial chairs in the Dominions over-seas. None of the women has yet been promoted to a university professorship, though at least six of them are doing work of much distinction and one has for some years been director of an important research laboratory. The opportunities for a woman to obtain a university chair in a scientific subject are still restricted.

Though the Beit fellows have come from all parts of the British Empire and have afterwards gone to laboratory posts all over the world, in their choice of a place of research during their fellowships they have tended to group themselves at three main centres. Out of the total 200, the laboratories at Cambridge have held 55, and 29 of these were personally directed by Sir Gowland Hopkins in the great Biochemical School that he developed in the Dunn Laboratories immediately after their opening in 1925. University College and University College Hospital in London together have provided opportunities for the work of 39. The Lister Institute of Preventive Medicine has accepted 35. The trustees have expressed their gratitude to the directors of these and of the other laboratories in Great Britain and elsewhere who have not only guided the work of the Beit fellows attached to them, but also provided the laboratory cost of that work.

The original Trust in London was founded by Sir Otto Beit as a memorial to his brother, Alfred Beit, a colleague of Cecil Rhodes in his great plans for the future of British South Africa. The names of both these brothers, members of a German family from Hamburg who later received British naturalization, will live in their benefactions for the advantage of the Empire. Mr. Alfred Beit left large sums for South African universities, and also founded a trust for the development of communications in South and Central Africa. This trust has been of material assistance in the development of Rhodesia. Empire Day, 1939, saw the opening of a great bridge 500 yards long over the Zambezi, north-west of Salisbury and joining the two Rhodesias. The gift of this "Otto Beit Bridge" costing £180,000 came ten years after the building of the "Alfred Beit Bridge" at a cost of £130,000 over the Limpopo farther south; and much besides has been granted by this trust for other bridges, for education, school buildings, maternity homes, and other social services.

The Beit Trust for Medical Research, which is established in London, cannot afford such material evidence of its benefits, though actually a total of nearly £190,000 has been disbursed in fellowships since 1910. But the foregoing summary of the positions now held by past Beit fellows, men and women drawn from all parts of the Empire, shows how great and widely spread have been the intellectual gains through these fellowships. They have enabled men to live for three or four years whole-heartedly in an environment of research and by so doing to learn to devote the rest of their lives to scientific thought.

All correspondence of fellows and candidates should be addressed to Prof. T. R. Elliott, Honorary Secretary, Beit Memorial Fellowships, University College Hospital Medical School, University Street, London, W.C.1.

The following elections to new fellowships were made:

Fourth Year Fellowships (£500 a year): Dr. I. Berenblum, to continue his work on the production of cancer by skin irritants, and to study the metabolism of living cells in tissue culture (School of Pathology, University of Oxford); T. A. H. Munr to continue his studies of the role of inheritance i mental disorders (Royal Eastern Counties Institutio Colchester); Dr. A. Neuberger, to extend his wor on the chemistry of amino-sugars in elucidation the structure of natural compounds (Department Pathological Chemistry, University College Hospit Medical School, University of London); Dr. R. Pumphrey, to continue his studies on the nervou system of cephalopods and on the auditory process in insects (Zoological Laboratory, University Cambridge, and the laboratory of the Marine Bi logical Association, Plymouth).

Junior Fellowships (£400 a year): Dr. V. F Booth, for research on (1) the internal constituent of bacteria by means of a wet-crushing mill, (2) ca bonic anhydrase (Physiological Laboratory, Un versity of Cambridge); E. G. L. Bywaters, fo research on rheumatoid arthritis (British Post graduate Medical School, University of London) Dr. W. I. Card, for research on the inhibition o gastric motility and secretion by experimental studie on man (Medical Unit Laboratories and Sherringto School of Physiology, St. Thomas's Hospital Medica School, University of London); Dr. Hans Heller, fo research on the antidiuretic principle of post-pituitar extract (Medical Unit Laboratories, University Colleg Hospital Medical School, University of London); Dr M. S. Jones, for investigations on insulin treatment o schizophrenic mental states (Maudsley Hospital, Den mark Hill, University of London); Dr. B. Levi to investigate the effect of spatial configuration o antigens on immunological reactions (Clinical Chemical Laboratories, London Hospital, University o London); I. Mackenzie, for immunological investigations on constituents of tumours (Department o Surgical Research, University of Edinburgh); D A. F. Rawdon-Smith, for research on congenital dea ness (Physiological Laboratory, University of Cambridge); Dr. B. R. Record, to investigate the specifi soluble substance found in the tissues in acut vaccinial infection (Lister Institute of Preventiv Medicine, University of London).

TRENDS OF PROGRESS IN TECHNICAL CHEMISTRY

THE annual meeting of the Society of Chemical Industry, held at Exeter on July 10–15 under the presidency of Dr. V. G. Bartrow, the eminent Canadian industrial chemist, was noteworthy for a symposium on "The Trend of Progress" to which important papers on various subjects in the field of chemical technology were contributed (*J. Soc. Chem. Ind.*, 58, 587, 613, 635; 1939).

P. W. Tainsh (chief chemist to Lever Bros., and Unilever, Ltd.) reported on progress in oils, fats (other than edible) and detergents, pointing out that during the last twenty years important advances have been made in the methods of treating oils and fats to render them suitable for soap-making, and in particular bleaching and hydrogenation processes have been remarkably improved. The main development in connexion with the technical bleaching of oils has been in the application of activated bleaching earths. At one time the bleaching of oils was mainly carried out with natural earth, such as fuller's earth and with this the bleaching effect obtained with a oil such as palm oil, for example, was strictly limited Activated earths are obtained by treating the natura earths with hydrochloric or sulphuric acid and washing the earth down to a limited free-acid content Tallow is still bleached for soap-making purposes b treatment with activated carbon after neutralization

The progress made in technical hydrogenatio during the last ten or fifteen years has been of grea benefit to the soap-maker, and the hardened produc may be so controlled that suitable artificial fats ma be obtained from such materials as whale oil an fish oils which are equal in all respects, and for som purposes superior, to tallow. The use of preservative in preventing oxidation has been developed. Improvements in soap-making, drying and milling soap, th production of soap powders and soap products, ar recorded. One of the latest developments is that o e so-called soapless detergents. Normal soaps are dium and potassium salts of long-chain carboxylic ids. In soapless detergents the long hydrocarbon ain is retained, but by the introduction of a variety solubilizing groups other than the simple carboxyl oup, products are obtained which are not affected hard water. Such products are sulphated higher cohols (C_{12} to C_{18}), condensation products of fatty ids with isethionic acid, products of interaction of tty acid chlorides and methyl taurine, and of the lphonation of the product from high molecular eight phenols and ethylene oxide. Many of these roducts are in industrial use, although for general rposes it would appear that the newer detergents e still inferior to soap.

The trend of progress in cosmetics was reported by . S. Redgrove. Titanium oxide may replace zinc xide as a white face-powder. Lake colours and nthetic iron oxides are used for tinting, cellulose itrate nail enamel has replaced wax and powder olishes. Other topics dealt with included hair dyes ad creams, shampoos (including soapless products) nd face creams.

The cellulose industry, with special reference to he paper and allied industries, was dealt with by . Grant (chief chemist to J. Dickinson and Co.). ellulose derived from wood takes the first place mong the raw materials, although esparto grass is idely used in Great Britain for printing papers. riginally, three main processes were used for producing wood pulp: the acid process (sulphite pulp), e alkaline process (kraft pulps), and the mechanical rocess (for newsprint). The paper manufacturer is ow met in competition in the pulp market by the akers of rayon (artificial silk), plastics and explosives. Other types of wood are now being investigated, and in Germany the exploitation of beech ood has been fostered by a nationalistic policy and now reaching considerable proportions, and esparto om Italian North Africa is now being exploited in aly, where sunflower stalks, hemp stalks and straw re also making the country largely independent of utside supplies. A combination of the two previously parated processes of isolation and bleaching is now ccupying the cellulose industry, one process being hlorination with elementary chlorine. This enables bres to be used which were previously unsuitable r paper pulp. A process still undeveloped commercially is the extraction of impurities from mildly rocessed raw material by means of organic solvents.

The cellulose textile industry was discussed by L. A. Thomas (of Messrs. Courtaulds, Droylsden) nder the headings of production, dyeing, finishing nd testing. Various modifications in the properties f the viscose fibre are possible in new processes, ome varieties, for example, being suitable for motor yre cords, which have to withstand temperatures the region of 100°, and also the fibres imitating ool. Modifications in the acetylation of cellulose r the production of acetate rayon include the use f special solvents which are miscible with the sterifying agents, but prevent dissolution of the ellulose ester. In the dyeing section, an important end is the production of coloured yarn by the incororation of insoluble pigments in a finely dispersed orm in the rayon spinning mass, a process known as pin-dyeing. This is overcoming the difficulty of roducing fast shades on acetate rayon. Suitable igments are carbon black and organic fast pigments. n the finishing section, the use of crease-resisting finishes by suitable impregnation of the fabric with solutions which on heat treatment produce a resin or polymer *in situ*, is extending. The technique of stiffening fabrics by employing cellulose esters or ethers, either as an interlayer or as woven threads, which are then plasticized and hardened, is used for semi-stiff shirt collars and cuffs. Viscose staple fibre is finding an increased use in the cotton trade.

In a paper on insecticides by J. T. Martin and F. Tattersfield (of Rothamsted Experimental Station) it is pointed out that the use of these materials has very greatly increased in recent years. The older products are still of great importance, although the supremacy of some has been challenged. Among stomach poison insecticides, lead arsenate has so far withstood all attempts to replace it. Of the many hundreds of synthetic compounds tested, phenothiazine (thiodiphenylamine) has aroused the greatest interest; among other things it is a potent poison for the mosquito larva. Nicotine bentonite is effective against codling-moth. The use of glycero-borates as a dressing in the treatment of blow-fly on sheep has given very satisfactory results. The application of various fluorine derivatives, including sodium silicofluoride, as moth proofing of fabrics gives satisfactory results. Among contact insecticides, nicotine, rotenone-containing plants, pyrethrum, quassia and petroleum are predominant, and recent progress is mostly concerned with their chemistry, mode of application and range of utility. The development of winter washes as ovicides has been a marked feature of the last twenty years. Experiments indicate that some insect pests can become highly resistant to the toxic substances used in their extermination.

Fungicides are reported upon by H. Martin (Research Station, Long Ashton, Bristol). Attention has been given to the factors affecting the efficiency of fungicidal treatments, such as the amount of fungicide retained on the treated plant or seed. This is connected with the wetting properties of the spray. Instead of water, a carrier of the active spray ingredient may be a liquid of low surface tension exhibiting low contact angles, such as kerosene and aqueous solutions of surface-active materials. Another promising method is to dissolve the active constituent in an oil and then emulsify this in an aqueous phase; an example is a nicotine - cottonseed oil - Bordeaux spray. The number of established active constituents of fungicides is limited to sulphur, copper, mercury, formaldehyde, and a few less widely used materials, and recent experimental work has modified generally accepted views of the action of these.

The paper of Sir John Russell (director of the Rothamsted Experimental Station) on crop production dealt with new crops, such as sugar beet, mechanization, increasing grass land, and the fertility of British soils. Sir John finds no evidence for the deterioration of British soils. The effects of small quantities of boron, manganese, copper and zinc in plant nutrition is now recognized, and other elements such as cobalt, molybdenum, selenium, fluorine and iodine in appropriate quantities considerably influence the nutritive value of the crop and animals. The question of the effect of reduced production of farmyard manure on soil fertility is answered by the statement that there is no evidence that it has lowered the fertility of British soils; there has been a corresponding shrinkage in area of arable land, and the grassland which has replaced it does not need farmyard manure.

GEOTHERMIC POWER IN ITALY

THE formation of a large company in Italy—Larderello S.A. per lo Sfruttamento delle Forze Endogene—with a capital of 54, and perhaps later of 150, million lire, for utilizing the natural heat sources of Italy, may well be regarded as a consummation of the life work of Prince Ginori Conti. He is honorary president of the new company which has taken over many of his patents together with his company, the Societa Boracifera di Larderello; and among other distinguished people on the board of directors is Dr. G. Fauser, the inventor of the well-known electrolytic cell.

In a small book published last year, Prince Conti described his new and well-equipped laboratory for research in this field, which he says dates back to 1906, and is a continuation of "the long and noble tradition" originating with Hofer who, in 1777, discovered boric acid in the Lagon Cherchiaio di Monterotondo. In 1916 was established the first and still probably the only Centrale Geotermica in the world, developed later into a Supercentrale of some 90,000 kw. The yield of gas and fume from the fumaroles (Ital. fumaioli or fumaruoli) and soffioni has increased very remarkably from a few hundred thousand kilos to two million kilos of fume or vapour per hour, besides enormous quantities of gas. The latter occurs in the proportion of about 30 litres gas to 1 kilo of fume, and consists of 93 per cent carbon dioxide, 2·5 per cent hydrogen sulphide, and combustible residue the composition of which is approximately 38 per cent hydrogen, 39 per cent methan 22·6 per cent nitrogen, together with small propo tions of helium, neon, argon, krypton, and xenon.

A well-equipped research station has for some tin been engaged on the analysis and industrial pos bilities of these various products.

The work is under the personal supervision Prince Conti, with the assistance of his son, D Giovanni Ginori Conti, Prof. Umberto Sborgi ar other distinguished Italian men of science ar engineers. The organization comprises librar administrative offices, and various departments f chemical, physical, geological, mineralogical, geoph sical, and seismographical investigations, not only connexion with the fumaroles and soffioni but also the 'boric acid fields' around Larderello. Since th operations of the new company extend to the who of Italy other similar research stations will doubtle be established in other districts, with Larderello headquarters. Provision is made, *inter alia*, for hig and low-temperature and high-pressure investigation the former ranging from −254° to 2000° C. and th latter up to 1000 atmos. Semi-large scale workin is also included, and a pilot plant has been installe for dealing with 150 cu. m. per hour. Among th principal items in the research programme at presen are the recovery of helium and other rare gases, al of hydrogen, methane, and a synthesis gas mixtu of hydrogen and nitrogen, presumably for ammon production and derivatives, such as nitric acid, etc.

TRAINING OF ENGINEERS

IN the June issue of the *Journal of the Institution of Civil Engineers* is published the record of a joint informal meeting of the three Institutions—Civil, Mechanical and Electrical—at which Mr. T. G. Rose introduced the subject "The Importance of a Training in Management for Engineers". Following the two claims (1) that the fundamental principles governing sound industrial management were now sufficiently clearly defined to be teachable, and (2) that a knowledge of these principles would be of advantage to an engineer in the pursuit of his profession, he indicated several systems on which the desired instruction might be given.

That the need of this is keenly realized was made evident by the brisk discussion, but the views expressed were very divergent as to how and when the training should be given. Some considered that it could only be usefully imparted to those who had had experience, while others held that the principles could be taught at an early stage. One suggestion was that the three Institutions should arrange lectures and meetings at which the problems of industrial management would be discussed by practical men. This would, no doubt, provide a finishing course which could be read and studied by all those, wherever situated, who had already been taught the fundamental principles. No clear indication was given as to the method of providing this elementary instruction, but there was a suggestion that it might form part of the production side of th National Certificate scheme. This, however, already heavily burdened and a little consideratio will show that, unless the subject is made optiona it will to some proportion of the students be a di tinctly unwelcome one forced upon them.

In the same issue of the *Journal* it is interestin to note the intimation that the Council will promot a conference on engineering education and trainin during the course of next session and has invited th universities and other bodies to appoint represent tives to form a general organizing committee. Th time is ripe for such a conference, for it is near thirty years since the last, and one would expect tha to ensure steady development, five-yearly co ferences would be held. At present it is very large left to the colleges themselves to devise systems an curricula, and the several branches of the professio take but a perfunctory interest in a matter so close affecting them. In consequence, there is a very lar class of students whose interests are wholly neglecte by the Institutions. This class consists of all tho who are outside the reach of the recognized college and for whom some authoritarian training should envisaged as at present is provided for those mo fortunately placed. Some responsibility rests o those who control the National Certificate arrang ments in respect of the thousands of students wh are, in effect, barred from them.

SCIENCE NEWS A CENTURY AGO

Baron de Prony, 1755-1839

On July 29, 1839, the distinguished French mathematician and engineer, Gaspard-Claire-François-Marie-Riche, Baron de Prony, died at Asnières, near Paris, at eighty-four years of age. For many years he had been the senior member of the Corps des Ponts et Chaussées and was famous both as a writer and a constructor. Born near Lyons on July 11, 1755, he had been trained under Perronet, "the Telford of France", at the École des Ponts et Chaussées, and afterwards became his assistant. With Perronet, too, he visited England. During the Revolutionary era, Prony formed one of the commission entrusted with the reformation of the French weights and measures and with the great survey of France. In connexion with this he organized and trained a body of computers for forming the logarithmic tables required, the result being seventeen large volumes of tables, afterwards deposited in the Paris Observatory. In 1798 he was raised to the rank of inspector-general in his corps and soon afterwards succeeded Chezy as director of his old school.

Though he declined to join the group of scientific men who accompanied Napoleon on his expedition to Egypt, Prony was employed by Napoleon on many considerable works in Italy, and with Count Fossombroni was entrusted with the drainage and improvement of the Pontine Marshes. His principal literary work was his "Nouvelle architecture hydraulique" published in 1790–96. He was one of the first professors of the famous École Polytechnique and one of the first members of the Institut de France. In 1817 he was made a member of the Bureau des Longitudes, in 1818 the Royal Society elected him a foreign member, in 1827 he was made a baron and seven years later a peer of France.

Dumont d'Urville's Voyage in the *Astrolabe*

On July 30, 1839, Captain Dumont d'Urville wrote from the *Astrolabe*, then at the island of Mindanao: "Our navigation since the 2nd of July, the day of our departure from Singapore, has been fertile in results. We have touched at Sambas, in the island of Borneo, closely reconnoitred the islands of Natunas, Balambangan, Banguey, and the northern portion of Borneo. Finally we have passed four days in the road of Sooloo. The people of these several places have acquired from our communications clearer notions in relation to the flag and power of France: they desire much to see the rest of our ships. I am about to spend a week at Samboangan. I shall depart there on the 6th of August, and reckon on reaching Port Jackson about the middle of December."

Society for the Diffusion of Useful Knowledge

On August 2, 1839, this Society sent out a letter from its headquarters, 59 Lincoln's Inn Fields, London, signed by Lord Brougham, which said: "It is the wish of the Committee of the Society for Diffusion of Useful Knowledge, to establish a correspondence among the various Mechanics' Institutions in England, and between them and this Society, so that neighbouring institutions, by dividing the travelling expenses of lecturers among them, may diminish the cost of each course of lectures; that one set of apparatus, or collection of models or specimens of natural history, or even one set of books, may serve for many institutions; and that local collections and duplicates from libraries and museums, may be interchanged all over the country".

By the issue of an annual report, correspondence and the interchange of suggestions, it was hoped to make the experience of one institution serve as a guide to others, and by collecting information to be able to issue an annual summary on the progress of adult education in Great Britain.

To further these objects, the Society called a meeting of representatives of institutions in London and neighbourhood which was attended by about forty, when a committee of delegates was appointed.

The Society for the Diffusion of Useful Knowledge existed from 1827 until 1846. It published a series of cheap books on science, history and literature, and also the *Penny Cyclopædia*.

UNIVERSITY EVENTS

Edinburgh.—At the graduation ceremonial on July 19 the honorary degree of doctor of laws was conferred on Dr. F. H. A. Marshall, fellow and dean of Christ's College, Cambridge, and reader in agricultural physiology in the University of Cambridge. On the previous day, Dr. Marshall declared open in the Edinburgh University Settlement the Wilkie Memorial Library, which has been established in recognition of the great interest which the late Sir David Wilkie and Lady Wilkie took in the work of Settlement.

Leeds.—Dr. E. C. Stoner, reader in physics, has been elected to the recently instituted chair in theoretical physics.

The following appointments have also been made: Dr. N. H. Chamberlain to be lecturer in textile chemistry; Arthur Johnson to be assistant lecturer in weaving mechanism; Dr. C. S. Whewell to be assistant lecturer in finishing and research assistant in the Textile Department; J. W. Roderick and W. A. Linning to be lecturers in engineering; J. F. Gaunt to be research assistant in dyeing; Dr. J. Stubbs to be temporary research assistant (for bracken investigation) in the Agricultural Department.

Prof. F. A. E. Crew, director of the Institute of Animal Genetics, Edinburgh, has been invited to deliver the Clive Behrens Lectures in the Agricultural Department during the two years 1939–1941.

London.—W. G. Barnard has been appointed, as from October 1, 1939, to the University chair of pathology tenable at St. Thomas's Hospital Medical School. Since 1931 he has been consultant histologist to the London County Council and pathologist-in-charge of the London County Council Central Histological Laboratory, Archway Hospital.

The title of reader in medicine in the University has been conferred on Dr. E. F. Scowen in respect of the post held by him at St. Bartholomew's Hospital Medical College.

The degree of D.Sc. have been conferred on the following: Miss Daphne Atkins (Bedford College), Miss M. C. Brough (University College), Dr. W. H. Linnell, University reader at the College of the Pharmaceutical Society, and J. A. B. Smith (Imperial College of Science and Technology).

R. M. Calder has been re-appointed to the Graham scholarship in pathology for a further period of one year from November 1, 1939.

APPOINTMENTS VACANT

Applications are invited for the following appointments, on or before the dates mentioned:

Principal Technical Officer and a Senior Technical Officer at Air Ministry Headquarters—Under-Secretary of State, Air Ministry (S2A/B3019), Berkeley Square House, W.1 (August 4).

Chief Assistant Engineer—Clerk of the County Council, County Buildings, Stafford (August 5).

Assistants Grade III—Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. (quoting A340.0) (August 11).

Technical Officer—Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (quoting A399.0) (August 12).

Assistant Lecturer in Botany (Grade III)—Registrar, University, Liverpool (August 15).

Lecturer in Anatomy—Secretary to the University, Aberdeen (August 18).

Physical Chemist—Director of Research, Research Association of British Flour-Millers, Old London Road, St. Albans (August 19).

Lecturer in Biology—Secretary, Royal (Dick) Veterinary College, Summerhall, Edinburgh 9 (August 20).

Waterworks Engineer—Town Clerk, Town Hall, Bradford (August 28).

Lecturer in Electrical Engineering—Secretary, University, Edmund Street, Birmingham 3 (August 30).

Demonstrator in Physiology—Registrar, University, Liverpool (September 1).

Lecturer and Studio-Instructor (Ungraded) in Architecture—Registrar, University, Liverpool (September 18).

Head of the Physiology Department—Secretary, Rowett Research Institute, Bucksburn, Aberdeenshire (September 30).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

The National Central Library. 23rd Annual Report of the Executive Committee, 1938–39. Pp. 77. (London: National Central Library.) [127

Permanent Consultative Committee on Official Statistics. Guide to Current Official Statistics of the United Kingdom. Vol. 17 (1938): Being a Systematic Survey of the Statistics appearing in all Official Publications issued in 1938. Pp. 404. (London: H.M. Stationery Office.) 1s. net. [127

The Strangeways Research Laboratory. Report for 1938. Pp. 24. (Cambridge: Strangeways Research Laboratory.) [137

Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences. Vol. 229, No. 564: Fused Neurons and Synaptic Contacts in the Giant Nerve Fibres of Cephalopoda. By John Z. Young. Pp. 464–503+plates 42–48. (London: Cambridge University Press.) 15s. [147

New Zealand Council for Educational Research. Studies in Education, No. 4: Science and the Community. By Prof. Alexander Findlay. Pp. 18. (London: Oxford University Press.) 1s. net. [147

City of Gloucester: Public Museum and Folk Museum. Short Guide to the Collections. Pp. 20. (Gloucester: Public Museum.) 3d. [147

Air Raid Precautions. Handbook No. 11: Camouflage of Large Installations. Pp. v+15. (London: H.M. Stationery Office.) 3d. net. [157

Statements relating to the Emergency Hospital Organisation, First Aid Posts and Ambulances. (Cmd. 6061.) Pp. 23. (London: H.M. Stationery Office.) 4d. net. [157

How to Stock your A.R.P. Larder: One Week's Emergency Food Store chosen by the *British Medical Journal*. Pp. 12. (London: British Medical Association.) 2d. [177

Transactions of the Royal Society of Edinburgh. Vol. 59. Part 3, No. 23: The Arrangement of Fibre Follicles in some Mammals, with Special Reference to the Ovidae. Being selected and illustrated Notes made by the late Dr. J. E. Duerden, compiled by Dr. A. B. Wildman. Pp. 763–771+4 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 2s. 6d. [187

Cambridge Observatory. Annual Report of the Director, 1938 May 1–1939 April 30. Pp. 4. (Cambridge: Cambridge Observatory.) [187

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 6: Carbon Bisulphide Vapour. Pp. iv+8. (London: H.M. Stationery Office.) 3d. net. [197

Air Ministry: Aeronautical Research Committee. Report for the Year 1938. Pp. 48. (London: H.M. Stationery Office.) 1s. 6d. net. [217

Other Countries

The Greatest Discovery of the Age. By Raj Vaida Anand Swami. Pp. 26. (Colombo. Kaya Kalpa Kanan (Rejuvenation Home).) 8 annas. [107

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 175: Flight Tests on the Range of the Kôken Long-Range Monoplane. By Hidemasa Kimura and Tatuo Takatuki. Pp. 127–148. 50 sen. No. 176: On Direction Finder. By Daizo Nukiyama, Mitsunobu Irisawa and Tasaburo Kobayasi. Pp. 149–192. 70 sen. (Tôkyô: Kôgyô Kosho Kabushiki Kaisha.) [127

Indian Lac Research Institute. Bulletin No. 33: Studies on the Constitution of the Shellac Complex. Part 1: Interaction of Tolyliodochloride with Shellac. By M. Venugopalan, H. K. Sen and S. C. De. Pp. 14+5 plates. 3 annas. Bulletin No. 34: Studies on the Constitution of the Shellac Complex. Part 2: Unsaturation in Shellac. By Y. Sankaranarayanan, M. Venugopalan, S. C. De and H. K. Sen. Pp. 8+2 plates. 3 annas. (Namkum: Indian Lac Research Institute.) [137

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Magnetisk Aarbog, Del 2: Grønland, 1932–1933. Pp. 22+xxviii+9+xxviii. (København: G. E. C. Gad.) [157

Sveriges Geologiska Undersökning. Ser. C, No. 419: Berggrunden inom sydöstra delen av Stockholms skärgård. Av Nils Sundius. Pp. 93. 2.00 kr. Ser. C, No. 423: Sjösediment från området Abisko-Kebnekaise. Av G. Lundqvist. Pp. 127. 2.00 kr. Årsberättelse for år 1938. Pp. 8. 0.50 kr. (Stockholm: P. A. Norstedt and Söner.) [177

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 17, No. 4: The Swedish Ordovician and Lower Silurian Lichidae. By Elsa Warburg. Pp. 162+14 plates. Serien 3, Band 17, No. 5: Studies in Species of Lecanora, mainly the *Aspicilia gibbosa* Group. By A. H. Magnusson. Pp. 182. (Stockholm: Almqvist and Wiksells Boktryckeri A.-B.) [177

Coconut Research Scheme (Ceylon). Bulletin No. 3: Annual Reports of the Soil Chemist for the period July 1933 to December 1937. By Dr. M. L. M. Salgado. Pp. iv+76. (Lunuwila: Coconut Research Scheme.) [177

British Honduras. Report of the Forest Department for the Year ended 31st December 1938. Pp. 25. (Belize: Government Printer.) [177

Ceylon. Part 4: Education, Science and Art (F.). Administration Report of the Director of the Colombo Museum for 1938. By A. H. Malpas. Pp. F19. Colombo: Government Record Office.) 20 cents. [177

Zoological Survey of India, Calcutta. Consolidated Report on the Shell-Fisheries in the Andamans during the Years 1930–35, with Extracts from Earlier Reports. Pp. v+130+2 plates. (Delhi: Manager of Publications.) 4.5 rupees; 8s. 3d. [177

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1931–1932. English Version, Part 1. Pp. 102+24 plates. (Cairo: Government Press.) P.T.50. [187

League of Nations: Advisory Committee on Social Questions. Study on the Legal Position of the Illegitimate Child. (Official No.: C.70. M.24. 1939. IV.) Pp. viii+194. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 4s. [187

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 198: A Yield Analysis of Egyptian Wheats. By Dr. James Philip. Pp. ii+22+5 plates. P.T.3. Bulletin No. 207: Biological Studies of some Hymenopterous Parasites of Aphidophagous Syrphidae. By Dr. M. Kamal. Pp. ii+111. P.T.10. (Cairo: Government Press.) [197

The American Philosophical Society. Year Book 1938. Pp. 407. (Philadelphia: American Philosophical Society.) [197

Sixty-first Report of the Connecticut Agricultural Experiment Station, New Haven, for the Year 1937. Pp. xi+790+106. (New Haven, Conn.: Connecticut Agricultural Experiment Station.) [197

Smithsonian Institution: Bureau of American Ethnology. Bulletin 121. Archeological Remains in the Whitewater District, Eastern Arizona. Part 1: House Types. By Frank H. H. Roberts, Jr. Pp. xii+276+80 plates. 50 cents. Bulletin 123: Anthropological Papers. Pp. viii+306+32 plates. 60 cents. (Washington, D.C.: Government Printing Office.) [197

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 774: Geology and Ground-Water Resources of the Snake River Plain in Southeastern Idaho. By Harold T. Stearns, Lynn Crandall and Willard G. Steward. Pp. ix+268+31 plates. 1.25 dollars. Water-Supply Paper 826: Surface Water Supply of the United States, 1937. Part 6: Missouri River Basin. Pp. vii+376. 45 cents. Water-Supply Paper 827: Surface Water Supply of the United States, 1937. Part 7. Lower Mississippi River Basin. Pp. iv+173. 25 cents. Water-Supply Paper 829: Surface Water Supply of the United States, 1937. Part 9: Colorado River Basin. Pp. v+197. 30 cents. (Washington, D.C.: Government Printing Office.) [197

U.S. Department of the Interior: Office of Education. Leaflet No. 14: Pharmacy. By Walter J. Greenleaf. Revised edition. Pp. 22. 5 cents. Pamphlet No. 86: Per Pupil Costs in City Schools, 1937–38. By Lulu Mae Comstock. Pp. 21. 5 cents. (Washington, D.C.: Government Printing Office.) [207

League of Nations: European Conference on Rural Life. Report of the Preparatory Committee on the Work of its First Session. Pp. 9. 6d. National Monograph 1: Finland. Pp. 59. 1s. 6d. National Monograph 2: Belgium. Pp. 66. 1s. 6d. National Monograph 10: The Netherlands. Pp. 55. 1s. 6d. National Monograph 11: Latvia. Pp. 92. 1s. 6d. National Monograph 12: Lithuania. Pp. 47. 1s. 6d. Technical Documentation No. 13: General Survey of Medico-Social Policy in Rural Areas. Pp. 46. 1s. Technical Documentation No. 15: Sickness Insurance and Rural Medical Assistance. Pp. 33. 9d. Technical Documentation No. 16: Intellectual Aspects of Rural Life. Pp. 56. 1s. Technical Documentation No. 17. Recreation in Rural Areas. Pp. 34. 9d. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) [207

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Department of Agriculture, St. Lucia, 1937. Pp. v+45. (Castries, St. Lucia: Government Printing Office.) 6d. [217

League of Nations: Information Section. Questions, 12: World Health and the League. Pp. 44. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 6d. [217

Advisory Committee on Education. Staff Study No. 16: Public Education in the Territories and outlying Possessions. By Lloyd E. Blauch, assisted by Charles F. Reid. Pp. xv+243. (Washington, D.C.: Government Printing Office.) 35 cents. [227

Editorial & Publishing Offices:
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

Telegraphic Address:
Phusis, Lesquare, London

Telephone Number:
Whitehall 8831

Vol. 144 SATURDAY, AUGUST 5, 1939 No. 3640

DEMOCRACY AND LEADERSHIP

IN a volume entitled "Recovery: the Second Effort", Sir Arthur Salter outlined a scientific programme of recovery conspicuous for its vision and sense of values. He has now produced an equally comprehensive review* of the international ituation to-day, which outlines an equally scienific programme for retrieving security, no longer in the field of economics but in that of power politics. Beyond this, however, Sir Arthur has given us not only a frank and realistic picture of he grave dangers which confront democracy and all that it stands for to-day, not merely a challenge, but also a vision of hope. Through all the dangers which now confront democracy, he sees its innate strength. Its weakness can still be repaired in time f we but bring to the service of its virtues bred and nursed to the pursuit of peace, the sterner virtues of fortitude, energy, the will to act together, the free acceptance of discipline and sacrifice. Faults of organization and leadership can be made good if recognized, and the book is to be welcomed even if only for this reminder that with courage and vision, the recognition of danger and not the refusal to see it, we can yet eliminate the sources of weaknesses in the free democracies.

Sir Arthur opens with a trenchant analysis of the chief material and political factors involved n the present position, and sets in clear relief the dangers confronting the democracies and the factors likely to precipitate conflict or avert it. Scientific workers, no less than the general reader, should welcome this sane and concise review of the situation.

The second part of the book consists of a brief review of the events and ideas which have been responsible for the failure to achieve collective security in the last two decades through the League of Nations. In this review, emphasis is laid in the transformation of the character of the League from the start, through the abstention of the United States and later defections with their consequences.

Sir Arthur Salter urges the undesirability as well as uselessness of attempting amendment of the League Covenant at present. The main task in respect of the League is to keep its organization active and efficient by developing the useful work which it can continue on social, economic and financial and labour questions. This pertinent reminder of the valuable work which is still being done in a number of technical and scientific fields should not be lost on scientific workers. We must have regard both to the practical and to the ideal. The ultimate goal must be either the restoration of the League, or the construction of some other form of collective system, including the revision of treaties by collective negotiation. Until we achieve this, peace must be at best precarious.

The third part of the book, entitled "National Strength", which is the longest of the five, deals with the various factors in the domestic situation. It contains most of the detailed criticism which Sir Arthur allows himself and reveals to the full the author's rich administrative experience and capacity. It is this section, with its highly stimulating and suggestive remarks regarding leadership, that scientific workers should find of special interest. In the fourth part, Sir Arthur outlines his views on present policy to lay the foundation of a new peace. He sets forth proposals for the basis of the discussion of a general settlement with Germany when conditions make the reasonable discussion of such a settlement practicable as an example of what might be possible with the other Axis powers also, while in the fifth part of the book he discusses the strength and weaknesses of the democracies and totalitarian systems, and summarizes the policy and action required in defence of democracies.

---

* Security: Can we Retrieve It? By Sir Arthur Salter. Pp. xv+390. (London: Macmillan and Co., Ltd., 1939.) 8s. 6d. net.

The policy outlined by Sir Arthur has every claim to be described as a scientific policy and as such merits the attention and support of all scientific workers. He reiterates, for example, the case for a Ministry of Supply as a first step in the reorganization needed to enable industry to meet the vast demands of the war services, and the arguments in support of the case with which he has long been associated are marshalled with force and lucidity. Here again he is on ground that is already common with many scientific workers, and this chapter on industrial mobilization deserves their close attention.

Beyond such particular questions, this part of the book raises the fundamental questions of leadership in a democracy. By what is implied, as much as by what is said, Sir Arthur Salter indicates the limitations and defects of leadership in Great Britain in the last decade or more, the lack of vision, the failure not merely to foresee dangers but even to recognize their existence. Once again he directs attention to the dangers of professional departmentalism and to the obstacles it opposes to vigorous and effective action in any new field. Not only in regard to the storage of food and air raid precautions, but also in such matters as the location of industry, Sir Arthur Salter is seriously disturbed at evidence of failure on the part of the Government to realize what is involved, and the charge of executive incompetence which he presses home is the more impressive through its sober restraint

Inevitably such criticism raises the whole question of the selection of executive ministers in a democracy in times of such stress. Far closer co-operation between the Government service and the public is required if the economic adaptation necessitated in modern warfare is to be achieved and quick and vigorous action facilitated both by the Government and by industry.

To this end several specific proposals are made. The personnel of the Civil Service should at once be reinforced; at the top with the leading men in science and industry, and throughout its ranks with young men of energy and constructive ability, some of whom would be specialists and others, while without specialized experience, should have a trained and adaptable intelligence. In addition to full transfer, Sir Arthur suggests that competent men of energy and constructive abilit and useful specialized knowledge in finance an other business houses could be associated at onc with appropriate departments on a part-tim basis. Stress is also laid on the opportunity f private initiative and, in particular, it is suggeste that scientific men, without waiting to be consulte on particular questions, should take the initiati themselves by reviewing in turn the obviou problems in which scientific knowledge is not yet fully utilized.

In regard to the executive, Sir Arthur suggests small inner Cabinet of Ministers, relieved of depar mental duties, of suitable personal qualities t conceive and elaborate a general policy an furnished with an adequate and appropria organization. Stressing the importance of nation unity, he would broaden the basis of the Nation Government and suggests the appointment b Parliament of a Committee of Foreign Policy an Defence, consisting of twenty or thirty of the mo trusted members of all important parties or group

This criticism, which rarely fails to be constructive, is essentially a most stimulating an suggestive essay on leadership in democracy i which, for all its failings, Sir Arthur is a convince believer. Inadequate preparations are not due t inherent defects in our parliamentary system Some of the conditions which militate against th selection of requisite administrators and executive of ability are clearly indicated by Sir Arthur, bu his essay should at least stimulate much fundamental and constructive thinking about the selection and training of leaders for the highest position both in industry and in the State. Scientifi workers, no less than other members of the community, may well be grateful that Sir Arthur ha lent the weight of his unrivalled experience as a administrator to the exposition of the dangers an possibilities of the present situation. The realization of the menace, no less than the message o hope which breathes through the pages of thi book, may well assist in overcoming the obstacle to the more centralized direction and coheren planning of all our effort and stimulate the acceptance of the essential discipline and sacrifice. No should this constructive and inspiring book fai also to stimulate fundamental thought on th evolution of modifications in our democrati institutions, which will enable them to meet th strain more effectively and to throw up the leader required, while preserving unimpaired the grea traditions which are theirs and theirs alone.

REGIOMONTANUS AND KEPLER

(1) Leben und Wirken des Johannes Müller von Königsberg genannt Regiomontanus
Von Ernst Zinner. (Schriftenreihe zur bayerischen Landesgeschichte, herausgegeben von der Kommission für bayerische Landesgeschichte bei der Bayerischen Akademie der Wissenschaften, Band 31.) Pp. xiii+294+46 plates. (München: C. H. Beck'sche Verlagsbuchhandlung, 1938.)

(2) Johannes Kepler Gesammelte Werke
Herausgegeben im Auftrag der Deutschen Forschungsgemeinschaft und der Bayerischen Akademie der Wissenschaften. Band 1: Mysterium Cosmographicum. De Stella Nova. Herausgegeben von Max Caspar. Pp. xv+493. (München: C. H. Beck'sche Verlagsbuchhandlung, 1938.) 12 gold marks.

FOR those who date the beginning of modern astronomy from Tycho Brahe, and confine their interest to the subsequent period, there is good excuse. Yet there were great men before that time, who gave themselves to the task of dissipating the intellectual mists of the Middle Ages. As Copernicus is accepted as an impressive figure of the earlier sixteenth century, so Regiomontanus is an outstanding figure in the fifteenth. For various reasons it seems particularly difficult to arrive at a just estimate of the importance of Regiomontanus, and therefore a scholarly monograph on his life and work has great value and interest.

(1) Johann Müller was born in the year 1436 at Königsberg in Franconia, or in the neighbourhood. His surname conveys the family occupation, which was actually followed by his father, but it is by the name Regiomontanus derived from his birthplace that he has become universally known. Before he reached the age of twelve, it is said, he entered the University of Leipzig. That this was no ordinary instance of precocity was quickly shown. In 1448 Gutenberg produced the first printed calendar, giving places of the planets. For the same year there still exists a latin MS in the childish hand of Regiomontanus, which gives the positions of the planets at closer intervals and, as comparison with modern tables has shown, more accurately. Whatever other suggestion may be found to explain away this evidence that the ephemeris is the unaided work of a boy of twelve, it is shown here that no member of the University staff was capable of using the cumbrous astronomical tables available at that time. Leipzig was no place for a young astronomical genius, and so in 1450, still before he was fourteen years of age, Regiomontanus migrated to Vienna.

The choice of this University (founded in 1365) was a good one. It had a tradition in mathematical studies, and J. von Gmunden had established what was for that time a respectable school of astronomy. He himself had died in 1442, but other teachers were not wanting. At an early date Regiomontanus attached himself to Georg Peuerbach, his senior by thirteen years, who became qualified to lecture in the University only some time later. Another factor coinciding with the arrival of the young student and of no little importance for him was the introduction of humanism under the influence of Aeneas Silvius Piccolomini (afterwards Pope Pius II). Thus as a student Regiomontanus enjoyed excellent opportunities both in mathematical and classical subjects. The granting of his master's degree was delayed until his majority, and thereafter he lectured in the University, it might be on Euclid or it might be on Vergil. Throughout he enjoyed the position of favourite pupil and assistant to Peuerbach.

Little or no light is thrown here on the nature of his financial resources. The omission is easily understood, but it is to be regretted. Presumably he was self-supporting from necessity, and his sources of income were his horoscopes, such as those compiled for Leonora of Portugal on her marriage and for the future Emperor Maximilian I, her son, and a series of year-books. The second of these horoscopes is here reproduced among a number of interesting plates. The year-books contain astrological data then in great demand, not least among physicians for the practice of their calling. It would appear that the astrological rules were fixed and recognized. All that remained to be done was to supply the astronomical predictions according to the scientific skill of the computer. In his department Regiomontanus enjoyed a not undeserved reputation from early youth.

It is but fair to recognize that the crass superstition of the age provided a valuable incentive to true astronomical research. It became plain that the planetary tables, either the Alfonsine Tables, now two centuries old, or derivatives from them, like Bianchini's, were extremely defective. To Peuerbach and his pupil the errors presented a scientific problem. As the tables were based on Ptolemy, the line of advance in the first instance was to go back to the Almagest in order to understand clearly what his theory was. The outcome was the Epitome, a work which Peuerbach did not live to finish.

Now comes on the scene the Greek cardinal Bessarion, who arrived in Vienna as papal legate in 1460. In the following year he persuaded Peuerbach to return to Rome with him, accepting the condition that the pupil should go too. On the eve of setting out, Peuerbach died, and Regiomontanus went with the cardinal alone. With his cultured patron he spent the next four, or possibly six, years, living in Rome or visiting other cities like Venice, where he discovered a unique manuscript of Diophantus. The collecting or copying of manuscripts was part of his task. But his first great work in Italy was the completion of the Epitome Almagesti begun by Peuerbach. This is a version of Ptolemy simplified by the mathematical form introduced by the Arabians and incorporating some of their main results in astronomy. Its great importance lies in the fact that this version came later into the hands of Copernicus and Kepler, and its critical comments had undoubted influence. The second great work, also written in Rome, is that on trigonometry, spherical and plane. This belongs to the history of mathematics. It may be difficult to distinguish the parts that are truly original, but on questions of plagiarism the only safe course seems to be to assume that Regiomontanus knew all that was to be known from his predecessors, for he was a remarkably learned man, and to remember that he was writing a text-book, not a history of the subject.

The years 1467–71 were spent in Hungary. Here superstition was rife, and both Vitez, the immediate patron of Regiomontanus, and the king, Mathias Corvinus, had complete faith in astrology. But the man of science, for he must have been truly that, remained unperturbed On the reasonable plea that the required calculations were highly laborious in the absence of suitable mathematical tables, he produced extensive tables of the sine and tangent. Then for the necessary observations he collected for the king the finest instruments to be procured—dials, astrolabes and cross-staffs. For the most part these have been dispersed and lost, though not all. His own observations, so far as they have been preserved, were few, but others may not have survived.

So far as can be seen, the scientific outlook of Regiomontanus was always thoroughly sound. The Ptolemaic system must be understood, but he had less illusion about its nature than anyone, except perhaps Ptolemy himself. It was merely a means of calculation, and far from satisfactory at that. The lunar theory, which gave a palpably impossible range to the apparent semi-diameter of the moon, was enough to show it. But before any real advance could be made in the theory, it was necessary to recognize that the ancient observations were thoroughly inaccurate and the science must be reconstructed on a foundation of modern observations All this Regiomontanus saw and stated as clearly as Tycho could have done Therefore, when in 1471 he saw trouble brewing between his archiepiscopal patron and the king, he persuaded Mathias to allow him to establish an observatory and settled in Nuremberg with that object in view.

But once there, his activities took a completely different turn. He set up a printing press and immediately embarked on a most ambitious scheme of publication. The actual output amounted to no more than nine works, almost exactly contemporaneous with Caxton's earliest undertakings, but the details of the whole plan were announced in a catalogue here described. Moreover, some of these works presented all the difficulties of mathematical printing, with figures reproduced in the form of wood-cuts. On the technical side of this achievement it will be recalled that a generation later Dürer was at work on the same spot. But the duty of making observations was not neglected. Regiomontanus collected and installed the necessary instruments, made observations himself and, not least, trained his successor Bernhard Walther to continue this side of his work. Walther observed assiduously between 1475 and the year of his death, 1504, and his results, though published later without the care and completeness they deserved, are the most important in the long interval between the Greeks and Tycho Brahe.

But the man who had started this new epoch had vanished from the scene. He may have been summoned to Rome to advise on a revision of the calendar In 1475 he left Nuremberg and the following summer died in Rome, perhaps a victim of the plague then prevalent in the city. A tradition that he died by poison cannot be traced farther back than 1512, and though it was transmitted by Rheinhold, it is here discredited. Indeed nothing is known of this last year of his life. The printing press came to an abrupt end, and the great plans of its founder with it. As much of his work, like the instruments he assembled, has been scattered and lost, it is unusually difficult to assess the scientific importance of Regiomontanus. But this is a point to which there will be occasion to return later.

(2) The first volume of the new edition of Kepler's works has now appeared, following the third, which contained the Astronomia Nova and was published at the end of 1937. Naturally it is in the same form as the volume already noticed in the course of last year (NATURE, 141, 665 ; 1938), and it reaches the same high standard in its

presentation. The Latin text of two of Kepler's earliest works is followed by an illuminating editorial commentary in German.

All that Kepler wrote must be considered valuable as a revelation of his personality and trend of thought. But the "Mysterium Cosmographicum" (1596), a short work, is scarcely, taken by itself, an attractive one. It has two merits. The Copernican system is adjusted to a more truly heliocentric form. Also the basic conjecture, absurd as it is, is subjected to the test of careful calculations. But here at the outset of his career Kepler reveals himself as a complete scientific mystic. A copy was sent to Galileo, who returned a polite but perfunctory acknowledgment. After that he was not to be drawn into further correspondence on the subject; and little wonder, for Galileo was anything but a mystic. Perhaps this example may suggest a reason why Kepler's greater work failed to find recognition among the next generation. Like Galileo, others may have been alienated by the mystical element and may have failed to probe and find the real treasure.

The second work contained in this volume is known by the short title "De Stella Nova" (1606). The star is Nova Ophiuchi (1604), and Kepler was naturally the more interested in it because he had recently assisted Tycho Brahe in editing his observations of Nova Cassiopeiae (1572). The appearance also was the more remarkable because it occurred near a conjunction of Jupiter, Saturn and Mars. Another strange and previously unknown star had been discovered in 1600, and Kepler included an account of it as a new star; it is the variable P. Cygni, not now accepted as a *nova*.

To an ounce of science in this work there is an intolerable deal of sack. Writing with an eye on his public, Kepler must give his views on the astrological significance of the triple conjunction with characteristic verbosity. No sooner has he dealt shrewdly with one school of superstitious thought than his mysticism leads him back into equal extravagances. Of greater interest are his views on the nature of the stars. But his notions of sidereal astronomy were always completely antiquated. The ideas of Giordano Bruno filled him with horror ("nescio quid horroris") at the mere thought. Yet they had probably been picked up during a visit to England twenty years before. The essential part can be traced to Thomas Digges's work, a "Perfit Description of the Cœlestiall Orbes" (1576). The immensity of stellar space, from which Kepler recoiled, had been accepted as obvious by Copernicus.

It is now possible to return to Regiomontanus. When Mästlin undertook to produce the "Mysterium Cosmographicum" for Kepler, it seemed to him that some introduction to the ideas of the Copernican system was wanted by the uninitiated. He had the happy thought to add to Kepler's work (1596) the "Narratio Prima" (1540) of Rheticus. This tract is once again reprinted, and it is a most important document, for in the circumstances in which it was written (as an open letter addressed to J. Schöner) it must have had the approval, if not the positive inspiration, of Copernicus. The reference to Aristarchus, never made by Copernicus himself, is to be found here. The tradition was familiar to all about that time. Regiomontanus had marked "Aristarchus samius" in the margin of his copy of Archimedes, showing what was in his mind. Robert Recorde recognized the ancient source immediately. It would have been strange if the tradition, which was a perfectly explicit one, had not had its full effect on Copernicus.

There are also references to Regiomontanus, chiefly to the Epitome. But the passage which bears on his greatness runs thus:

> Principio autem statuas velim doctissime D. Schonere, hunc Virum, cujus nunc opera utor, in omni doctrinarum genere, et astronomiæ peritia Regiomontano non esse minorem; libentius autem eum cum Ptolemæo confero, non quod minorem Regiomontanum Ptolemæo aestimem, sed quia hanc felicitatem cum Ptolemæo Praeceptor meus [Copernicus] communem habet, ut institutam astronomiæ emendationem, divina adjuvante clementia, absolueret, cum Regiomontanus (heu crudelia Fata) ante columnas suas positas e vita migrarit.

The marginal note "Regiomontanus Romae veneno extinctus est An. 1476, 8. Julii, aetatis anno 40. vix completo" was supplied by Mästlin, and of course adds no weight to the earlier report of Rheinhold.

The judgment of Rheticus is valuable in itself, because he was a sensible man, with access to material and verbal traditions no longer available, and there is no reason to suspect hero-worship in this case. But more than this, it must have been endorsed by Copernicus himself, for otherwise there can have been no reason for introducing the name of Regiomontanus at all. This tribute is not to be lightly dismissed like some of the undiscriminating eulogy which has had a prejudicial effect on his reputation in later times.

The subject of Regiomontanus has been dealt with at some length in this review because in his "Planetary Systems", generally a trustworthy work, Dreyer has done far less than justice to this very remarkable man. Had he been spared another thirty years of active life, what might he not have accomplished? Heu crudelia Fata.

H. C. PLUMMER.

PLANT PHYLOGENY

Textbook of Paleobotany
By William C. Darrah. (Century Biological Series.) Pp. xii+441. (New York and London: D. Appleton-Century Co., Inc., 1939.) 25s. net.

THE publication of a short but comprehensive text-book of palæobotany in English is a noteworthy event, for great progress has been made during the last forty years in our knowledge of fossil plants, and the discoveries of the latter half of this period must eventually revolutionize many widely accepted views on evolutionary morphology. The author, who is a member of the staff of Harvard, has all the enthusiasm of youth, and has produced a book which covers a very wide field of study. The subject is treated mainly from a phylogenetic point of view, the historical evidence relating to each of the main groups of plants being considered. A few chapters are devoted to a review of the floras of the great geological epochs and to more general topics. Each chapter is accompanied by a bibliography of the more important papers, mainly from recent publications. There is a large number of illustrations which add to the interest and value of the book. Many of them are reproductions of photographs of actual specimens, though these vary in quality.

The reviewer feels considerable regret that he is unable to give an unqualified recommendation of this volume. It will certainly interest many who wish to know of the progress of palæobotany, and the descriptions of recent discoveries in the Devonian rocks will be useful to teachers. But the author of a scientific text-book has grave responsibilities. His work will provide the foundations upon which the knowledge of many students is to rest; it will largely determine their outlook on the subject. A text-book should be unimpeachable on matters of fact and should be a pattern in logical reasoning. The boundary line between objective observation and inferences drawn from the observations should be clearly discernible, so that the reader may be prepared for the changes in the interpretation of the facts which must come with new discoveries in every healthy branch of science.

From this point of view, the present work is disappointing. The author gives too little space to straight description of structures and too much to considerations of phyletic morphology. The brief mention of many of the well-known Upper Palæozoic and Mesozoic plants, sometimes little more than a catalogue of names, will scarcely allow the student to visualize their structure, and consequently the author's interpretation of their morphological significance must be accepted without question. But this interpretation may be quite speculative, or depend on the definition given to terms which are not explained. Even though a particular interpretation has been widely accepted and may be generally held at the present time, it does not follow that it is really true.

We may take as an example a reference to the Cycadales with which almost every botanist would agree. The author states that the ovules of these plants are borne laterally upon the sporophylls. "The Cycad 'carpel' is typically foliar and is a convincing example of the Phyllospermic type." But in spite of the universal repetition of this view, it cannot be said that it is based on any unquestionable evidence derived from either fossil or modern forms; until such evidence is provided, the view is just a piece of morphological dogma. It would be far better for the student and for the progress of the science to refrain from describing the seed-bearing organs of the cycads as 'carpels' and the pollen-bearing organs of the Bennettitales as 'stamens', even although these terms are placed in inverted commas.

One of the many difficulties which confront the student of fossil plants is the nomenclature used, and it is regrettable that the author did not give some indication of the international rules of palæobotanical nomenclature and classification. It may be mentioned that he has followed these rules in employing the new generic name 'Horneophyton' Barghorn and Darrah for the plant previously known as *Hornea Lignieri* Kidston and Lang. This will in future be the valid name for this important Devonian fossil, since it has been found that the name 'Hornea' was preoccupied.

Unfortunately, a considerable number of errors have got into the text and there are many very questionable statements. *Sphenophyllum fertile* is described as having the structure which Scott, with his limited material, ascribed to it. In the bibliography, however, papers by Leclercq are cited and this work, carried out by means of serial sections, showed that the cone had a very different structure. In view of the far-reaching hypotheses that have been founded on the supposition that cones actually existed having the structure described by Scott, it is surprising that the important work of Leclercq was not mentioned in the text.

In the chapter on the origin of the angiosperms, Darrah favours the view that the flowering plants originated from Cycadeoid-like ancestors. He says, "the modifications which would be required to transform the Cycadeoid flower into that of the ter flowering plants are simple ones". But, nfortunately, he stops there and does not explain hat these simple modifications would be, or what vidence he has to show that they have actually ccurred. Much of what he says about the aytoniales appears to be based on a misapprehension. He speaks of Thomas finding the greatest difficulty in demonstrating how the Caytoniales ould be the ancestors of the flowering plants, and this, like statements of other recent authors, appears o suggest that the writer of this review advocates the derivation of the flowering plants from the aytoniales, although he has repudiated it in four different publications since it was ascribed to him. As this misapprehension is finding its way into current teaching, attention must be directed to the statement made in 1930 (paper read at the Fifth International Botanical Congress 1930; *Annals of Botany*, 45, 670; 1931) and since maintained as a working hypothesis. Thomas wrote: "The flowering plants are considered to be derived from one or more groups of pteridosperms intermediate between those which gave rise to the Bennettitales and Caytoniales".

Of course, it is far easier to criticize a book of this character than to write one, and the ungracious remarks that have just been made refer mainly to the volume as a manual for students. Plant morphologists and those engaged in the study of systematic botany will find information and interest in this work as giving a modern view of the fossil evidence for plant evolution. It shows how much more we need to know and how wide is the gap still to be bridged between the lower and the higher groups of the vascular plants.

H. HAMSHAW THOMAS.

THE SCIENCE OF COLOUR

Colour in Theory and Practice
Vol. 1. General Theory. By H. D. Murray and Dr. D. A. Spencer. Pp. xvi + 176 + 3 pl. (London: Chapman and Hall, Ltd., 1939.) 25s. net.

NATURAL colour phenomena have been to a large extent accepted, rather than investigated, until fairly recent times, but our knowledge of what the dictionaries call 'chromatics' is now growing rapidly, and the word may soon lose its unfamiliar and faintly ambiguous savour. Such commercial activities as colour photography and an ever-expanding dye industry are largely responsible for the increasing colour-consciousness of to-day, and the chief stimulus to the study of colour comes from technical, rather than academic scientific, sources. The authors of "Colour in Theory and Practice" have travelled from the particular field of colour reproduction to the general consideration of colour.

But although the present volume is primarily intended as a preliminary to a survey of the applied aspects of colour, it is none the less welcome for its own sake, as a presentation of the basic facts and theories concerning the visible spectrum and its relationships with matter and mind. The authors waste no space on a historical approach to the subject, but begin with a brief résumé of present views as to the origin and nature of light, and from this pass on to an account of the ways in which a coloured or "unbalanced" visible radiation may be produced. The next short chapter, concerning the chemistry of colour, might well have been combined with the review of coloured substances which concludes the book. The consideration of the possible transformations of absorbed light energy would then follow on with uninterrupted continuity of theme. Similarly, the reviewer would have been inclined to put the relatively long chapter on practical light sources (if included in this volume of general theory at all), and the notes on light filters, before, rather than after, the account of spectrometers and spectrophotometers, and follow the latter directly with the important discussion of colour measurement and specification.

With the exception of this chapter ("The Measurement of Colour") the text is not too technical to be intelligible to the layman, and much of it, including the descriptions of the human eye, colour vision and its physiology, and the all too brief notes on colour in Nature, is very pleasantly readable. The authors are careful in their use of terms, and rightly at pains to stress the distinctions between objective and subjective concepts. The diagrams are helpful, although some indication in the graphs of the colours corresponding to various wave-lengths would be a convenience to non-physicists less familiar with the angstrom unit.

References to publications are scattered throughout the pages. The value of the work as a much-needed introduction to colour science would have been greatly augmented by a bibliography.

The book is handsomely produced, with excellent illustrations, including seven pages in colour to hearten the general reader into overcoming his fear of mathematical symbols; but its price is regrettably high.

SAMPSON CLAY.

THE LIVING BODY

A Text in Human Physiology
By Prof. Charles Herbert Best and Prof. Norman Burke Taylor. Pp. xxii + 563 + 15 plates. (London: Chapman and Hall, Ltd., 1939.) 18s. net.

A TITLE such as "The Living Body" raises the hope that this is no ordinary text-book of physiology for medical students designed for a group of readers who have already passed their first medical examination and are now studying not only physiology but also anatomy and biochemistry, on each of which they read special books. "The Living Body" suggests, and according to the authors' preface rightly so, an elementary account of how our bodies work, which includes everything, anatomy, histology, biochemistry, as well as the topics commonly included in the narrower sense of medical physiology. Only the most elementary knowledge of physics and chemistry is presupposed, and such a book might well be designed for the intelligent layman who remembers a little of the science he did at school, for nurses, and for others who are not concerned with more specialized aspects of the subject.

There may be some truth in the saying that our generation which reads avidly of the advances in physics and even biology has no interest in physiology because concern with one's body is not quite healthy or not quite proper. Yet many, not only the unhealthy or improper but also those who are healthy enough not to bother about being thought so, and those who are specifically interested in subjects such as the nutrition of the people and athletics, have been asking for a book which will tell them about the spectacular discoveries in physiology and their application to medicine which have featured in the news of the last few decades. To make these discoveries intelligible and interesting they must be accompanied by a general account of the happenings in the body. If such a demand exists, it is certain that it has not been adequately met by physiologists, who have become increasingly preoccupied with the rapid advances in their own special branches of the subject. Occasional works of genius re-fashion the shape of the subject on a wider scale, for example, Bayliss's "Principles of General Physiology" or Barcroft's "Features in the Architecture of Physiology", but these are addressed to readers who are living with the material of physiology. For the non-specialist reader some similar creative effort is needed to break away from the presentation of the subject which has become traditional in connection with the medical curriculum, to reorientate the study of the body around certain themes of immediate social urgency such as nutrition and muscular exercise, and to muster appropriately new selections of our physiological knowledge, much of it recently acquired, which might catch the imagination of the reader as a scientific adventure in exploring the functions of the body.

"The Living Body" scarcely aims so high. It professes to be elementary and dogmatic. It is elementary perhaps most noticeably in the sense that we regard anything we did in our youth as elementary, that is to say it has something of the flavour of the text-book of a generation ago, this impression being reinforced by the unusually high proportion of old friends one recognizes among the illustrations. Many instances of the danger of such a method can be found; for example, Fig. 201 showing the effect of temperature on the isotonic contraction of muscle was in its day a famous example of inappropriate apparatus yielding results which are misleading to the point of being in the opposite direction of those recorded by modern instruments. Other figures emphasize aspects of the subject which have become unfashionable because displaced by the wealth of material nearer the heart of physiology; no less than five figures, for example, depict water flowing through models consisting of rigid tubes, but the properties of the models are not to any extent used to elucidate the features of the blood circulation, the physical analysis of which is now so elaborate that the subject—hæmodynamics as it was grandiloquently called—has almost dropped out of elementary text-books.

The degree of dogmatism which is needed to make a short account of physiology clear to a reader is a hotly disputed subject, and differs according to the aims and tastes of the author. Fashion in physiology has on the whole dictated sparing use of dogmatism about disputed matters when simplicity seems to require it, but has discouraged statements appearing as facts when no evidence about the matter exists. As an example of the less fashionable view taken by the authors on the latter point may be quoted the rather unlikely value of 5 mm. given as the pressure in Bowman's capsule in the mammalian kidney.

"The Living Body" is profusely illustrated and straightforwardly written and meets the requirements of the class of reader, such as nurses and some dental and agricultural students, who requires, as the authors say, "a less scientific and more dogmatic method of instruction than that customary in more advanced texts."

F. R. WINTON.

AERONAUTICAL RESEARCH: WIND TUNNELS, OLD AND NEW

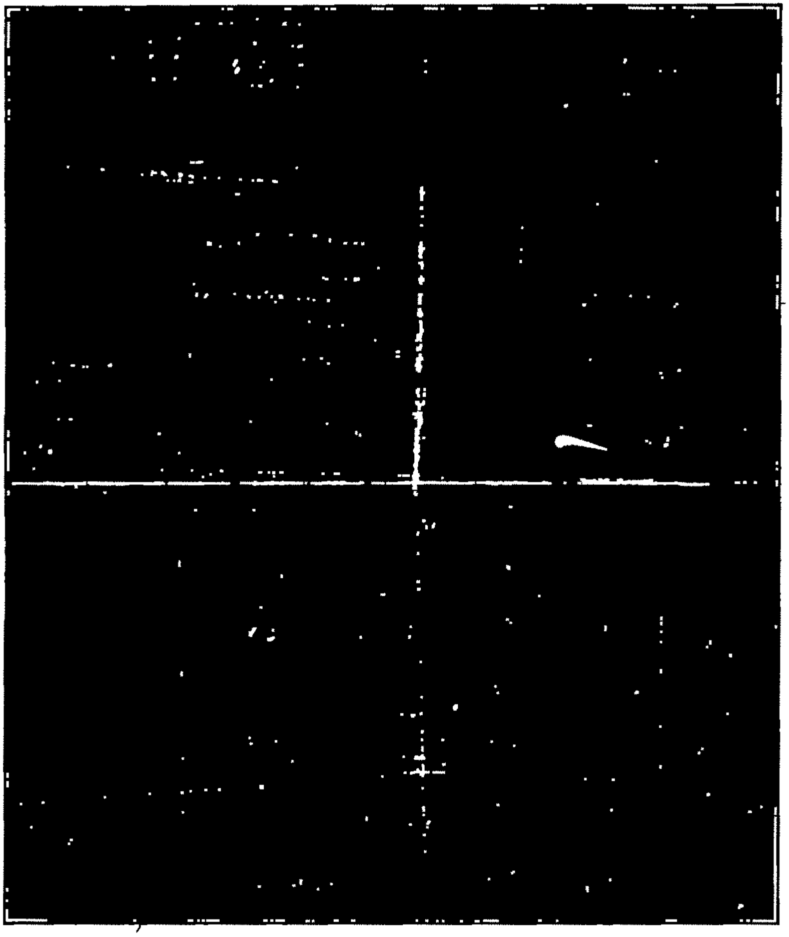


Fig. 1.
REPRODUCTION FROM THE WRIGHT BROTHERS' ORIGINAL RESEARCH PROGRAMME (1901).

R. G. W. LEWIS, director of aeronautical research, National Advisory Committee for ronautics, U.S.A., delivered the Wilbur Wright morial Lecture before the Royal Aeronautical ciety on May 25, taking as his subject "Some odern Methods of Research in the Problems of light", with some personal reminiscences of the rothers Orville and Wilbur Wright, and gave ome hitherto unpublished details of their original esearches into the problems of flight in 1901. ig. 1 shows profiles and plan forms of some of he aerofoils used by the Wrights in their wind unnel. It can be seen that models 7, 8 and 9 are ircular arcs with a systematically varied camber, nd 10, 11 and 12 have a similar camber in a more orward location; also the models have a 1-inch hord with a 6-inch span, giving an aspect ratio of 6. Research up to to-day has universally confirmed that the assumption of these forms was correct to such an extent that it almost appears to have been an extension of their original work. Since this work was never published, these later day conclusions are an independent testimony to their far-sightedness and understanding of the basic principles.

The balances used in the Wrights' wind tunnel were ingeniously contrived in such a way that the fundamentally important requirements of obtaining readings that could be translated directly into effective forces upon a full-scale flying machine were given by direct readings, having reduced their critical assumptions to one. This was that the order of merit of the various shaped aerofoils would not be seriously affected by the Reynolds

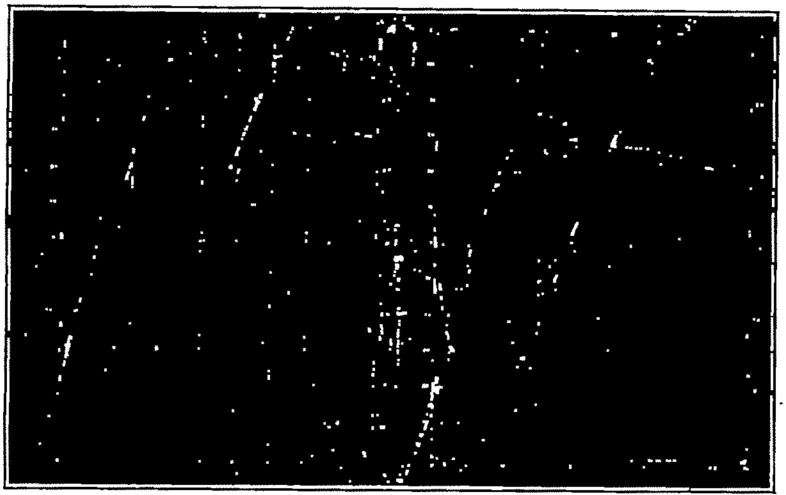


Fig. 2.

REPRODUCTION FROM ORIGINAL PLOTS OF DATA (1901).

number of the experiment, although the absolute value of the coefficients would change. An actual case is worthy of mention in this respect. The Wright brothers, combining wind tunnel results and flight tests on their 1902 glider, found that the unit drag of a square flat plate was equal to the square of the speed, in miles per hour, multiplied by the coefficient 0·0033. To-day, after considerable research directed upon this question, the figure generally adopted is 0·00328, a truly astonishing agreement.

Fig. 2 shows some results from the models 7, 8 and 9 in Fig. 1, and the familiar shape of the lift and drag curves are such that they might well apply to many aerofoil forms in use to-day.

Dr. Lewis then devoted the main part of his lecture to a description of the recent additions to the U.S.A. wind tunnels at Langley Field, the principal research station of the National Advisory Committee for Aeronautics. The general trend of improvements has been that of increase of size to allow the use of larger models, higher speed of the air stream to keep up with the increase of performance of actual aircraft, and provision for investigations at larger Reynolds numbers by the use of compressed air. Principally, the recent tunnels have been constructed with the definite object of solving the problems that arise in aeroplane design. The most outstanding of these are, the variable density wind tunnel for research at high Reynolds numbers, the 20-ft. propeller research tunnel, the full-scale tunnel, the high-speed jet tunnel for aerofoil research under propeller operating conditions, and an 8-ft. 500 mil per hour wind tunnel. The mo recent tunnel, designed in 193 and now being placed in oper tion, is shown in Fig. 3. This h a throat diameter of 19 ft., bei able to accommodate large-sca models, and works up to spee of 250 miles per hour at pressur from sub-atmospheric to sever atmospheres.

There is a general trend towar the use of dynamic models for t investigation of stability and co trol problems, based on principl adopted originally by the Aer nautical Research Committee Great Britain at Farnboroug Also certain classes of investig tions are tending towards methods, developed b Prof. B. M. Jones in England and Dryden an Jacobs in the United States, of carrying out fund mental research and applying the results by vali theoretical methods to the prediction of aircra characteristics.

The most highly specialized piece of equipmen yet constructed is the low-turbulence wind tunne designed in accordance with Eastman Jacob suggestions, and completed in the spring of 193 Turbulence and velocity fluctuation in the a stream of wind tunnels have long been a matte of concern in this work, but a helpful simplificatio is obtained from the generally accepted concep that turbulence in the atmosphere is of such nature that, in free flight conditions, its effec upon the transition from laminar to turbulent flo in the boundary layer is negligible. Tests in smok tunnels, as well as G. I. Taylor's theoretical work suggested that in low-turbulence conditions th transition point on an aerofoil might tend t

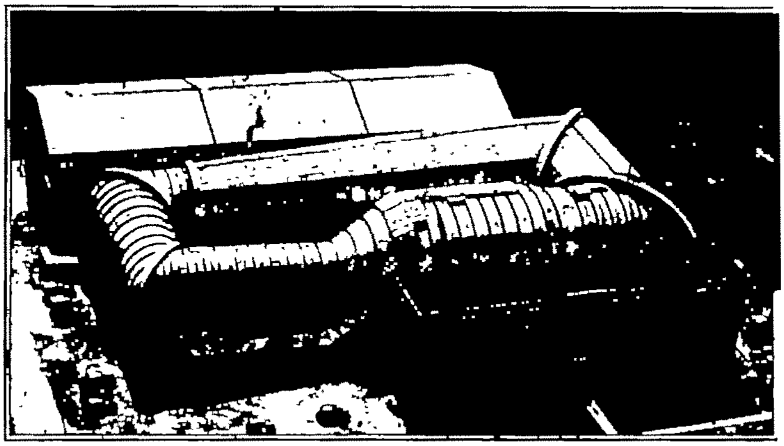


Fig. 3.

THE N.A.C.A. 19-FOOT PRESSURE TUNNEL.

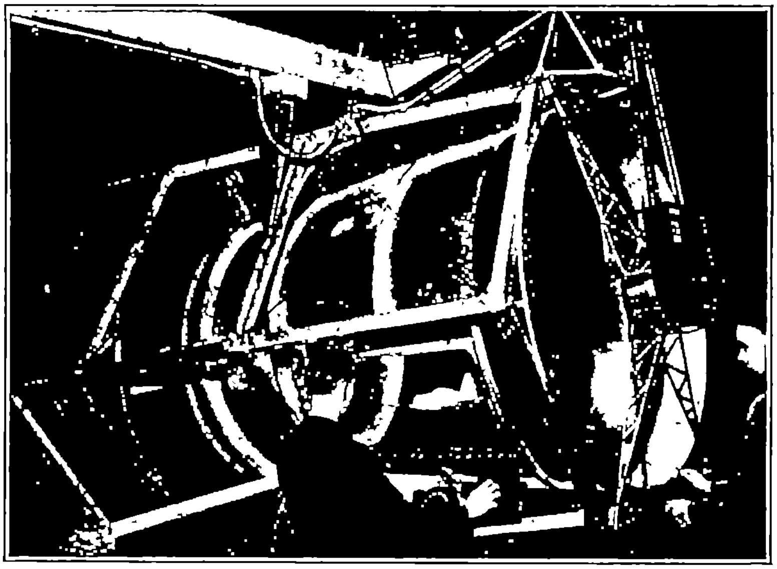


Fig. 5.
The N.A.C.A. 5-foot free-flight tunnel in operation.

main in a constant position ather than to move forward, as does in turbulent wind tunnels, nd thus an aerofoil could be degned to take advantage of true w-drag laminar boundary layers ver a major portion of its surface. is claimed that aerofoils so esigned and tested in the low-rbulence wind tunnel are showg spectacular drag reduction, hich should give valuable ineases in speed, range, and eneral efficiency of aircraft.

Another problem that has been iving increasing concern to airraft designers is that of the ynamic loading upon the strucure due to accelerations consequent upon encountering atmopheric gusts. Increase in size nd speed of the aeroplane both ccentuate this problem, and it is becoming bviously necessary to establish criteria for design gainst gust loads. The problem has been pproached from two aspects. An instrument, nown as the N.A.C.A. V-G recorder, was designed nd installed in a number of machines, the total ying time of which, to date, approximates to 7,300 aeroplane hours or 10 million miles, under s widely varying conditions of topography, eather, etc., as possible. The instrument is self-recording, needs no attention from the aircraft's crew, and gives a simultaneous recording of accelerations and air speeds. Statistical results from these instruments suggest a probable maximum effective gust velocity of about 30 feet per second for an aeroplane of the large flying boat type.

Upon this assumption, a 'gust tunnel' has been built in which it is possible to determine experimentally the reaction of suitably scaled dynamic models. It consists of an expanding rectangular channel discharging a controlled current of air in an upward direction, see Fig. 4. A weight-driven catapult launches the model into a free glide at constant speed, and when it enters the air jet it moves according to the changing forces imposed upon it. These movements are recorded photographically by light from small lamps at the nose and tail, and from these the movements of the centre of gravity and the pitching motion can be estimated. An accelerometer inside the model is synchronized with the photographic mechanism, so that the two records can be correlated.

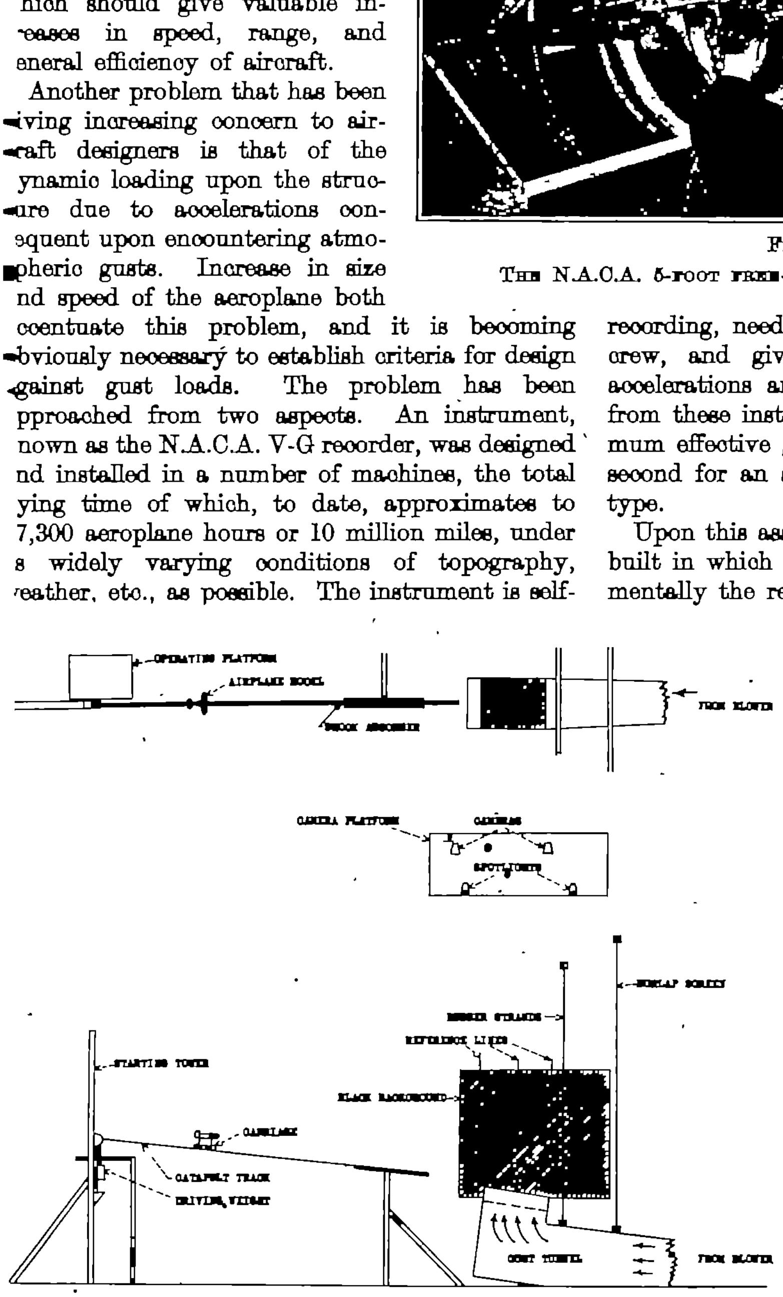


Fig. 4.
Diagram of the gust tunnel of the National Advisory Committee for Aeronautics.

The general problem of stability and control in flight is also being dealt with in a more precise manner than hitherto by means of a free-flight wind tunnel. The body of the tunnel is 5 ft. in diameter, provided with a normal fan giving air speeds up to 25 ft. per second. It is suspended on trunnions so that its inclination can be varied, and an operator maintains the inclination and air speed in proper co-ordination with the gliding characteristics of the model under test. A second operator manipulates the controls of the model, governed by small electro-magnets inside i body, by a series of switches connected the model by a fine wire of length sufficie to hang slack and allow the model perform any manœuvre unrestricted. Fig. shows this tunnel with a model in free flig inside it.

PRIESTLEY AND LAVOISIER

TWO lectures delivered by Sir Philip Hartog at University College, London, on May 9 and 16 dealt with "The Newer Views on Priestley and Lavoisier", these being given under the scheme for advanced lectures of the University of London.

It was pointed out that the usual estimates of Priestley's work are based on too little acquaintance with his writings, and do not do him sufficient justice. The work of Lavoisier is now better understood, largely by reason of the publications of the late Dr. A. N. Meldrum, and Sir Philip was concerned with some aspects of the relations between Priestley and Lavoisier.

Priestley's early work on electricity is contained in his "History of Electricity", first published in 1767 and written in a year. This shows him making quantitative experiments and putting forward hypotheses which Sir Philip Hartog thinks were based on what Priestley calls the "bold eccentric thoughts of the Queries in the Opticks" of Newton. Priestley's first thoughts on chemistry are also to be found in this book, and in it he describes some experiments on mephitic air and charcoal, the mephitic air being made by passing air over heated charcoal. After finding that a candle would not burn in air that had passed through a charcoal fire, or through the lungs of animals, Priestley says: "I was considering what kind of change it underwent, by passing through the fire, or through the lungs, etc., and whether it was not possible to restore it to its original state, by some operation or mixture". This early work provides a key to Priestley's later studies on gases, beginning with those published in 1772.

When Priestley began his work, there were three special pitfalls into which an investigator on gases could stumble, as well as the general bar to progress set by the phlogiston theory: (1) it was not known whether heat was ponderable or not, (2) it was not known whether light was ponderable or not, (3) permanent gases were regarded as essentially different from solids and liquids. Hales, in his "Vegetable Staticks" (1727), had failed to differentiate gases from air, and although Boerhaave in his "Elements of Chemistry" (1731) speaks as though he distinguished betwe the different varieties of air—including van He mont's *gas sylvestre* (carbon dioxide)—yet it w Black and Cavendish, in 1756 and 1766 respe tively, who sharply differentiated fixed air (carbo dioxide) and inflammable air (hydrogen). Priestle discovered a number of new 'airs', some of whic he collected over mercury, and his publication on these begin in 1772. The airs discovered b Priestley were stated by Sir Philip to be: hydroge chloride, nitrogen, nitric oxide, nitrous oxid nitrogen peroxide (which he collected by downwar displacement), ammonia, sulphur dioxide, silico fluoride, oxygen and hydrogen sulphide, all discovered in the period 1772–1790. After his lon paper in the *Philosophical Transactions* in 1772 Priestley published his work on gases in his books "Experiments and Observations on Different Kind of Air" (3 vols., 1774–77), "Experiments an Observations relating to various branches o Natural Philosophy with a continuation of th Observations on Air" (3 vols., 1779–86), an "Experiments and Observations on Air" (3 vols 1790). These volumes are a rich mine of experimental results.

Of Lavoisier, Sir Philip said: "From the firs Lavoisier's work is distinguished from that o Priestley and many other predecessors, not by th use of the balance as is often stated, for Priestley was quite capable of using the balance and t excellent purpose, but by the systematic use o the balance in checking chemical reactions especially in dealing with gaseous reactions". In his earlier work (November 1772), Lavoisier had discovered that in the combustion of sulphur and phosphorus, air is absorbed and the combustible increases in weight. He was also persuaded that the increase of weight of a metal during calcination is caused by absorption of air. In 1792 Lavoisier wrote: "It is easy to see that from the year 1772 I had conceived the doctrine of combustion as a whole". In February 1773 (not 1772, as Lavoisier himself, by a slip of the pen, dated his memorandum), he proposed to make a long series of experiments on gases, and in his "Opuscules hysiques et chimiques" in 1774 he fulfils this romise, both in regard to a history of the subject nd a new series of investigations. In 1774 he ad suspected that it is some *constituent* of the air, ot the whole air, which is concerned in combustion nd calcination. Although Priestley had prepared specimen of oxygen on August 1, 1774, by heating red precipitate of mercury, and observed the brilliant combustion of a candle in the gas, Sir Philip Hartog claims that the true date of Priestley's discovery of oxygen was April 1, 1775. Previous to this, Priestley had not distinguished the gas from nitrous oxide, and the crucial test distinguishing the two gases, namely, the action of nitric oxide gas, was not applied by Priestley until March 1775, and in April he speaks of oxygen as an air five or six times as good as common air".

Priestley met Lavoisier in Paris in October 1774 nd spoke of his preliminary experiments to Lavoisier and others. Lavoisier began to work n red precipitate in November 1774, and in February to March 1775 he made experiments which he communicated to the Academy of Sciences on April 26, 1775, the title of the paper printed in its first state in the May number of Rozier's "Observations sur la Physique") being: On the Nature of the Principle that Unites with Metals During their Calcination and Increases their Weight". Although Priestley had found by the nitric oxide test that the new gas (oxygen) was five times as good as common air, Lavoisier failed in this experiment and reached the erroneous conclusion that the new gas "is not one of the constituent parts of the air . . . but is the air itself, entire, unchanged, undecomposed". Lavoisier's correct interpretation of combustion and calcination was, in fact, not put forward until March 1777, when for the first time he clearly distinguished between the two constituents of atmospheric air, although his estimate of the relative proportions is again less accurate than Priestley's. Although Lavoisier does not mention Priestley in this paper, Sir Philip pointed out that he does so in other papers, and he regards the suggestion that Lavoisier made no acknowledgment to Priestley as "pure fiction". Lavoisier's mportant memoirs on combustion in general 1777), on caloric (with Laplace, 1783), and his "Reflections on Phlogiston" (1786) in which he definitely rejects the phlogiston theory, were dealt with by Sir Philip.

Priestley's views on phlogiston were of a very varying character. Sir Philip Hartog directed attention to a remarkable quantitative experiment made by Priestley in 1785. He calcined iron with a burning glass in oxygen standing over mercury, and showed that the weight gained by the iron is equal to the weight lost by the gas. He then reduced the oxide of iron by means of hydrogen and showed that the two processes can be repeated indefinitely, that the volumes of hydrogen and oxygen involved are as 2 to 1, and that the ratio of the loss of weight of the iron oxide to the weight of water formed is as 15 to 17 (actually it is 16 to 18). Although he very nearly adopted the correct explanation, Priestley says he "was taught by Mr. Watt to correct this hypothesis and to account for this result in a different manner". As Sir Philip said: "Priestley henceforward displays what seems to us almost a perverse ingenuity in adapting the phlogiston theory to fit every new fact". The later developments of the phlogiston theory have recently been studied in the publications of Partington and McKie in the *Annals of Science*, and it seems as if Priestley had been on the point of escaping from this maze but was induced to penetrate still further into it by following the lead of James Watt.

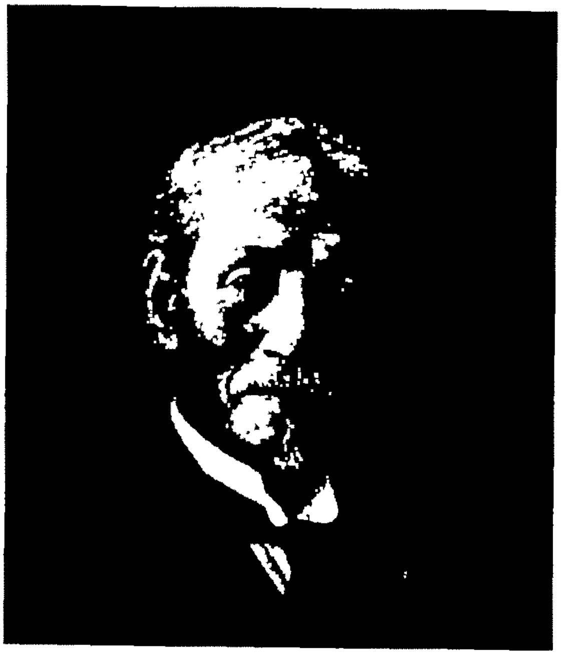
Lavoisier first enunciated his own views as a body of doctrine in his classical "Traité Elémentaire de Chimie" in 1789, a work which, according to McKie, marks the foundation of modern chemistry as securely as Newton's "Principia" marked the foundation of modern mechanics. In this book, Lavoisier lays down certain general principles of scientific method, which he had mostly taken from Condillac. Priestley had, in his earlier work, been guided by Franklin and he says: "Every experiment in which there is design, is made to ascertain some hypothesis. For an hypothesis is nothing more than a preconceived idea of an event. . . . An hypothesis absolutely verified ceases to be termed such, and is considered as a fact." Thus, science is to be reduced to a statement of all the facts in the smallest compass and the hypotheses finally disappear.

In concluding his lectures, Sir Philip said: "It may be said of Priestley and of Lavoisier individually that where a generation of chemists had been blind those two men saw. Yet neither of them was impeccable. And they had far more in common, both in their successes and their failures, than has been generally recognized, though ultimately Lavoisier outdistanced Priestley. By a combination of their discoveries Lavoisier effected a transformation of chemistry and a revelation of some of the most fundamental processes of vegetable and animal life". Although we are told that the old foundations of scientific thought are now being broken up, yet "at that earlier turning point, a century and a half ago, the pattern imagined by Lavoisier, in part with elements supplied by Priestley, was a great pattern, which served a great purpose. It multiplied man's control of external nature a thousandfold; and in itself was a vision of beauty".

OBITUARIES

Baron Joji Sakurai

ON January 28 of this year there passed away from this world, at the ripe age of eighty years, Prof. Baron Joji Sakurai, the great promoter of scientific research in Japan, ardent lover of peace and friendship among men, and one of the finest spirits and greatest gentlemen of this or any age. Proud indeed must be his homeland to have produced one who was honoured, respected, and beloved by men of science of many nations, and proud are we in England to have had him in our care during his formative years of study at University College, London (1876–1881). No one who had the privilege of meeting him ever failed to be deeply impressed and strongly attracted by his quiet dignity, his gentle and endearing modesty, and the warm glow of friendliness and high intelligence that shone from his eyes and suffused his every word. Throughout a long and laborious life he strove with a total disregard of self to make his fellow-countrymen strong and healthy in mind and body by the light of reason and science, to promote their peaceful, cultural relations with men of other lands, and to build up an amity of nations, founded on mutual co-operation directed to the high goal of a civilization, purified from ignorance and prejudice and illumined by a great hope. So lived and died this great and good man that came from the East, and was the friend of all men of goodwill throughout the world.



J. Sakurai

Joji Sakurai was born in Kanazawa (Province of Kaga) on August 18, 1858. He went to Tokyo in 1871 and studied chemistry under R. W. Atkinson at the Kaisei Gakko, a forerunner of the University of Tokyo. At the request of the Japanese Government, Atkinson had been sent to teach chemistry at Tokyo by Prof. Alexander W. Williamson, of University College, London. Williamson had early interested himself in the welfare of Japan, especially in the education of young Japanese students in England, among whom were the celebrated Prince Ito and Marquis Inoue. In 1876 young Sakurai was sent by his Government to prosecute the study of chemistry in England, and entered University College in October of that year. He studied chemistry und Prof. Williamson, physics under Prof. Carey Fost and Dr. Oliver Lodge, mineralogy under Prof. Morris, and hygiene under Prof. W. H. Corfiel At the end of his first year he won the gold med for chemistry, and a year later the Clothworker Scholarship for proficiency in chemistry and physic Under the guidance of Williamson, Sakurai began a interesting research on metallic compounds containi bivalent hydrocarbon radicals, which was continue after his return to Japan and resulted in three pape communicated to the *Journal of the Chemical Socie* in the years 1880, 188 and 1882. In 1885 h obtained methylene chlor iodide, a sign that h interest in organic chemistry still continued.

In September 1881 Sakurai returned to his nativ country and was immediately appointed lecture in chemistry in the University of Tokyo. In th following year he becam professor at the early ag of twenty-four years. A time went on, he becam deeply impressed with th importance of the nev physical chemistry associated with the names c Raoult, Le Chatelier, Arrhenius, van't Hoff, Ostwald and Nernst. By hi example and his teachin he exercised a profound influence on the direction o chemical studies in Japan and became indeed th founder of scientific chemistry in that country. Hi important modification of Beckmann's boiling-poin method for determining the molecular weights o substances in solution, an account of which appeare in 1892 in the *Journal of the Chemical Society*, was a notable contribution to the practical side of physica chemistry, whilst his work on the molecular conductivity of amidosulphonic acid (*J. Chem. Soc.* 1896) had an important bearing on the problems o molecular structure and the influence of substituen groups. In this connexion, mention must also b made of his allied investigations on the constitutio of glycocoll and its derivatives, in which he brough forward evidence for the ring- as against the usuall accepted chain-structure.

Sakurai was the founder of a great school o chemical research in Japan, many of his pupils, fo ample, Ikeda, Osaka, and Matsubara, becoming emselves university professors and leaders of emical research. He retired from his University ofessorship in 1919, having served the cause of ience and education for nearly forty years, not only inspiring teacher and investigator, but also as niversity councillor, dean of the Faculty of Science, d acting president of the University (elected norary professor soon after his retiral).

It is not possible to exaggerate the importance of e work which Sakurai did in promoting the estab-hment and development of great organizations for ientific research in Japan. Indeed, it is only fair say that the eminent position which that country cupies to-day in the world of pure and applied ience is largely due to his initiative, energy, and resight. Having been for more than thirty years fore the outbreak of the Great War one of the most tive members of the Tokyo Chemical Society, of hich he was several times elected president, the ents of 1914–18 convinced him (and others in pan) that a great development of scientific research as necessary for the well-being, prosperity and fety of that country. The first result of these forts was the establishment in 1917 of the important Institute of Physical and Chemical Research". Not ntent with this great success, Sakurai, with his lleagues and friends, worked for many years for e establishment of a national organization of much ider scope, which would have for its main object e promotion of research in *all* branches of science. he final result was that, backed by the influence nd a splendid gift of H.M. the Emperor, and pro-ided with an ample subsidy voted by the two ouses of the Imperial Diet, the Japanese Society r the Promotion of Scientific Research, with H.I.H. rince Chichibu as patron, Viscount Saito (then remier) as president, and Prof. Sakurai as chairman f the Board of Directors, came into existence in 933.

The labours involved in the accomplishment of hese great designs by no means exhaust all that akurai did for his country and for science. He was lected president of the National Research Council f Japan soon after the international conferences eld in 1918 in London and Paris, and retained this osition until his death. He attended, as the leader f the Japanese delegation, the second Pan-Pacific cience Congress, held in Australia in 1923, and at he third Congress, in Tokyo in 1926, prepared, as hairman of the International Committee, a draft onstitution and by-laws for the permanent organiza-ion of the Congress. These were adopted with only light verbal alterations, and the Pan-Pacific Science ssociation came into existence.

Prof. Sakurai attended, as the scientific represen-ative of his country, very many international meet-ngs and congresses. His dignified bearing, clear-ighted wisdom, and charming personality became in his way widely known to men of science of many ations. He was twice elected a vice-president of he International Chemical Union, namely, in 1923 nd 1928, and at the third general assembly of the International Council of Scientific Unions (London, 1937), was elected a vice-president, filling the vacancy created by the death of Marconi.

Many honours came to Sakurai from foreign countries. Thus he received the honorary degree of LL.D. from the University of Glasgow in 1901, and was elected an honorary member of the Chemical Society of France, the Society of Chemical Industry, the Royal Institution of Great Britain, the American Chemical Society, the Academy of Sciences of the U.S.S.R., and the Chemical Society of Poland. In 1931 he was elected an honorary fellow of the Chemical Society, and in 1937 an honorary fellow of University College, London. This very high distinction from his old *alma mater* gave him particular pleasure.

It was natural and just that the great and meritorious services which he rendered to his country were signalized by distinguished honours: Order of the First Class of the Sacred Treasure (1916); appointed by the throne a member of the House of Peers (1920) and Privy Councillor (1926); Grand Cordon of the Rising Sun (1929). Shortly before his death he received the Grand Cordon of the Rising Sun and Paulownia, and was created a baron*.

Owing to the old connexion of University College, London, with Prof. Sakurai and with the development of the Empire of Japan as one of the scientific great powers of the world, I had the privilege of welcoming to the Chemical Department of University College a number of Japanese men of science, including many Ramsay Scholars, amongst whom may be mentioned K. Matsuno, K. Suzuki, R. Azuma, H. Tsukamoto, Y. Hori, N. Kameyama, K. Kodama, R. Sato, S. Takagi, Y. Yamaguchi, M. Emi, R. Shinoda, Y. Nagai, T. Somiya, I. Sawai, R. Tsuchida, R. Matsuda, N. Ando, and H. Oosaka. The pleasant and friendly association with these young men, many if not all of whom now occupy important positions in their own country, was a very happy experience in my life; and to have been able to contribute to the preservation of a long and faithful friendship an especial joy.

The name of Joji Sakurai will live in the history of science and civilization. As a great patriot, his name will shine in the history of his country. Joji Sakurai, the man, lives as a fragrant memory in the minds of his host of friends.

F. G. DONNAN.

---

* I am deeply indebted to Prof. Koichi Matsubara for much of the biographical information embodied in this notice.

Prof. M. V. Shuleikin

SOVIET science has suffered a great loss in the death on July 17 of Prof. M. V. Shuleikin, member of the Academy of Sciences of the U.S.S.R. and chief engineer of the Department of Communications of the Red Army.

Prof. Shuleiken spent thirty years of strenuous work in the preparation of numerous scientific workers in the field of radio-communications and in the development of Soviet radio-technics. He commenced his scientific and teaching career in 1908 after graduating from the St. Petersburg Polytechnical Institute. Soon after the Revolution he removed to Moscow, where he worked in the Red Army on the development of military communications. As a result of this work he was successful in solving many complex problems; he produced numerous valuable works dealing with the strengthening of the country's defence capacity. At the same time, Prof. Shuleikin was engaged in extensive educational work. He gave all the principal courses in radio-technics at the former Moscow Higher Technical School, at the Military Electro-Technical Academy, at the Institute of National Economy and at the Moscow Electro-Technical Institute of Communications.

The last six years of Prof. Shuleikin's activities were closely connected with the Academy of Sciences of the U.S.S.R. In 1933 he organized the work at the Academy relating to electro-communications. Under his guidance this work helped to solve a number of problems connected with the diffusion of radio waves, the maintenance of regular communications on the main radio services, and also the adoption of measures to combat magnetic storms.

Prof. Shuleiken was elected a member of the Academy of Sciences of the U.S.S.R. at the beginning of this year. He threw himself with still greater energy into the work of solving the complex problems relating to modern radio-technics and the working out of material for a general plan of development of communications in the Third Five-Year Plan. He also took part in the building of the Palace of Soviets in Moscow, in the capacity of chief consultant on questions relating to communications.

Mr. F. W. Jones, O.B.E.

MR. F. W. JONES, well known for his work in small-arm ballistics, died at a London nursing home on June 25. He was a native of Nottingham but received his training (1887–89) at the Royal College of Science, South Kensington. On leaving college, he joined Colonel Schultze's factory in the New Forest, where the first smokeless shotgun powder, 'Schultze granulated gunpowder', was in its initial stage of development. Within two years, Jones became the manager of the factory and he was thus one of the earliest pioneers of the smokeless powder industry.

Shortly afterwards, Jones joined the Smokeless Powder Company, Ltd., at the works at Barwick, Hertfordshire, and in the following year became works manager. At this factory colloidal nitrocellulose powders were first manufactured in Great Britain, and a wide series of 'rifleites' was prepared for military and sporting use. In 1898, Jones was the principal witness for the defence in a long and important action brought by Heidemann against the Company for infringement. Although the Company won the action, it was crippled financially and soon passed into liquidation.

Jones then became a consultant on explosives. His early clients included Eley Bros., New Explosives Co., Ltd., Cogswell and Harrison, and the *Field* newspaper, and he was also 'proof master' to the London Proof House. At this time he advanced considerab the science of ballistics, both in rifles and shotgun and published many articles on this subject in *Arm and Explosives.* A large portion of his work w incorporated in the "Service Textbook of 1929" a justifies his title as the greatest small arms ballistici in Great Britain.

Jones was not only pre-eminent in the theory rifle shooting, but also at the target, using the matc rifle. At his first visit to Bisley some twenty-eigh years ago, he was the winner of the aggregates, on to lose the prize because the barrel of his Ross rif was slightly overweight. His successes at Bisley hav continued regularly ever since, and last year, seventy-one years of age, he won the first three the match rifle competitions. He was generally on of the first selections for the English team. H worked indefatigably after the Great War for th production of a British military cartridge firing nitro cellulose powder and a streamline bullet, and he live just long enough to see this cartridge, largely th result of his own personal labours, adopted by th British Government. His successes at Bisley wer most popular, since his advice and great experienc were always at the service of those who desired them

During the Great War, Jones rendered assistanc to the Ministry of Munitions in the large field experimental and research work found necessary i meeting ever-changing war conditions. Developmen of caps and tracer and armour-piercing rifle bullet were some of the most important items.

After the War, on the concentration in Imperi Chemical Industries of the manufacture of powde and ammunition, Jones was appointed technic adviser, and his services were invaluable in assistin the improvements and developments in powder an cartridges.

WE regret to announce the following deaths:

Dr. Vladimir Brandstätter, who has collaborate with Prof. Absolon, curator of the Moravian Museum in extensive local archæological excavations, o July 18, aged forty years.

Dr. Alfred Harker, F.R.S., emeritus reader i petrology in the University of Cambridge, on July 28 aged eighty years.

Prof. W. P. Lombard, emeritus professor of physiology in the University of Michigan, on July 13, age eighty-four years.

Prof. J. H. McFadden, assistant professor o psychology in the University of Pittsburgh, o May 28, aged forty years.

Dr. W. J. Mayo, co-founder with his brother, th late Dr. C. H. Mayo (see NATURE of July 15, p. 103) of the Mayo Clinic, Rochester, Minnesota, on July 28 aged seventy-eight years.

Prof. R. W. Reid, emeritus regius professor o anatomy in the University of Aberdeen, on July 28

Mr. Scoresby Routledge, known for his investigations among the Akikuyu of East Africa and of th archæology and ethnology of Easter Island, o July 31, in his eightieth year.

NEWS AND VIEWS

ir George Stapledon, C.B.E., F.R.S.

All who are interested in the progress of agricultural science and practice will hear with great atisfaction that the Royal Agricultural Society has warded its Gold Medal to Sir George Stapledon, professor of agricultural botany and director of the Welsh Plant Breeding Station, Aberystwyth, for his conspicuous services to agriculture. This follows losely on the knighthood recently conferred upon him and on his election into the Royal Society, and the triple recognition of the good work he has long done for agriculture during a very strenuous life is xtremely gratifying. Sir George began his agriultural career at Cirencester, where he early became interested in grassland problems and laid the foundaions for the special studies that he has since brilliantly developed. When the plant breeding station was established at Aberystwyth he was put in charge of it and commenced work on the breeding and selection of grasses, clovers and oats. He did not confine himself to the experimental fields, but also undertook wider investigations in grassland management which were greatly developed when the magnificent donation of Sir Julien Cahn enabled the College authorities to acquire a hill farm. In the course of his activities, he has visited Australia and New Zealand and studied grass problems there. At present he is making a survey of the grasslands of Great Britain, and those who have read his books will look forward with interest to the account which it may be hoped will be published when his review is complete. His many friends wish him many years of continued fruitful activity.

Dr. David Fairchild

Dr. David Fairchild, veteran plant explorer of he United States Department of Agriculture, has been awarded the Meyer Medal of the American Genetic Association for distinguished services in plant introduction at the Glendale, Maryland, Plant ntroduction Station of the United States Department of Agriculture. Dr. Fairchild has been associated with the U.S. Department of Agriculture or fifty years. Through his unflagging interest and enthusiasm, hundreds of new plants have been introduced into America. From this work has grown the date industry in California. The soybean, another ntroduction resulting from Dr. Fairchild's work, is now an industry worth seventy million dollars. Many of the superior cereals now grown on American farms owe their resistance to disease and their ability to withstand unfavourable weather conditions o plant introductions which have been used in breeding work. A most important recent incident in plant introduction has been the saving of the cantaloupe industry in California which was decimated some years ago by a fungus disease, powdery mildew. A wild variety from India, itself of such poor quality as to be scarcely edible, was found to be resistant to the mildew. This resistance has been transferred by applied genetic method to excellent new varieties, also resistant. Dr. Fairchild joined the U.S. Department of Agriculture in July 1889, fifty years ago. He established, and was for many years head of, the office of Foreign Seed and Plant Introduction. During this time he travelled widely through all parts of the world. In 1938 he retired from active service with the Department, but his interest in plants has remained, and in the years following his retirement he has been instrumental in much work with new plants now being carried on in Florida, where he has lived since his retirement.

Prof. Jaroslav Perner

Prof. Jaroslav Perner, professor of palæontology in the Charles University, Prague, has recently celebrated his seventieth birthday. He was born at Týnce on the Labe (Elbe) in 1869 and studied zoology and palæontology under Profs. Antonin Frič and Otokar Novák. He acted as assistant and later as keeper of the Geological Department at the National Museum, where his chief work was the arranging of Barrande's collections. After Barrande's death, Prof. Perner continued his great treatise "Systême Silurian du centre de la Bohême". He described the Gastropoda of the formations included in the system, in three quarto volumes, during the years 1903–1911. Before this, Perner had published four volumes of his important treatise "Études sur les Graptolites de la Bohême" (in Czech) wherein he corrected the old and incorrect accounts of this fauna and laid the basis for the modern stratigraphic division of the Lower Palæozoic rocks of Bohemia. After the death of Prof. E. Koken of Tübingen in 1912, the Russian Imperial Academy of Science at St. Petersburg asked Mr. Perner to continue Koken's "Gastropoden des baltischen Untersilurs". This Perner did during 1913–1925. In addition he has written a number of scientific articles on Phyllocarida, trilobites, fishes, conodonts and other fossils of the Palæozoic rocks of his country. These have appeared mainly in the *Journal of the Bohemian Academy of Sciences* or in the *Centralblatt für Geologie*. On the death of Prof. Filip Počta in 1928, Prof. Perner was appointed professor of palæontology in the Charles University, and had control of the palæontological collections at the Geological Institute (under Prof. Radim Kettner). He obtained part of the great Hanus collection, which contained much new and rare material. A new development of his subject has taken place since his appointment, which can be seen from the published work of his pupils. He is a corresponding member of the Palæontological Society of Washington, a member of the Bohemian Academy of Arts and Sciences, and an honorary member of the Bohemian Royal Society of Sciences.

Close Approach of Mars

MARS was in opposition with the sun on July 23, and was nearest the earth, at a distance of 36 million miles and with an angular diameter of 24·1″, on July 28. Despite the closeness of the approach, the apparition is a most unfavourable one for observation in high northern latitudes. This is because of the planet's very large south declination. In May its declination ranged between −22½° and −23°; by the end of June it increased to −24°; and it is now −27°. Thus, since observations began, the altitude above the horizon in the latitude of Greenwich has never exceeded 16° and is now less than 12°. It follows that observers in Great Britain and in most northern observatories cannot expect to get good views of the planet during the present apparition. We shall have to rely almost entirely for our results on observers in the southern hemisphere. Astronomers in northern latitudes may look forward confidently to the next apparition in 1941; for then the planet will be high in their skies and not very much farther away from the earth. During the present apparition, the southern hemisphere of Mars is tilted towards the earth, the latitude of the centre of the disk being −12° at the beginning of June and −7° at the end of August. The spring equinox of Mars' southern hemisphere occurred on June 1; the summer solstice will occur on October 24.

IN addition to the disadvantage of the planet's low altitude, English observers have had to contend with exceptionally bad weather conditions. The long spell of unsettled weather has brought with it very poor definition, which is, of course, greatly exaggerated when observations have to be made near the horizon. On the few clear nights available, Mars has generally resembled a pulsating ball of wool; and only on rare occasions, and then for brief intervals, has the disk been steady enough for the more prominent features to be made out. The south polar cap which up to the beginning of July was large is now starting to melt rapidly. The southern *maria* have in general appeared fairly dark and many of the lighter regions situated in their midst have appeared shaded over. This phenomenon has been particularly striking in certain regions. Thus the Rev. T. E. R. Phillips observed Hellas deeply shaded; and during the last two weeks Dr. R. L. Waterfield found the region *south following* the *Solis Lacus* to be much darker than usual: But the *Solis Lacus* itself, so far as one could see, presented its normal configuration, and had not undergone any such striking metamorphosis as it presented in 1926 and 1928. There have been remarkable whitenesses towards the north polar regions, which about July 10 and July 30 were almost as dazzling as the southern snow cap. These may be due to cloud, although their brilliance suggests that they are snow; but if they are due to snow, they are probably not part of the pole-cap proper, as they are situated very eccentrically with regard to the north pole itself. It is gratifying to hear that Dr. V. M. Slipper of the Lowell Observatory has gone to Bloemfontein to observe the planet. So far, no official reports have come to hand; but according to brief reports in th Press he has already detected some interesti changes in the *Solis Lacus* region, which are possib those referred to above.

Official Tests of 'Anderson' Shelters

A SERIES of official tests was recently carried o on the 'Anderson' air raid shelter, and the resul published. The A.R.P. Co-ordinating Committe which is an independent body of architects, surveyo medical men and men of science under the chairma ship of Prof. J. B. S. Haldane, has made some serio criticisms of these tests in a statement forwarded Sir John Anderson. The Committee admits that certain amount of useful information has bee obtained, but it considers that insufficient tests we carried out to justify what it calls 'far too optimisti conclusions. A number of interesting points a raised; for example, the Committee thinks that is not enough to do each explosion test once only and if, as is claimed, apparently similar bombs ofte behave differently in exploding, the objection woul seem to be justified. The Committee also asks f further research into the physiological effects blast, a subject which is very imperfectly understoo It is well known that 'blast' is, in effect, a very rapi rise in pressure followed by a slightly slower fall. is this *rapid* fluctuation of pressure, presumabl which gives blast its lethal effect. The Committe rightly points out that there is strong evidence tha it is not the *magnitude* of the changes in pressur which matters so much as the rate at which th pressure changes. The reactions of the human bod to fairly slow changes of pressure have long bee well known to physiologists, but there is little exa knowledge of the results to be expected when th body is subjected to wide fluctuations in a fractio of a second. If, as we are told, the general populatio is to be exposed to just such changes, the Committe would seem to be justified in calling for more researc

THE Committee's statement raises the furthe point that the tests indicate that in many Londo boroughs the population, if sheltered entirely i Anderson shelters, might be expected to suffe approximately seventeen casualties per ton of bomb dropped, and says, "When it is borne in mind tha the President of the Air Raid Protection Institut estimated in March 1939, that Germany alone coul despatch 3,000 tons of bombs per day to this country the seriousness of the position will be apparent" The Committee urges that this is further reinforce ment for the case for a scheme of heavily protecte shelters, particularly in fairly densely populate areas, and argues that if the tests had preceded th adoption of the official shelter policy a differen policy might well have been adopted.

Saxon Time Measurement

IN making a clearance of earth during alteration to the Cloister Garth at Canterbury Cathedral Saxon pocket sun-dial, or time-piece, of gold an silver was found recently at a depth of two fee below the surface. It is described (*The Times*, Jul 31) as being in the form of a tablet of silver with a gol ap and chain, and for gnomon a gold pin surmounted by a delicately chased animal head, with jewelled eyes and a ball in its mouth. This pin, when not in use, rested in a hole at the lower end of the tablet, and was in this position when the time-piece was found. On the faces of the tablet are inscribed the names of the months, abbreviated and in pairs. At the top of each of the three columns is a hole for the pin when in use, and below each hole two spots. Of hese the higher in each month, when the dial hangs free, indicates noon and the lower 9 a.m. and 3 p.m. marking the hours of the monks' services. Along the edges runs the inscription: *Pax Possessori—Salus Factori*. The dial has been tested for accuracy by Dr. A. H. Smith of University College, London. The grouping of the months in pairs according to their equivalent distances from the summer solstice s based, it is to be presumed, on the table given by Bede for measuring the shadow of a six-foot gnomon. Dr. Smith finds that owing to its small size, the dial would only be approximately accurate. It would, however, be more or less correct at noon in latitude 53° N. at the middle of certain months, or early in others, while in the far north of England it would be more or less accurate through the summer months. At 9 a.m. and 3 p.m. it would be more or less accurate in late January, mid-February, mid-March, early April, early May, late July, mid-September, early October, early November and early December.

Anglo-Saxon Ship Burial

Ship burials are of sufficient rarity, even on the Continent, for the discovery of an Anglo-Saxon ship burial at Sutton Hoo, near Ipswich (*The Times*, July 26, July 31) to be regarded as a memorable and, indeed, remarkable event. This is, in fact, only the second of the kind to be found in England, a previous discovery, though of a rather less impressive character, having been made at Snape, two miles away. In the present instance, the vessel in which he interment had taken place was a rowing galley 82 ft. long. The quantity and character of the jewellery and other personal objects associated with the burial were such as to justify the assumption that a chief lay buried here. The personal relics were found collected together in the centre of the ship, and included a handsome gold buckle, clasps and fastenings of the garments, gold studs from a belt, and small plaques of gold bearing figures of human beings and animals. The sword had been laid by the side of the body; but it has almost entirely perished, with the exception of the richly ornamented gold and jewelled pommel. The deceased had also been provided with money, the remains of a purse being found beside some coins. Other articles found with the burial were iron pots and spearheads, and an object which has the appearance of a sceptre, having faces carved at either end. A metal cup may, it is thought, have contained some articles of symbolic significance. The grave is situated on the estate of Mrs. E. M. Pretty, and has been excavated by the authorities of the Ipswich Museum, under the field direction of Mr. Guy Maynard, with the co-operation of H.M. Office of Works and the British Museum.

Lightning Flashes and High Tension Mains

During July there were many violent thunderstorms and much damage was done to overhead electric mains and substations connected with them. The damage done to main stations was also severe. On July 19, a violent thunderstorm cut off Valley Road Power Station at Bradford from the Grid and shut down all the generating sets there. For about an hour, mills, factories, trams and trolley-buses on many routes came to a standstill; the traffic lights failed and there was no light anywhere for about an hour. A similar occurrence took place at the Brighton Power House at Southwick. In both cases the difficulties of the staff were increased as they were engaged in changing over on the Grid supply from 6·6 kilovolt to 33 kilovolt. There was a heavy storm over Cumberland and the overhead transmission was struck. This affected the supply to more than 30,000 houses in Cockermouth, Maryport, Aspatria and Wigton as well as part of Workington, the lights being out from 3.15 p.m. to 8.30 p.m. On July 19, at 8 p.m., the B.B.C. National Transmitter at Droitwich was struck by lightning and put out of action. The flashes striking the 700-ft. masts of the Radio Station were extremely violent. Flames shot from the cage of aerial wires slung between the masts. In some places transformers or switchgear were damaged and three fires broke out, destroying substation roofs or walls. Since thunderstorms are less frequent in Great Britain than in South Africa and other parts of the world it might be useful to study the effects of modern lightning protectors in protecting poles, steel towers, overhead mains, etc., in places where thunderstorms are frequent and violent. Also when designing new grids or extensions of old ones to get estimates of the relative costs of overhead mains and of underground mains. A decision could then be arrived at as to which is the better method of transmitting high-tension electric power.

Empire Broadcasts on Scientific Topics

The British Broadcasting Corporation has instituted a short series of quarter-hour broadcasts to the Empire on recent advances in science. The first talk of the series was given at 11.15 p.m. on July 31 by Prof. Allan Ferguson, one of the general secretaries of the British Association. Prof. Ferguson, after giving a simple picture of the structure of the atom, and the results to be expected from atomic bombardment, described briefly the development of the cyclotron, recent experiments on nuclear disintegration, including the uranium-fission experiments, and the production of 'labelled' particles. Succeeding talks will be given by Wing-Commander Cave-Browne-Cave on mechanical engineering (August 7), by Dr. S. J. F. Philpott on psychology (August 14) and by Prof. F. A. E. Crew on biology (August 21).

League of Nations

"The League from Year to Year (1938)", which has recently been issued by the Information Section of the Secretariat of the League of Nations, contains the usual concise account of the year's activities in sufficient detail to facilitate careful study of the political, legal and technical work of the various organs of the League of Nations. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1939. Pp. 214. 1*s*.). Of special interest to scientific workers are the chapters on intellectual co-operation, the health organization, the communications and transit organization and those on the European conference on rural life and technical collaboration with China. A chapter dealing with refugees is included as well as one on mandates. The detailed chronological table of the principal events in the League's sphere of activity during the year, giving the dates of the meetings of the different organs of the League and of their principal decisions, as well as of world political events affecting the League's work introduced last year for the first time is again a feature of the new edition.

The Colonial Problem

THE proposals of the Labour and Peace movements for dealing with the colonial question are examined in a pamphlet "New Tendencies in Colonial Policy" issued by the Pacifist Research Bureau (New Tendencies in Colonial Policy. With an Introduction by Leonard Barnes. Pp. 16. London: Pacifist Research Bureau, 1939. 2*d*.). It is argued that there are only two alternatives: an extended and re-arranged imperialism with new rival imperialisms of greater equality and an ultimate clash between them; or the removal of existing imperialisms and their substitution by a great conception of civilization's responsibility for the so-called uncivilized, with an equally great conception of world economic organization. The necessity of conforming to the wishes, or, at least, obtaining the consent of the native peoples in all matters affecting their welfare is also emphasized, including the application of this principle not only to the mandated territories but also in other colonial questions. The problem is further discussed in another pamphlet issued by the Bureau, "War and the Colonies" (War and the Colonies: a Policy for Socialists and Pacifists. Pp. 16. London: Pacifist Research Bureau, 1939. 2*d*.), in which proposals for a world conference to effect the liquidation of imperialism are briefly outlined.

Language in Science

THE general considerations of linguistics which throw light upon the procedure of science are discussed by L. Bloomfield in the fourth number of volume one of the "International Encyclopedia of Unified Science" (Linguistic Aspects of Science. By Leonard Bloomfield. Pp. viii+60. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 5*s*. net.). If language is taken into account, science can be distinguished from other phases of human activity by agreeing that science shall deal only with events that are accessible in their time and place to any and all observers or only with events that are placed in co-ordinates of time and space, or that science shall employ only such initial statements and predictions as lead to definite handling operations o only terms such as are derivable by strict definition from a set of everyday terms concerning physica happenings.

IT is the task of science to provide a system o responses which are independent of the habit of any person or community, but Mr. Bloomfield points out how far short we are of accurat definition in regard to meanings which are involve in the habits of communities and individuals, sinc the relevant branches of science are quite undeveloped. Discussing the development of scientific language he distinguishes between the informal and forma scientific discourse, and emphasizes the importanc of defining exactly the meaning of technical term and limiting their use within the agreements upon which they are based. When meanings of the outsid world are admitted, error may be incurred an certainty is lost. With regard to the place of linguistic in the scheme of science Mr. Bloomfield places i between biology and ethnology, sociology an psychology. It stands between physical and cultura anthropology. It is closely related to logic, sinc it observes how people conduct a certain type o discourse. The critique and theory of scientific speech is the task of logic. Mathematics, however, is a science only so long as we believe that the mathematician is not creating speech-forms and discourse (which is a skill, craft, or art) but exploring a unknown realm of concepts or ideas.

Library Services in the United States

UNDER the title "Professional Library Education" the Office of Education, United States Department of the Interior, has issued a bulletin by Nora E Beust (*Bull.* No. 23; 1937) describing the present position of library services in the United States and indicating the possibilities it offers as a career, and the qualifications required for the various fields o service. Much that is said of the different types of library such as the public library, the school, the university or the special library is true generally, and if due allowance is made for the different conditions and details in the United States, this pamphlet gives a reasonably sound guide to the possibilities in Great Britain also, even if some directions have been much more developed in the United States. Details regarding training for librarianship, like the figures showing the present status of the profession, relate solely to the United States and attention is directed to a marked growth in the number of librarians in the last three decades, particularly in comparison with the number of practitioners in other professions. Some reasons for success and failure in library work which are set forth in conclusion are of general validity.

The Society of Applied Biologists

PRIOR to the year 1904 there was no scientific society or journal in the United Kingdom devoted to applied biology. There was, moreover, little opportunity or encouragement for research in this field, and the work of the universities and other ucational institutions was primarily concerned with ure science. Owing to the initiative of Mr. W. E. llinge of the University of Birmingham and others, owever, the Society of Applied Biologists (as it is ow termed) came into being. And as 1938 marked e publication of the twenty-fifth volume of its urnal (*Annals of Applied Biology*), Prof. W. Brierley, int editor since 1921, has written an interesting ccount of the development of the Association (*Ann. pp. Biol.*, 26, 178; 1939), correlating it with more eneral trends of development in the country over e same period of years. From the outset the Society as welcomed all investigators in economic biology, hether agricultural, horticultural, medical or com- ercial, and since its inception has steadily widened s interests. The journal, too, has increased in scientific alue, developing from a volume of 359 pages in 922 to one of 891 pages in 1938. The inclusion of hotographs of the presidents of the Association om 1904 up to the present time adds much to the nterest of the retrospect.

gricultural Research Institutes

THE reports on the work of the agricultural research nstitutes in the United Kingdom carried out during e year ending September 1936 have now been pub- shed (London: H.M. Stationery Office. 5*s*.). The olume also includes reports of a number of other nvestigations, particularly into animal diseases, set foot by the Agricultural Research Council, and ccounts of the research activities of the agricultural dvisory officers. Those who require fuller informa- ion on any subject are invited to consult the original apers, a list of which is attached to each report, or to nquire of the director of the institution concerned. armers and others in need of advice on agricultural r horticultural matters are reminded that by apply- ng to the agricultural organizer for their county, they an draw direct benefit from these research and dvisory services. It is perhaps unfortunate that so much delay occurs before these reports are published, s thereby some of their value is inevitably lost.

Know Your School" Movement in the United States

To the various agencies which foster local interest n the public schools of the United States, such as the fficial popular magazine *School Life* and parents' ssociations, a notable addition has recently been ade. At the request of the American Association f University Women, the Office of Education pre- ared a series of study outlines of certain aspects of he public school system for the use of the Associa- ion's branches. These proved so widely acceptable hat they are being reprinted as ten-page leaflets. hose already issued are: "Know your Board of ducation" (Local Education Authority), "Know our Superintendent", "Know your School Principal" nd "Know your Teacher". They deal simply and learly with such questions as "What are the duties f the principal?", "What should be his qualifica- ions?", "Relationship to the local education author- ty, to the superintendent, to supervisors, to teachers, o the school janitor, to the community". They are well adapted for guiding discussion by study circles and contain suggestions for investigation and discussion. In an article by the president of the University of Chicago which appeared in *The Times* United States Supplement of June 8, reference is made to "the deep and abiding faith of the people in education", and it concludes—"we shall yet make good our boast that we are giving the world a demonstration of education by and for democracy". The leaflets should serve as an acid test of this faith, and eventually tend to strengthen it.

Manufacture of Rare Gases

IN an article by H. C. A. Holleman on the manufacture of rare gases (*Philips Tech. Rev.*, May), a method is described by which rare gases, as well as oxygen and nitrogen are obtained from the air at the Philips' factories at Eindhoven in Holland. During the Great War, when it became more and more difficult to import the argon necessary for filling the incandescent lamps made in the factory, they were forced to manufacture the gas itself and a gas liquefaction plant was installed. This plant continued to grow steadily after the War, as it was found to supply many needs. So many different gases, all of which can be obtained from liquid air, are used in the Philips' factories that it was very important to have the whole manufacture under one control. Besides argon, which is used for filling electric lamps, the rare gases helium and neon are also used in gas discharge tubes. For glass blowing and in the machine shops large quantities of oxygen are used in order to reach higher combustion temperatures than it is possible to reach with air. Liquid oxygen and nitrogen are both used on a large scale for cooling purposes and as aids in obtaining a high vacuum.

As a protective gas in the working of metal parts for electric lamps and radio valves, much use is made of a mixture of nitrogen and hydrogen. Nitrogen is also used during the manufacture of electric lamps as a washing gas, while it is also used to fill special kinds of lamps. A modern installation for the separation of air by the Linde method is described. Since krypton and xenon have relatively high boiling points, they collect in the liquid container below the main column, which contains oxygen for the most part. Methane occurs in variable amounts in the air and has about the same boiling point as krypton, so that it is collected with the krypton in the liquid oxygen. This leads to difficulties in practice since liquid oxygen together with a combustible substance like methane can easily form an explosive mixture and lead to accidents. Hence the strictest precautions have to be taken in the preparation of krypton and xenon.

Earthquakes registered at De Bilt during 1936

THE "Seismische Registrierungen in De Bilt", 24; 1936, published in November 1938 and written by Dr. G. Van Dijk with a foreword by Dr. H. G. Cannegieter, contains a description of the instruments in use at the station with the constants necessary for the interpretation of the seismograms obtained, a list of the abbreviations used, acknowledgments, a short paragraph on microseisms together with a table, followed by fifty-three pages in small clear type of the earthquakes recorded. This record contains details of 443 earthquakes, giving in each case the date, phase and time of recording, the period of the phase, direction of initial impulse and remarks. The remarks consist chiefly of amplitudes, epicentre, and readings obtained by other observers who have communicated with De Bilt. A very sound practice has been not to give the recorded time of every prominent pulse but to limit the identifications to *P*, *PP*, *PPP*, *S*, *SS*, *SSS*, *L*, and *M* phases, so presenting very valuable data for seismological research in many directions.

Diploma in Fuel and Refractory Materials at Leeds

FOR many years past the University of Leeds has provided courses for post-graduate students leading to special diplomas both in gas engineering and in fuel and metallurgy. A one-year course leading to a post-graduate diploma in fuel and refractory materials has now been arranged, in order to meet the growing demand for men with special training in refractory materials. Commencing in October next, the new course will be given in the Department of Coal Gas and Fuel Industries, and will be additional to the normal instruction in the subject received by all students reading for degrees in gas engineering and in fuel and metallurgy. An approved degree in science or technology is required as a preliminary qualification; and the subsequent specialized training in fuel and refractory materials is intended as preparation for entry into either the 'manufacturer' or 'user' sides of the refractories or allied industries. Particulars of these courses may be obtained from the Registrar of the University.

Announcements

THE following awards of the Royal College of Physicians have recently been made: the Moxon Gold Medal to Sir Arthur Hurst, senior physician to Guy's Hospital, for his researches and observations in clinical medicine; the Baly Gold Medal to Prof. C. H. Best, professor of physiology in the University of Toronto, for his physiological researches; the Weber-Parkes Medal and Prize to Sir Pendrill Varrier-Jones, founder and medical director of the Papworth Village Settlement, for his work on tuberculosis at the Settlement.

THE Council of the City and Guilds of London Institute has conferred the distinction of fellow of the Institute upon the following: Mr. L. B. Atkinson, Mr. C. R. Fairey, Mr. E. Fawssett, Dr. L. F. Goodwin, Sir Follett Holt, Sir Gilbert T. Morgan, Mr. F. Handley Page, Sir Leonard Pearce.

A TEAK memorial seat to the late Sir William Perkin, the chemist, is to be unveiled and dedicated to the public at Sudbury, Middlesex, on August 12. The memorial will be outside a recreation ground, and opposite the site where Sir William's house and laboratory stood. The cost of the memorial has been met by public subscription.

DR. GWENVRON M. GRIFFITHS has been appoint to the Kathleen Schlesinger research fellowship f the year 1939–40. The fellowship is provided fro a fund established by the late Mr. Eugen M. Schl inger and Mrs. Schlesinger in memory of th daughter, and is given for investigations of cysts the brain or allied conditions. It is ordinari tenable at the National Hospital for Diseases of t Nervous System, Queen Square, London.

PROF. THEODOR VAHLEN, president of the Prussi Academy of Sciences, has been awarded the Goeth Medal for Art and Science by the German Chancello

THE Medical Research Council has appointed D Donald Hunter, physician to the London Hospita and Mr. Harold E. Clay, national secretary of th Passenger Services Group, Transport and Gener Workers' Union, to be members of the Industri Health Research Board, in succession to Prof. J. Nixon and Mr. R. Coppock.

MR. E. J. LUDLOW of Brylls, Waltham S Lawrence, Berks, has been awarded the Founde Company fellowship to commence in Septemb next. Mr. Ludlow will be the first person to hol this fellowship, which has been recently create The normal value of the fellowship is £250 a yea and will be renewable for a second year and in speci cases for a third year.

MR. PAUL VELLACOTT, headmaster of Harrow, ha been elected master of Peterhouse, Cambridge, i succession to the late Prof. H. W. V. Temperley.

THE fourth International Congress for Racia Hygiene will be held in Vienna on August 26–2 under the presidency of Prof. E. Rudin. The fee i 10 marks. Further information can be had from th Office of the Congress, Einemstrasse 11, Berlin, W.6

IN NATURE of March 25, p. 515, it was stated tha the University of Peiping has been reopened unde the direction of Prof. Hisomu Nagat, formerly of th University of Formosa. Monlin Chiang, writing a chancellor of the National University of Peking states that the National University is now in Kunming, Yunnan, as part of the National Southwester Associated University. He says that, following th fall of the city on July 29, 1937, all the nationa universities in Peiping moved with their facultie and staffs and almost 90 per cent of their students leaving behind them practically all their books an apparatus, to the interior and combined into severa groups under new names, of which the Nationa Southwestern Associated University is one. As th evacuation took place during the summer vacation these universities were able to reopen in their nev homes more or less according to their origina academic calendars, with what little equipmen they had secured in the short interval.

ERRATUM.—In NATURE of July 22, p. 150, th dates for the Congress of the International Unio against Tuberculosis were incorrectly given a August 11–September 20. They should rea September 16–20.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 251.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Expression of Vacuolar Sap

RECENT work carried out here supports some, but, re think, not all of the views recently expressed by hillis and Mason[1] regarding the composition and tructure of cytoplasmic and vacuolar saps in plants. opper beech leaves which contain anthocyan in the acuoles of epidermal and palisade tissues were used nd were carefully pressed between flat plates in the 0-ton testing machine of the Engineering Department through the kindness of Prof. C. H. Bulleid. are was taken to avoid slipping of the leaves as uggested by Phillis and Mason.

Juice exudes when the leaves are pressed. Increase n pressure above approximately 400–500 atmospheres loes not result in expression of any further appreciable uantities of juice from the leaves when alive and ninjured. If this residue is killed by freezing in olid carbon dioxide a considerable further amount f juice is expressed at these relatively low pressures s described by Phillis and Mason. Data regarding he samples of juice in a typical experiment are given n the accompanying table:

	Before killing			After killing
Pressure applied normal to leaf surface (atmos.) ..	133	230	350	350
Osmotic pressure of expressed juice (atmos.) ..	8	11	11·5	24
Volume of juice per 100 gm. leaf (ml.)	9·5	7·7	2·2	10·1
Colour of juice in Lovibond units per cm. depth—				
Red units ..	22	20	—	10
+ Yellow units ..	22	19	—	6
+ Blue units ..	30	24	—	2
Mean plasmolytic value in atmospheres—epidermis	24			
mesophyll	30–35			

It will be noted that the juice expressed before illing was strongly coloured by anthocyan. In fact, t contained 80 per cent of the total anthocyan. The uice obtained after killing contained little anthocyan nd had an osmotic pressure two to three times reater than the juice obtained before killing. It is ifficult to escape from the conclusion previously rawn by Phillis and Mason that the first pressing xpressed vacuolar sap (of low osmotic pressure) and he second, after killing, expressed cytoplasmic sap. he distribution of anthocyan in the samples rules ut the suggestion that the low osmotic pressure of he alleged vacuolar sap is due to filtration of water rom the solutes which remain behind.

With a different technique, it is possible to bring bout this filtration and compare the two processes. n the experiment just described the pressure was uickly applied, that is, the pressure rose from zero o 133 atmos. in the space of about five minutes. n the 'slow pressure' treatment leaves are subjected o, say, 25 atmos. for about thirty minutes, by which ime all the juice expressible at that pressure will ave exuded. The pressure is raised at first by 5 atmos., later by about 10 atmos. increments until no further juice is obtained; after each increment the system is allowed to come to equilibrium before the next increment is given. The juice so obtained is colourless and tends towards pure water in composition. In our experiments its osmotic pressure has varied from 1–4 atmos. Finally, when the residue from this treatment is killed by carbon dioxide freezing and pressed, a further quantity of juice is obtained which is strongly coloured by anthocyan and has the very high osmotic pressure of 30–37 atmos. The explanation is that the slow pressure treatment has squeezed out the vacuolar water, leaving the solutes behind, and when the tissue is killed and pressed the juice obtained contains the cytoplasmic water and solutes and the vacuolar solutes also.

With the slow pressure treatment no liquid is obtained at all below about 23–25 atmos. and only traces at this pressure; but in the pressure range 30–50 atmos. about half the expressible liquid is obtained (it should be emphasized that it exudes very slowly, as indeed it exudes very slowly during plasmolysis). When one recalls that the plasmolytic value for the epidermis of these leaves is about 23–25 atmos. this result is very significant and strongly suggests that this figure (the plasmolytic value) actually represents the hydrostatic pressure within the cell.

To conclude, our view is that when a relatively large pressure is suddenly applied, as in the quick-pressure treatment, weak parts of the liquid protoplast are distended and fissures are formed through which the vacuolar liquid is forced. Phillis and Mason suggested expression of vacuoles through fissures without making clear whether they regard these fissures as being produced by sudden application of pressure. When the slow pressure treatment is applied, bursting in this manner does not occur and filtration of water through the semi-permeable protoplast takes place, resulting in a concentrating of the vacuole exactly similar to the concentrating of the vacuole which occurs during plasmolysis. The anthocyan distribution and osmotic pressure data show, we believe, that the vacuolar sap of these leaves has an osmotic pressure of about 8–11 atmos., that the hydrostatic pressure within the cells is about 25–35 atmos. (in the several tissues), and that the difference is attributable to secretory work done by the living protoplasts[2].

T. A. BENNET-CLARK.
DOROTHY BEXON.

Botanical Department,
University College,
Nottingham.
July 4.

---

[1] Phillis and Mason, NATURE, 140, 370 (1937); Brit. Ass. Rep. 1938, p. 493.

[2] Bennet-Clark, Greenwood and Barker, *New Phytol.*, 35, 277 (1936).

Liberation of Potassium by Acetylcholine in the Central Nervous System

SIMILARITIES in the physiological activities of potassium and acetylcholine have been frequently pointed out[1]. As we know that potassium directly affects the functions of the cells, one should consider whether acetylcholine works through a liberation of ionic potassium or not. This might be the case, as in such organs like muscles and the central nervous system a combined form of potassium has been actually detected. Consequently, the liberation of potassium under the influence of acetylcholine was the first thing to look for.

As an object for our inquiry, we took the central nervous system of the Hungarian Esculenta. The whole nervous system was carefully isolated and cut into two homologous longitudinal portions. Both were soaked in isotonic saline (1 c.c.), one being kept for a control, the other being submitted to the action of the drug. After a while (about one hour), nervous tissue and surrounding saline were treated in a mortar in a final concentration of 96 per cent alcohol, and free, uncombined potassium was estimated in the liquid after centrifuging. The following data have been gathered:

(1) Neither eserine alone nor acetylcholine alone affected the content of free potassium.

(2) Acetylcholine, when eserine had been previously supplied for thirty minutes, increased the ratio of free potassium (12–56 per cent, with an average of 23 per cent).

(3) A previous treatment with atropine inhibits the effect of acetylcholine.

Thus it is demonstrated that acetylcholine liberates potassium from some compound. Considering our experimental conditions are purposely unphysiological in the sense that nervous cells turn rapidly inactive in the absence of oxygen, it is highly probable that the effect of acetylcholine should not be considered as the consequence of a functional alteration due to it, but rather to its primary and direct effect.

What adrenaline would do under the same circumstances is now the matter of our investigations.

WALTHER DULIÈRE.
OTTO LOEWI.

Laboratoire de Pharmacodynamie,
Université, Bruxelles.
July 5.

---

[1] Pichler, *Arch. exper. Pharmakolog.*, 175, 85 (1934).

Influence of Sodium Chloride on Glucose Absorption from the Intestine of Iodoacetate-poisoned Rats

IODOACETATE poisoning decreases the rate of absorption of glucose and the 'actively absorbed' hexoses from the intestine of rats by about 60 per cent, whereas the absorption of xylose is not affected by this poison[1]. Adrenalectomy has the same effect on sugar absorption[2]. According to Meyerhof[3], iodoacetate acts on glycolysis by suppression of the oxido-reduction between pyruvic acid and triosephosphate. It has been suggested[4] that adrenalectomy influences the glycolytic metabolism in a similar way. Now it has been shown by various American workers that adrenalectomy is followed by a severe disturbance in the excretion and distribution of electrolytes, and that by means of a diet containing no potassium and much sodium it is possible to maintain life with adrenalectomized animals indefinitely. It was ther fore tried whether the effect of iodoacetate on sug absorption also depends on the electrolyte compo tion.

Female rats of 150–200 gm. were used. Six hou before the absorption experiment they were give subcutaneously 1·5 c.c. 1 per cent NaCl + 0·5 c. N/10 Na_2CO_3. Two hours before the absorption th dose was repeated and 1½ hours before the absorptic the animals were poisoned with 0·1–0·12 mgr iodoacetate 1 gm. body weight. The experimen were carried out in urethane narcosis using the san methods as in the above-mentioned previous work Simultaneously with the sugar, a third dose of sodiu chloride (0·5 c.c. 1 per cent subcutaneously) w given. The experiments showed indeed that th inhibiting effect of iodoacetate on sugar absorptic is suppressed after sodium chloride administratio The accompanying table shows the experimental dat (including experiments in which Na_2CO_3 was replace by NaCl, and which show the same type of result

AMOUNT OF GLUCOSE ABSORBED IN 45 MINUTES (PER CENT OF TOT AMOUNT INJECTED).

Normal rats	Iodoacetate-poisoned rats		
	Without NaCl	After NaCl + Na_2CO_3 administration	After NaCl administration
83·5	26·0	62·0	73·0
49·3	25·0	75·5	63·2
72·6	28·0	73·0	65·5
62·8	31·0	69·0	81·5
61·5	31·0	58·0	
Average: 65·9	28·2	67·5	70·8

The general toxic effect of iodoacetate on rats i counteracted by sodium chloride in a similar way Female rats of 90–110 gm. die 12–16 hours afte injection of 0·05 mgm. iodoacetate/gm. body weigh whereas after administration of sodium chloride in similar dose as above they survive after a dose 0·08 mgm./gm.

L. LASZT.

Physiological Laboratory,
University, Fribourg,
Switzerland.
June 19.

---

[1] Wilbrandt, W., and Laszt, L., *Biochem. Z.*, 259, 398 (1933).

[2] Wilbrandt, W., and Lengyel, L., *Biochem. Z.*, 267, 204 (1933). Las L., and Verzar, F., NATURE, 138, 844 (1936).

[3] Meyerhof, O., *Helv. chim. Acta*, 18, 1030 (1935).

[4] Laszt, L., and Verzar, F., *Pflügers Arch.*, 236, 693 (1935).

Nicotinic Acid, Pentose-nucleotides and Anæmia

IN a recent issue of NATURE[1], Caspersson an Schultz stress the importance of the occurrence o pentose-nucleotides in the nucleus and especially i the cytoplasm of cells in rapid mitotic division. Thei observations would appear to have a distinct bearin on the subject of the pathogenesis of perniciou anæmia and other blood abnormalities of kindre mode of origin.

Some time ago[2], the suggestion was made that, i these conditions, the normal formation of erythrocyte by the mitotic division and subsequent ripening o the erythroblast was in abeyance: and that the re blood cells were here formed, heteroplastically an directly, from the corresponding hæmocytoblast (primitive or definitive as the case might be) afte multiplication had occurred by an amitotic process

In support of this hypothesis, it was found[3] in the ase of a major sequela of iron deficiency in the pig vhich was characterized, among other appearances, y great destruction of liver parenchyma and a nacrocytic anæmia, that the administration of liver xtract produced a dramatic amelioration in which here took place a return of the circulating blood to ormality and a replacement of the amitotic hæmocytoblastic blood formation in the marrow by a nitotic erythroblastic one. Recently Elvehjem and is collaborators[4] have shown that liver extract conains nicotinamide, a substance which, as is well mown, constitutes with pentose-nucleotide the oenzyme system. Further, Chick and co-workers[5] ave demonstrated that nicotinic acid brings about rapid restoration of health in a condition of the pig ermed by them "pellagra", but which, failing vidence to the contrary being forthcoming, would ppear to be the iron deficiency sequela.

Casperson and Schultz emphasize the point that n rapidly growing embryonic tissues (with frequent nitotic division, therefore) the cytoplasm of the cells tains basophile, an occurrence which they attribute o the presence of nucleotides. The characteristic eature of the hæmocytoblast is intense basophilia f the cytoplasm with marked achromasia of the ucleus. This state of affairs, on the contrary, is not ssociated with mitosis, rapid or otherwise, but with mitotic division, a process recognized by the cometent authorities as being, in the majority of cases, degenerative one. The degenerative aspect of the ase is further added to by the fact that ripening f the erythrocyte, whether directly, as here, from he hæmocytoblast or indirectly, as in normal conlitions, from the erythroblast, is essentially a legeneration.

In these circumstances it does not appear to be mreasonable to assume that, in mitotic division onditions with rapid increase in the chromatin of he dividing nuclei, nicotinic acid is a necessary djunct to the nucleotides in the formation of oenzyme for the carrying out of important intraellular functions such as mitosis must be. Its absence vould seem to furnish an explanation of the deenerative amitosis, defective chromatin formation, nd premature ripening of the erythrocytes in the onditions just considered, in that coenzyme would e unable to function without it: while the return o normality in such cases after its administration ould be construed as a restoration of the activity f the coenzyme by its presence.

On these lines it would seem that a tentative nderstanding of the pathogenesis of the anæmic onditions under discussion could be arrived at, hough it is not suggested that nicotinic acid is the ole agent in liver extract which is active in such ircumstances. At the same time, it is not supposed hat failure of mitotic division in such cases is limited o the cells of the hæmopoietic system.

J. P. McGOWAN.

16 Ruthriehill Road,
Stoneywood,
Aberdeen.
June 19.

Casperson and Schultz, NATURE, 143, 602 (1939).

McGowan, "Pernicious Anæmia, etc." (London: Lewis, 1936). *Proc. Roy. Soc. Med.* (Sect. Compar. Med.), 21, 33 (1928). *Edin. Med. J.*, 37, 330 (1930); 42, 203 (1935).

McGowan and Sinclair, *Edin. Med. J.*, 38, 405 (1931).

Elvehjem *et al.*, *J. Amer. Chem. Soc.*, 59, 1767 (1937).

Chick *et al.*, *Biochem. J.*, 32, 10 (1938).

Preliminary Investigation of the Metabolism of Stilbene

EXPERIMENTS on the recovery of synthetic œstrogenic compounds related to stilbene and diphenylethane[1] from the urine of female rabbits have shown that the recoveries are very high compared with that of œstrone under the same conditions[2]. Compounds such as 4 : 4′-dihydroxy-γ : δ-diphenyl-*n*-hexane and 4 : 4′-dihydroxy-α : β-diethylstilbene give recoveries of the order of 20 per cent compared with 1·5 per cent found for œstrone. This indicates a metabolic process for the synthetic œstrogens different from that of œstrone.

In studying the metabolism of these compounds, it was considered of importance to include stilbene, the simplest related active compound, which has been shown to produce full œstrous response in ovariectomized rats when injected in doses of 25 milligrams[3].

Two grams of stilbene were injected into two female rabbits over a period of twenty days, and from the urine a crystalline phenol, melting at 283° C., was isolated. No depression in melting point was observed on mixing with an authentic specimen of 4 : 4′-dihydroxystilbene, melting point 284° C. No *p*-hydroxybenzoic acid was isolated from the urine, but benzoic acid was found in such quantities, more than twice that found in the control rabbit urine, as to leave little doubt that benzoic acid is a metabolic product of stilbene.

It is of particular interest to note that 4 : 4′-dihydroxystilbene is a more active œstrogen than stilbene, as it produces full œstrous response in doses of 10 milligrams, and 60 per cent response in doses of 5 milligrams, when injected into ovariectomized rats[4].

Further extensive work on this subject is now in progress.

S. W. STROUD.

Courtauld Institute of Biochemistry,
Middlesex Hospital Medical School,
London, W.1.
June 24.

[1] Dodds, E. C., Golberg, L., Lawson, W., and Robinson, Sir R., *Proc. Roy. Soc.*, B, 127, 140 (1939).

[2] Stroud, S. W., *J. Endocrin.*, 1,

[3] Dodds, E. C., Fitzgerald, M. E. H., and Lawson, W., NATURE, 140, 772 (1937).

[4] Dodds, E. C., and Lawson, W., NATURE, 139, 627 (1937).

Vaginal Smears and the Œstrous Cycle of the Cat and the Lioness

A STUDY of vaginal smears taken from ten cats during a period of a year showed that their œstrous cycle consists of the following four chief phases:

(1) *Pro-œstrus.* Characterized by the presence of very numerous nucleated epithelial cells, of fairly uniform shape.

(2) *Œstrus.* The picture obtained is variable, being apparently dependent on the individual intensity of the reaction[1]. Thus in the spring large, flat, non-nucleated cornified cells predominate, together with a smaller number of nucleated cells of similar shape. The proportion of nucleated to non-nucleated cells is reversed during shorter seasons of lower temperature, such as autumn. It should be noted that these are not the only cellular elements of the œstrous smears; smaller, intensely staining round cells, with distinct nuclei, being also encountered

sporadically. The appearance of these uncornified cells may be ascribed to irregular cornification of the vaginal epithelium, as was shown by histological preparations in which differently shaped and non-cornified cells could be observed in the folds of the vagina. The diagnosis of the phase of the œstrous cycle thus depends not only on the presence of characteristic elements but also on their mutual proportions. Thus, the presence of sporadic leucocytes does not exclude œstrus. We would add that the œstrous smears also contain fairly numerous, free deformed nuclei.

(3) *Metœstrus* in the cat is, as in the other animals, characterized by the appearance of masses of leucocytes in the smears. The leucocytes are also evident in histological preparations of the vaginal wall, showing that their appearance is not due to irritation involved in taking smears.

(4) *Anœstrus*. Various types of nucleated epithelial cells, differing in size, shape, and affinity to stains, both of the plasma and the nucleus, are found in anœstrus. The relative proportions of these various cells are neither characteristic nor constant.

Smears were taken from two lionesses in œstrus and anœstrus. During the resting period the smears contained various types of epithelial cells, as in the case of the cat. The œstrous smears contained preponderatingly large, flat, non-nucleated, cornified cells, with a smaller number of cells containing pyknotic nuclei. Here also free deformed nuclei were found. Similar results were obtained for occasionally taken œstrous smears in the wild polecat. Only sporadically were epithelial cells of other types encountered.

It may, on the basis of our findings, be stated that the vaginal smears of the cat and the lioness are practically identical, and may be used for the diagnosis of the phase of the œstrous cycle; the most characteristic is the smear obtained during œstrus.

H. Liche.
Kazimierz Wodzicki.

Department of Anatomy,
College of Agriculture,
Warsaw.
May 31.

---

[1] Liche, Nature, 143, 900 (1939).

Δ 3,5-Cholestadiene from Cholesteryl Oleate and its Possible Bearing upon the Formation of Carcinogenic Substances in Heated Fats

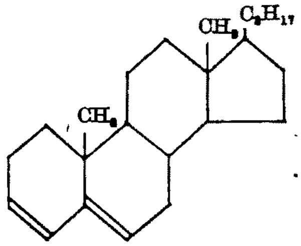
In recent years, several research workers have studied the problem, whether cancer of the skin in the tropics could be caused by carcinogenic substances formed in the skin after strong irradiation and whether the high percentage of cancer of the stomach in northern regions was connected with the usual diet and its preparation (for example, heating of fats). In a number of communications, Roffo[1] has proved the carcinogenic action by the ultra-violet rays of sunlight, and his results have been corroborated by other authors[2]. He has put forward, too, the theory[3] that a carcinogenic substance may be formed by the action of ultra-violet rays from cholesterine, which accumulates in the skin under the influence of the irradiation. Roffo has tried to strengthen this view by experiments *in vitro* with cholesterine; however, a definite reaction product has not yet been isolated and, moreover, the chemical evidence given is not convincing[4].

Concerning cancer of the stomach, Waterman[5] added heated fats or an extract of them to the diet of mice and observed consequently papillomas of the stomach, in some cases with ulceration. Administration of cholesteryl oleate produced similar results, even of greater malignity[6].

According to Roffo[7], oral administration of irradiated cholesterine, irradiated egg-yolk, or several fats boiled for thirty minutes causes neoplastic alterations of the alimentary tract of mice.

Recently, Domagk[8] in some cases obtained tumours of the stomach in mice fed on a diet rich in olive oil, while Widmark[9] concludes from his experiments that extracts of roasted food (horse muscle treated at 275° C., browned butter and roasted coffee) contain one or more carcinogenic substances. In collaboration with Dr. Waterman, we have attacked the problem from the chemical side by trying first to isolate an active substance from heated fats, secondly studying the pyrolytic decomposition of cholesteryl oleate as a type of cholesteryl ethers, which occur normally in fats. In the latter case, one may expect[10] the formation of an unsaturated steroid hydrocarbon, related to those studied by Staveley and Bergmann[11] "in order to discover whether the presence of any particular number and arrangement of double bonds would produce carcinogenicity in steroids" and to Δ 2,4-cholestadiene, the photo-oxide of which has been studied by Butenandt and Kudfuss[12] upon carcinogenic activity in tarring experiments.

Therefore synthetic cholesteryl oleate (British Drug Houses) was distilled *in vacuo* (0·3 mm., bath-temperature 300–340° C.). From the distillate a hydrocarbon $C_{27}H_{44}$ was isolated with m.p. 77–78° C. and $\alpha_{D} = -114°$. (Analysis $C_{27}H_{44}$: C. 87·96, H. 12·04. Found C. 87·68, H. 11·89.) From this evidence we conclude that we are dealing with Δ 3,5-cholestadiene[11].



The reaction with but one molecule of bromine, indicating that the two double bonds present are located in two different rings, and the absorption spectrum* with maxima at 228, 235 and 243 mμ confirm this opinion.

In feeding experiments with this hydrocarbon in a group of mice during a year, Dr. Waterman[13] obtained four papillomas of the stomach, one of which showed infiltrating properties. Though these experiments are to be continued for a longer time and on a larger scale, it seems to be very probable that a carcinogenic hydrocarbon may be formed from a cholesterine ether occurring in fats. With regard to this property, other cholesterine ethers are being examined.

The isolation of Δ 3,5-cholestadiene[14] from *irradiated* cholesteryl acetate, which substance otherwise n be distilled without decomposition, possibly forms linkage between the thermal decomposition of a olesterine derivative examined and the changes ought about by irradiation in Roffo's experiments. so, the irradiation experiments carried out *in tro* with free cholesterine should be extended to olesterine ethers.

---

* I am greatly indebted to Prof. L. S. Ornstein and co-workers, Utrecht, for measuring this and other absorption spectra.

Still in another way these facts are linked together, nsidered in connexion with the results of a recent vestigation by Waterman[14], who, studying carcino- nic hydrocarbons polarographically, found that any of them, and also △ 3,5-cholestadiene and radiated cholesteryl oleate, showed a reduction terval at 350 mv, while cholesterine, irradiated or ot, did not possess this property.

From later experiments[15] it appeared that the nsaponifiable matter of heated fat, freed to a large ctent from sterols, showed the same reduction henomenon and that the similar fraction from nheated fat did not do so.

Synthetic cholesteryl oleate in higher concentra- ons than formerly used also gives the same interval ccording to the mode of preparation the presence f traces of △ 3,5-cholestadiene may be expected !).

The details of this investigation, together with the sults of feeding experiments by Dr. Waterman, will e published elsewhere.

H. VELDSTRA.

Laboratory,
ntoni van Leeuwenhoek-huis,
Amsterdam.
June 21.

Roffo, A. H., *Bol. Inst. Med. Exp. Estud. Cancer* (1933–1938), compare *Z. Krebsf.*, 47, 473 (1938).
See literature cited by Bergman, W., *Z. Krebsf.*, 48, 546 (1939).
Roffo, A. H., *Z. Krebsf.*, 47, 473 (1938).
Compare the detailed critical survey by Bergmann, *loc. cit.* 2.
Waterman, N., Conférence Leeuwenhoek-Vereeniging V. 86, Paris, 1937 (in details still to be published).
Waterman, N., *Acta Cancrologica* ii, 5/6, 375 (1936); *Nederl. Tijdschr. Geneesk.*, 81, 1273 (1937); *Acta brevia neerlandica*, 7, 18 (1937) and *loc. cit.* 5.
Roffo, A. H., *loc. cit.* 3.
Domagk, G., *Z. Krebsf.*, 48, 284 (1939).
Widmark, B. M. P., NATURE, 143, 984 (1939).
Compare Dimroth, K., Trautman, G., *Ber.* 69, 669 (1936). (Formation of a cholestadiene from 7- hydroxy-cholesterine-benzoate).
Staveley, H. E., Bergmann, W., *J. Org. Chem.*, 1, 567, 575 (1936). See also, Eck, J. C., van Peursem, R. L., Hollingsworth, E. W., *J. Amer. Chem. Soc.*, 61, 171 (1939).
Butenandt, A., Kudszus, H., *Z. Physiol. Chem.*, 253, 1 (1938).
To be published in *Acta Internat. Contra Cancrum.*
Bergman, B., Hirsberg, Y., NATURE, 142, 1037 (1938).
Waterman, N., *Acta brevia neerlandica*, 9, 143 (1939).

Constitution of Solasonine (Solanine-*s*)

FURTHER analyses of the gluco-alkaloid, solasonine olanine-*s*), the aglycone, solasodine (solanidine-*s*) nd its derivatives are in agreement more with the olecular formulæ, $C_{45}H_{73}O_{16}N$, for the glycone and $_{27}H_{43}O_2N$ for the aglycone. Formulæ, $C_{27}H_{45}O_2N$ nd $C_{26}H_{43}O_2N$, for the aglycone and corresponding rmulæ for the gluco-alkaloid are not yet excluded ut are less likely on theoretical grounds. From iochemical considerations a formula containing 27 rbon atoms is also to be preferred since there are o well-authenticated steroid derivatives, with the ception of solanocapsine and solanocapsidine[1] to hich the same argument may apply, containing 3 carbon atoms. Since solasonine gives rise to uose, galactose, rhamnose and solasodine on hydrolysis[2], it must now be built up from these sugars and one molecule of the aglycone and not two as suggested by Oddo.

According to Oddo and his co-workers, solasodine contains two active hydrogens (Zerewitinoff) and forms an amorphous diacetyl derivative (a crystalline monoacetyl derivative has now been obtained, m.p. 195°, which is soluble in dilute acids). Since it gives with nitrous acid a crystalline compound richer in nitrogen, Oddo concluded, on the basis of a formula, $C_{18}H_{31}ON$, that solasodine contains both a hydroxyl and a secondary amino group.

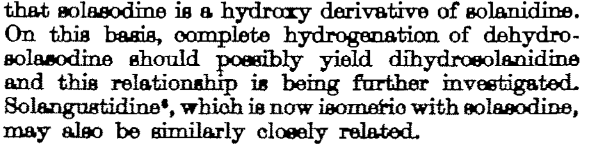
When the compound formed by nitrous acid is crystallized from alcohol containing a little ammonia, however, pure solasodine is regenerated indicating its salt-like character. Also, solasodine yields quaternary salts by simple addition [methiodide, m.p. 286° (decomp.), ethiodide, m.p. 284° (decomp.)] so that it is a tertiary base. A Zeisel estimation shows the absence of an NCH_3 group so that the nitrogen probably forms part of two rings.

Consequently, both oxygens must be present as hydroxyl groups (Zerewitinoff) and since only a monoacetyl derivative is formed, the second hydroxyl group is probably tertiary. Dehydration by means of methyl alcoholic hydrogen chloride removes one hydroxyl forming dehydrosolasodine, identical with 'solanidine-*s* ether'[2] and 'solanosodine'[3] and the same compound has also been isolated from the mother liquors during the purification of solasodine (cf. Rochelmeyer[3]).

On selenium dehydrogenation, methylcyclopentenophenanthrene and pyrrole bases are produced[4] indicating a steroid structure. It gives a digitonide[5] thus placing one hydroxyl group in *cis* position on C_3.

Solasodine forms a hydroderivative on catalytic hydrogenation and a dibromo derivative by addition. It must therefore contain one double bond, provisionally placed on analogy with other steroids at C_5—C_6.

On the above evidence and assuming a cholesterol carbon skeleton and one point of attachment of the basic portion to the steroid nucleus, the structure of solasodine is most probably



The same conclusion has been reached by Clemo, Morgan and Raper[6] for the basic structure of solanidine which is very similar in its chemical reactions to solasodine. It would appear therefore that solasodine is a hydroxy derivative of solanidine. On this basis, complete hydrogenation of dehydrosolasodine should possibly yield dihydrosolanidine and this relationship is being further investigated. Solangustidine[6], which is now isomeric with solasodine, may also be similarly closely related.

Both solasodine and solanidine give a series of beautiful colour reactions with *p*-substituted aldehydes and acetic-sulphuric acid, indicative of a pyrrolidine rather than a piperidine type of compound.

With R. Culford Bell, the alkaloid purapurine[7] from the fruit of *Solanum aviculare* has now been shown to be identical with solasonine, while a more detailed examination of the alkaloid from *S.*

auriculatum[8] has shown that it is not identical with solasonine.

Thanks are due to the Chemical Society and the Australian and New Zealand Association for the Advancement of Science for grants.

L. H. BRIGGS.

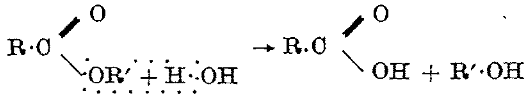
Auckland University College,
Auckland, New Zealand.
June 1.

---

[1] Barger and Fraenkel-Conrat, *J. Chem. Soc.*, 1637 (1936).
[2] Oddo and Caronna, *Ber.*, 67, 446 (1934) and earlier papers.
[3] Rochelmeyer, *Arch. Pharm.*, 275, 336 (1937).
[4] Rochelmeyer, *Arch. Pharm.*, 274, 543 (1936).
[5] Clemo, Morgan and Raper, *J. Chem. Soc.*, 1299 (1936).
[6] Tutin and Clewer, *J. Chem. Soc.*, 105, 565 (1914).
[7] Levi, *J. Soc. Chem. Ind.*, 49, 395 T (1930).
[8] Anderson and Briggs, *J. Chem. Soc.*, 1036 (1937).

Mechanism of Hydrolysis of Inorganic Esters

BY the use of water containing an excess over the normal of the heavy oxygen isotope (^{18}O), it has been definitely and very directly shown that during the hydrolysis of the esters of weak carboxylic acids the break occurs at the C—O bond of the ester, thus:



$$R\cdot C\begin{matrix}\diagup O\\ \diagdown OR'\end{matrix} + H\cdot OH \rightarrow R\cdot C\begin{matrix}\diagup O\\ \diagdown OH\end{matrix} + R'\cdot OH$$

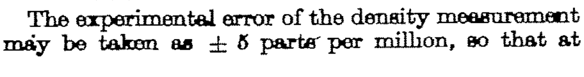
Thus the alcohol resulting from the hydrolysis contains only the normal proportion of heavy oxygen isotope. This has been shown by Polanyi and Szabo[1] for the case of alkaline hydrolysis and by Datta, Day and Ingold[2] for the case of acid hydrolysis after Roberts and Urey[3] had shown that the same C—O bond is involved in the reverse process of esterification.

We have recently carried out a similar experiment on the alkaline hydrolysis of trimethyl phosphate, using aqueous sodium hydroxide prepared by acting with sodium on water enriched in the heavy oxygen isotope. The hydrolysis was carried out at 80–90° C. and proceeded until slightly more than one methyl group was removed. The resulting aqueous methyl alcohol was distilled off and purified by fractionation. The alcohol vapour was then passed over a red-hot platinum filament, whereby it was 'cracked' to give carbon monoxide and hydrogen. The mixture, plus excess hydrogen, was passed over a nickel catalyst and the carbon monoxide thereby reduced to water. This water thus contained the oxygen for the alcohol produced in the hydrolysis. Its density was measured, after purification, by the usual micro-pyknometer method[4].

The results are shown in the accompanying table, where $\Delta\rho$ (initial) is the excess density of the original water in parts per million and $\Delta\rho$ (final) is that of the water produced from the alcohol.

$\Delta\rho$ (initial)	$\Delta\rho$ (final)
180	0
180	+1
200	0

The results show quite clearly that during the hydrolysis the P—O bond of the ester is broken thus:



$$O{=}P\begin{matrix}\diagup OCH_3\\ -OCH_3\\ \diagdown OCH_3\end{matrix} + H\cdot OH \rightarrow O{=}P\begin{matrix}\diagup OCH_3\\ -OCH_3\\ \diagdown OH\end{matrix} + CH_3\cdot OH$$

The experimental error of the density measurement may be taken as ± 5 parts per million, so that at least 97 per cent of the hydrolysis must proceed indicated above.

This is a somewhat surprising result in view the fact that trimethyl phosphate is a fairly efficie methylating agent[5].

Density measurements of the residual water sho that, apart from the hydrolytic *replacement* of oxyge there is only a very slight *exchange* of oxygen betwee the water and the ester.

During the hydrolysis carried out as describe above, a considerable quantity of dimethyl ether produced. We are endeavouring to determine wheth or not this ether contains excess of ^{18}O, and also investigate the course of the hydrolysis in acid solution. We also hope to extend the work to oth inorganic esters.

J. B. M. HERBERT.
E. BLUMENTHAL.

The University,
Manchester.
June 30.

---

[1] Polanyi and Szabo, *Trans. Far. Soc.*, 30, 508 (1934).
[2] Datta, Day and Ingold, *J. Chem. Soc.*, 838 (1939).
[3] Urey and Roberts, *J. Amer. Chem. Soc.*, 60, 2393 (1938).
[4] Gilfillan and Polanyi, *Z. phys. Chem.*, 166, 254 (1933)
[5] Noller and Dutton, *J. Amer. Chem. Soc.*, 55, 424 (1933).

Application of the Coincidence Method to Testin the Lifetime and Level Scheme of Radium C′

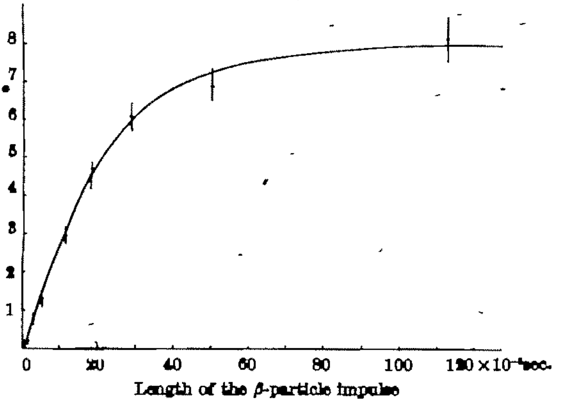
THE application of the coincidence method t investigations of nuclear processes may be extende in certain ways by using a variable resolving time the coincidence circuit and by measuring pseud coincidences, that is, counts arising from two impulse which are not simultaneous but separated by a ver short time. The number of 'coincidences' given b two particles, in which one follows the second in time determined by the radioactive constant λ, proportional to $1 - e^{-\lambda\tau}$, τ being the length of th impulse. The duration of the impulse is dependen upon the electrical constants of the circuit, and b changing the constants of one or both circuits it possible to obtain various determined lengths of th impulses. In order to measure λ, two sets of exper ments are made: (*a*) with the impulse τ_1 of the fir particle long and of different durations, and th impulse τ_2 of the second very short; (*b*) with th conditions reversed. The difference $a-b$ is equal $\frac{N_1N_2}{N}(e^{-\lambda\tau_2} - e^{-\lambda\tau_1})$ where N_1 and N_2 are the numbe of counts in each counter, N the number of di integrations. The method of lengthening the impulse only from one kind of particle allows one also decide the order in which the particles are emitted

In these experiments the method was applied the transformation

$$RaC \xrightarrow{\beta} RaC' \xrightarrow{\alpha} RaD.$$

Coincidences were observed between the various type of radiations, namely, $\alpha-\beta$, $\alpha-\gamma$, $\beta-\gamma$, and $\gamma-$ The β- and γ-radiations were measured in the usu way by means of Geiger-Müller tubes; the α-particle were counted separately by operating a Geiger-Mülle tube in the proportional region. The curve on th accompanying graph gives the number of re 'coincidences' ($a-b$) from radium C β-particles an radium C′ α-particles as a function of the length o the impulse from the β-particles. From this curv one obtains a value for the half-lifetime of radium C of $1{\cdot}40 \pm 0{\cdot}15 \times 10^{-4}$ sec.*

The investigation of the $\alpha-\gamma$ coincidences gives curve which is identical with the former, showin at no γ-radiation follows the emission of the -particle, and thus giving a direct proof that there o not exist any γ-rays of appreciable amount rising from the transition RaC′ → RaD. The easurements of the β−γ and γ−γ 'coincidences' ow no dependence on the length of the impulses, owing that none of the excited levels can have a fetime longer than 10^{-5} sec.



In order to check the level scheme of radium C′ of llis and Oppenheimer[1], sets of measurements were ade of the coincidences between β−γ and γ−γ due the radiations from radium C and C′. The β−γ incidences were measured as a function of the ab- rption of the β-particles. The result is that the ratio coincidences to the number of β-particles decreases pidly with the thickness of the absorber, but be- mes nearly constant for thicknesses of 1·3– mm. aluminium. The presence of coincidences at absorber thickness of 2 mm. aluminium shows at even the hardest β-group (upper limit 3·15 Mv.) connected with the γ-rays, in agreement with the heme of Ellis and Oppenheimer. This latter result in contradiction to the results of Bothe and Maier- eibnitz[2], who found no coincidences between the ard β-rays and the γ-rays, an observation very ifficult to reconcile with the level scheme.

Although my own results agree broadly with the vel scheme, a closer comparison shows certain iscrepancies; the decrease in coincidences with bsorber thickness is more rapid than expected, and e number of coincidences with the hard β-rays is o small. It ought to be mentioned that the com- arison is very dependent on the values adopted for e efficiencies of the γ-counter for rays of different ergy. Special experiments were made in order to etermine these values. The differences between the pected and experimental results are greater than e possible error in the determination of the ficiencies and must be explained in some other way.

The γ−γ coincidences were also measured as a nction of the thickness of lead between the source d one γ-counter. The shape of the experimental sorption curve of the relative number of coinci- nces is in fair agreement with the values expected om the level scheme.

J. ROTBLAT.

eorge Holt Physics Laboratory,
University, Liverpool.
July 19.

---

* *Footnote added in proof.* J. V. Dunworth has recently (NATURE, ly 22, p. 152) used the same principle. His result for the half fe period of radium C′ is 1·50 × 10^{-4} sec., in good agreement with at given here.

llis, C. D., International Conf. of Physics, London, 1934.

othe, W., and Maier-Leibnitz, H., *Z. Phys.*, 104, 604 (1937).

Adsorption of Helium Gas on Active Charcoal between 4·2° and 1·78° K.

MEASUREMENTS have been made on the adsorption of helium gas on charcoal between 4·2° and 1·78° K. We determined the quantity adsorbed at various pressures and various temperatures. At the same time we also observed the adsorption velocity.

Above the λ-point, the adsorption seems to be normal. However, on passing the λ-point, the adsorption seems suddenly to be stopped (this could not be explained by the 'film' phenomena). Further, it seems to us that the adsorbed helium assumes a metastable state. The equilibrium pressure remained practically constant on lowering the temperature still further. However, at 1·97° K., the adsorption started suddenly again. It was also possible to get the adsorbed helium from this metastable state by a slight increase of temperature.

By increasing the temperature, starting from a temperature below the λ-point, it was again found that the adsorption becomes constant on passing the λ-point.

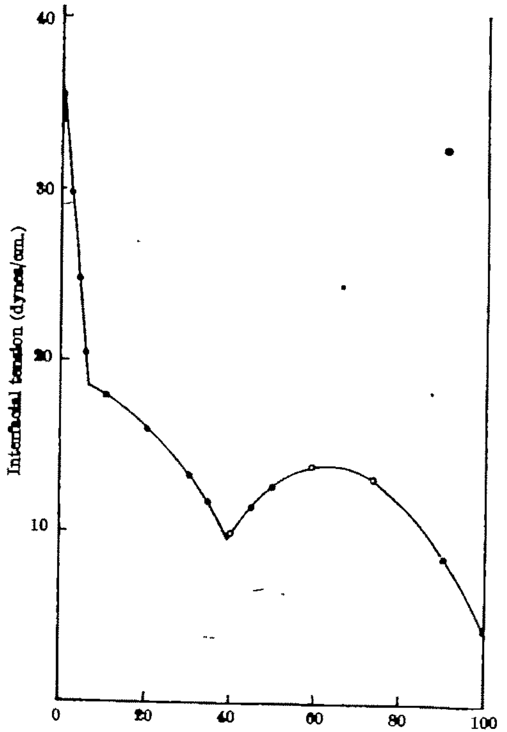
Briefly, it seems to us that the observed phenomena shows a certain analogy with 'critical' adsorption.

A. VAN ITTERBEEK.
W. VAN DINGENEN.
J. BORGHS.

Natuurkundig Laboratorium,
Louvain.
July 5.

'Breaks' in Interfacial Tension Curves

WHEN a single solute is adsorbed from one phase to a water – oil interface, the interfacial tension usually falls in a regular manner with increasing adsorbate concentration, to a limiting value corre-



INFLUENCE OF BENZYL ALCOHOL ON BENZENE – WATER INTERFACIAL TENSION sponding to a close-packed monomolecular surface layer. In the very few cases[1] where exceptions have been found to this rule, the adsorbates have been soaps or similar hydrolysable molecules, and interattraction between the long-chain molecules and their products by hydrolysis has been given as explanation of the sharp breaks which occur in the interfacial tension – adsorbate concentration curves.

In order to test this, a study has been made of much simpler systems where no secondary reaction is possible. The accompanying graph represents the change in interfacial tension between water and benzene as molecules of benzyl alcohol accumulate at the interface, and was obtained by measuring[2] the tension between a water phase saturated with benzyl alcohol, and a benzene phase containing varying amounts of the alcohol. The curve shows two very well-defined breaks, indicating that such breaks must be due to a much simpler cause than has hitherto been believed; it is suggested that they occur whenever an amphipathic adsorbate is soluble in both phases, and that the *two* breaks which normally occur represent the beginning and the end of interpenetration of two identical adsorbed films. It is significant that no break is obtained in the curve for benzyl chloride, which is soluble only in the benzene phase.

C. C. ADDISON.

Harris Institute Technical College,
Preston.

---

[1] Powney and Addison, *Trans. Faraday Soc*, 34, 628 (1938).

[2] Powney and Addison, *Trans. Faraday Soc.*, 33, 1243 (1937).

On the Theory of Dielectric Polarization in Liquids

ONSAGER[1] has developed a theory of the dielectric polarization in liquids, in many respects different from the current theory of Lorentz-Debye. We propose to show that the method of calculating the dipole energy, used by Onsager in his theory, does not correspond exactly to the assumptions of this theory. Onsager calculates the momentum of forces rotating the molecule in such a manner as if the rotation of the resulting moment (being the vectorial sum of both the permanent and induced moment) were decisive for the rotation of the molecule. In fact, however, only the axis of the permanent moment, and not that of the induced moment is rigidly bound to the isotropic molecule. This fact causes the real expression for the energy of the molecule to differ from the formula presented by Onsager. We obtain therefore instead of Onsager's formula:

$$\frac{4\pi N\mu^2}{9kT} = \frac{(\varepsilon-n^2)\,(2\varepsilon+n^2)}{\varepsilon(n^2+2)^2} = \rho(\varepsilon, n), \quad . \; . \; (1)$$

the following expression:

$$\frac{4\pi N\mu^2}{9kT} = \rho(\varepsilon, n) \cdot \frac{2\varepsilon+n^2}{2\varepsilon+1} \cdot \frac{3}{n^2+2}, \quad . \; . \; . \; (2)$$

where μ denotes the permanent moment of an isolated molecule (that is, measured in the vapour state), ε is the dielectric constant of the liquid, n is its refractive index (for $\lambda = \infty$) and N is the number of molecules per ccm.

Böttcher[2] has proved on ample experimental data that formula (1), when applied to numerous liquids, gives for μ values in excellent agreement with those determined from measurements of the dielectric constant of vapours. If we apply, on the other hand, to the same liquids the corrected formula (2), we obtain lower values, generally by about 15 per cen The deviations therefore between Onsager's theor and experiment become rather considerable. F example, for nitrobenzene, in which $\mu = 4{\cdot}2$ (deter mined in the vapour), formula (1) gives $\mu = 4{\cdot}$ while formula (2) gives $\mu = 3{\cdot}6$.

Onsager deduces also an expression for the rati $\mu_{app.}/\mu$, where $\mu_{app.}$ denotes the dipole moment dete mined by Debye's method applied to solutions i non-polar solvents. We have shown that the valu of this last expression turns out to be greater than for such solutions as nitrobenzene-hexane, nitr benzene-benzene and others. It is, however, generall known that numerous experiments yield $\mu_{app.}/\mu <$

The question will be discussed more fully in a pape to be published shortly in *Bull. Ac. Pol.*

K. ZAKRZEWSKI.

Institut of Experimental Physics,
Jagiellonian University,
Cracow.

A. PISKARA.

Physical Laboratory,
Sulkowski Lyceum,
Rydzyna, Poland.

---

[1] Onsager, L., *J. Amer. Chem. Soc.*, 58, 1486 (1936). See also Falke hagen, H., *Phys. Z.*, 39, 806 (1938).

[2] Bottcher, C. J. F., *Physica*, 6, 59 (1939).

Avoidance of Crystal Formation during Embeddin of Plant Material in Paraffin Wax

THE formation of wax crystals in paraffin block containing material for microtoming is a commo source of annoyance. As a result of various trial I have found that the following simple metho eliminates the trouble, at least in so far as the variou types of wax used in this department are concerne

Float 'boat' containing melted wax and materi suitably spaced in a 500 c.c. beaker containing wate the temperature of which is within a few degrees zero and in which ice is floating. As soon as possib submerge block and remove it from 'boat'. Kee block submerged until hard, and repeat process unt all material has been embedded. Then transfer th beaker containing the paraffin blocks to a refrigerat at a temperature about 5° or 6° C. and leave the for one or two days. Then remove beaker fro refrigerator, and allow the water and wax therei gradually to assume the temperature of the atm sphere. The paraffin block is now ready for immediat or future use.

PATRICK BROUGH.

Botany Department,
University, Sydney.
June 14.

Insects in Aircraft

DR. WHITFIELD's recent communication on th problem[1] rightly emphasizes its importance. But might be gathered from his letter that it is a ne problem—one which has hitherto received litt attention or one for which no adequate preventiv measures have been devised.

Such assumptions would be wrong. The proble has exercised the minds of tropical sanitarians a least since the time of Manson, and the danger one which has been reiterated on many occasion by the Ross Institute and other authorities. Activ measures have been taken and are being taken b aircraft companies and by the sanitary authoriti various African airports, notably Cairo, Khartoum nd Durban, to minimize or abolish noxious insects om aircraft.

The work of Dr. Park Ross of Durban, Mr. C. B. ymes of Kenya Colony, the Entomological Staff of e Government of India and by ourselves, as well the valuable work of Mr. Whitfield himself at hartoum, has served to throw considerable light n this problem and the measures taken to meet it. Ve[2] have found that there are at least two efficient queous base pyrethrum insecticides on the market hich, applied in the dilutions we suggest, will ensure e death of mosquitoes and other flying insects in ircraft within a few minutes of application.

Preparations of pyrethrum are being used all over e world by aircraft companies and ground sanitary uthorities, and we may safely say that science has rovided the means of abolishing the danger of insect ansmission by aircraft, and it only remains for nternational authorities to insist on these measures eing carried out.

The authority responsible for these regulations is the International Sanitary Convention for Aerial Navigation, but this body has unfortunately laid down no precise rules on the subject. The responsibility for doing this and the manner of doing it is at present left to the decision of each authority concerned, with the result that the methods used in different countries vary considerably in their efficiency.

It is hoped that Mr. Whitfield's letter will impress all concerned with the necessity of concerted action to meet this danger, in place of the inco-ordination of effort which at present exists.

F. P. MACKIE.
(Medical Adviser.)

Imperial Airways, Ltd.,
Airways House,
London, S.W.1.
July 25.

---

[1] NATURE, 144, 158 (1939).

[2] Mackie and Crabtree, *Lancet*, 447 (August 20, 1938).

Points from Foregoing Letters

RAPID application of pressure to beech leaves which ave coloured vacuoles expresses sap of low osmotic ressure (about one third of the plasmolytic value) ontaining 80 per cent of the vacuolar pigment. . A. Bennet-Clark and Dorothy Bexon support the ontention of Phillis and Mason that this treatment xpresses vacuolar sap rather than water which is ltered from the solutes.

W. Dulière and O. Loewi have found that acetylcholine, when applied after eserine, liberates ionic otassium in the isolated nervous system of the frog.

L. Laszt finds the inhibiting effect of iodoacetate n glucose absorption from the intestine of rats is sup-ressed by sodium chloride in a similar way as sodium lts counteract the symptoms of adrenalectomy.

J. P. McGowan shows that an important phase in e histogenesis of red blood cells in pernicious and ome other anæmias would appear to be the multilication of the hæmocytoblasts by amitotic division nd the subsequent ripening of these into erythroytes. When nicotinic acid is administered, it is uggested that this forms with the pentose-nucleotides resent in the cytoplasm of the hæmocytoblasts—the oenzyme system. The latter then plays an important art in the development and mitotic division of the rythroblasts which are now the cells which ripen to rythrocytes.

4 : 4′-dihydroxystilbene and benzoic acid have been olated by S. W. Stroud as metabolic products from he urine of rabbits injected with stilbene.

H. Liche and K. Wodzicki describe the vaginal mears obtained during various phases of the œstrous ycle of cats. The similarity between smears for cats nd lionesses is pointed out. In both species, the mears may serve for diagnosis of the phase of the estrous cycle.

By thermal decomposition of cholesteryl oleate, 3,5-cholestadiene was obtained by H. Veldstra. n feeding experiments by Waterman with mice this ubstance caused papillomas of the stomach, one of hich showed infiltrating properties. As cholesteryl thers normally occur in fats, the formation of arcinogenic substances by heating of fats has to be onsidered as possible.

Further analyses of solasonine and solasodine are in agreement with molecular formulæ, $C_{44}H_{73}O_{16}N$ and $C_{27}H_{43}O_{2}N$, for these bases, and from chemical evidence a constitutional formula for solasodine is proposed by L. H. Briggs. A comparison of its chemical properties with those of solanidine indicates that solasodine is possibly a hydroxy derivative of solanidine.

By using water containing excess of heavy oxygen isotope J. B. M. Herbert and E. Blumenthal show that the mechanism of hydrolysis of trimethyl phosphate in alkaline solution is the same as that for the hydrolysis of the simple organic esters. That is, that the rupture occurs at the P–O bond of the ester.

By the use of a coincidence apparatus with a variable resolving time, J. Rotblat has found the half value period of radium C′ to be $1{\cdot}40 \times 10^{-4}$ sec. He has also shown that no γ-radiation is emitted in the transition radium C′ → radium D. Coincidence observations on the radiations emitted in the process radium C → radium C′ → radium D have also been made, from which deductions concerning the level scheme of radium C′ are drawn. The results confirm in general the accepted level scheme, but certain discrepancies remain to be examined.

C. C. Addison finds that the breaks in interfacial tension curves, usually associated with complex systems, are found to occur in the simple benzene–benzyl alcohol–water system; he believes them to be due to penetration of two identical adsorbed layers.

K. Zakrzewski and A. Piekara criticize Onsager's theory of dielectric polarization in liquids, and give a modified expression for Onsager's formula which corresponds more strictly to the assumptions of the theory. This theory, however, yields values deviating considerably from the experimental data.

P. Brough describes a simple method whereby crystal formation, commonly experienced during embedding of plant material in paraffin wax, may be avoided. The essentials of the process are rapid cooling of wax during embedding, the immediate transfer of the blocks to a refrigerator and the gradual bringing of the temperature of the wax to that of the laboratory.

RESEARCH ITEMS

Maya Mounds of British Honduras

THE late T. W. Gann, with Mary Gann, in the course of two seasons spent in the Corozal District of British Honduras, between the valleys of the Rio Hondo and the Rio Nuevo examined by excavation a number of mounds belonging to the ancient Maya civilization. These centred around a group of large banks and mounds known to the Indians as Nohmul, or Great Mound, so called because one of the pyramidal structures is the loftiest in the district, reaching a height of 95 ft. In a report on the excavations (Smithsonian Institution: *Anthropological Papers Bull.*, 123; 1939), Dr. Gann points out the probable influence of a liberal water supply in determining the choice of this site for settlement. In all, 28 mounds were examined, these falling into six distinct groups. (1) Burial mounds unassociated with either cists or stucco floors, numbering ten in all, probably the graves of poor people, grave furniture being scanty and poor. (2) Sepulchral mounds with the corpse buried above or below the former floor of a house. Of these there were four; and they probably belonged to householders of sufficient importance to have their houses wrecked and converted into burial mounds. (3) Sepulchral mounds containing specially constructed burial cists. These, including the great mound of Nohmul itself, number eight. They vary in height from 9 to 95 ft., and contain all the finest artefacts of shell, stone, pottery, etc. In some the cists were beneath the floors of houses, in others the mounds were constructed specially to cover them. (4) Mounds constructed over the ruins of stone buildings and not used for sepulchral purposes—five in number, all flat-topped, and of very solid masonry. (5) Mounds built over the former floors of wood or adobe buildings, not containing burials. Of these there were two, each appearing to have been low stucco-covered substructures of houses of perishable materials. (6) Mounds containing only fragments of crude clay censers. Two were examined.

Ontogeny and Phylogeny of the Human Nose

THAT very prominent feature of the human face, the outer nose, its various types and their methods of growth, have been investigated by C. B. Benedict (*Proc. Amer. Philos. Soc.*, Jan. 1939). The anatomical elements concerned in the formation of the outer nose are considered and their histories in the foetus outlined. Five absolute measurements and eight ratios are employed for the purpose of statistical definition. A large series of measurements on persons from three to twenty years of age and of different races were taken. Nasal height increases *pari passu* with stature; but becomes greater in boys than in girls. This sexual difference, which is widespread, is due in large measure to the greater body size in boys, on the average; but also to the earlier differentiation of the nose in the female which is related to the earlier assumption of maturity. The wide diversity of the shape of the nose in various races suggests that a number of different genes are involved in its development. Comparison with lower forms suggests that the ontogenetic succession follows the phylogenetic steps.

Determination of Histamine in Biological Extracts

M. ROCHA E SILVA, of the Instituto Biologic S. Paulo, Brasil, has introduced a slight alteration Code's method for estimating histamine, whic permits a big reduction in the final volume of th extract (*Arqu. Inst. Biol.*, 9, 145; 1938). Code method is a modification of that of Barsoum a Gaddum. In this last technique, after removing th proteins by trichloracetic acid, and the acid by ethe the filtrate is boiled with hydrochloric acid for minutes and then dried *in vacuo*. The dry resid is extracted with hot alcohol saturated with sodiu chloride. Code has shown that the most serious lo of histamine occurred in the extraction of the drie residue by alcohol. Aqueous extraction in Code method gave higher and more consistent recoverie but the removal of an excess of salts that was possibl by Barsoum and Gaddum's method is not possibl by Code's method. It is true that it was shown b Code that the salt content of extracts of the bloo constituents does not interfere with the reaction the guinea pig ileum to histamine; but in certai circumstances it may be very important to effect big reduction in the final volume in order to attai more accurate results. The following technique ha been devised: (1, 2) The filtrate, after precipitatio with trichloracetic acid, is boiled with one tenth its volume of concentrated hydrochloric aci (3) This boiling is carried out until crystallizatio of the salts begins. The water is also carefull evaporated, avoiding any deposition of solid cake on the wall (complete dryness must also be avoided (4) A few c.c. of 96 per cent alcohol saturated wit sodium chloride is added. Filtration allows a complete removal of the precipitated salts. The filter washed out repeatedly with the same 96 per cen alcohol saturated with sodium chloride. (5) Th filtrate is dried *in vacuo*, the hydrochloric acid removed by repeated additions of absolute ethyl alcoho and (6) the residue dissolved in a small volume saline. The removal of the excess of salts permits big reduction in the final volume of the extract without interference with the guinea pig gut reactio for histamine. This method is being used for determining the histamine content in fluids (blood plasma where the usual content is very low.

Sex Determination in Melandrium

H. E. Warmke and A. F. Blakeslee (*Science*, 8 391–392; 1939) have studied the sex determinatio in polyploid forms of Melandrium produced by colchicine treatment. Plants of the chromosome constitution $3A + XXY$ and $4A + XXXY$ are fertil males whereas $4A + 3X$ is a female. This indicate that the Y-chromosome is active in sex determination, contrary to the situation in Drosophila. hermaphrodite results from the constitution $4A$ + $4X + Y$. 37·5 per cent of the meiotic association in an $XXYY$ complex consist of $X - X$ and $Y - Y$ bivalents, and the remainder are chiefly association of 4 chromosomes. It is pointed out that a polyploid sex mechanism of $XXXX$, $XXXY$ is comparable in efficiency and survival value with that i the diploid.

fteen Years' Research on Datura

A. F. Blakeslee and A. G. Avery ("Co-operation Research", Carnegie Institute, 501, 315–351; 38) have summarized the data on 60,000 trisomic ants in *Datura stramonium*. The viability of the imary and secondary trisomics differs widely, nging from 32·7 per cent for $2n + 23\cdot24$ to 3 per nt for $2n + 19\cdot20$. The proportions of primaries rown by the related secondary trisomics also varies, d this indicates that disjunction is not at random. ore unrelated primaries are given by primaries than normal types, indicating that general non-sjunction is more common in $2n + 1$ types than diploids. Double trisomics $2n + 1 + 1$, however, ow a decreased production of unrelated primaries. tes of non-disjunction are different in different romosomes, and these are not correlated with the e of chromosome.

lorophyll Deficiencies in Red Clover

R. D. Williams (*J. Genet.*, 37, 440–458 and 459–1) has identified genetically eight genes for albino edlings and seven for yellow, chlorophyll-deficient hal seedlings in red clover. In addition, ten other ino and nine other yellow chlorophyll-deficient pes were found. Linkage between some of these pes and morphological characters is demonstrated. and *y*[illegible] act both as embryonic and seedling lethals, ile the chlorophyll production of *y*[illegible]*y*[illegible] varies greatly th the environment.

bridization in Yeast

O. Winge and O. Laustsen (*C.R. Trav. Lab. rlsberg*, 22, 337–352; 1939), continuing their work yeasts, have made several hybrids between various pes of yeast belonging to the species *Saccharomyces licus*, *S. cerevisiae*, *S. Mandshuricus*, *S. validus*, *gosaccharomyces Priorianus*. Two haploid spores placed in a drop of a culture solution and allowed form a diploid zygote. It was found that five brids showed low germination (0·13 per cent) of zygote, while six gave a germination of between and 94 per cent. The relationships of the parents y therefore be determined. It is found that these ationships correspond to the properties shown by types in biochemical fermentation.

male Reproductive Organs of the Toad

The female reproductive organs of the toad *Bufo narum*, their cyclic changes, and the effect thereon the hypophysis, have been studied by Inés Lopez lombo de Allende (Inst. Physiol. Cordoba, Argen- a). The cycle of changes falls into three parts: period of rest from the end of summer to the lowing spring; a period of activity from the last rt of spring to early summer, and a period from er oviposition until the end of summer. The anterior uitary factor induces ovolution and secretion of glands of the Müllerian ducts. The influence of hypophysis is complex, but on the full-grown ary it causes the larger ovules to be freed and charged, and this effect is produced in the isolated ary even if this be placed in the abdomen of a le. Mammalian hypophyseal implants have no luence. Homo-implants of the hypophysis induce ndular activity in the Müllerian ducts, but repeated plants result in degeneration. Hypophysectomy induces involutive changes in the oviducts. Sexual hormones of mammals produce no effect in this toad, which is somewhat remarkable in view of their striking effects in *Xenopus laevis*.

Australian 'Sooty Moulds'

Miss Eileen E. Fisher has recently published an important study of the 'sooty moulds' of Australia (*Ann. Bot.*, 3, New Series, No. 10, 399; April 1939). After a critical analysis of previous investigations and a discussion of the taxonomy of these moulds, a classification is proposed by which they are grouped according to the microscopic appearance of their growth. With the exception of Trichothyriaceæ, six families are discussed. Capnodiaceæ and Chaetothyriaceæ have therefore been amended. The geographical distribution of epiphytic 'sooty moulds' is considered in relation to temperature and humidity requirements, and from this it is suggested that the rarity of species of Capnodiaceæ in cool temperate climates may be due to the deciduous vegetation. A bibliography, four text-figures and one plate are appended.

Parasitism of the Pitch-Crust Fungus

The pitch-crust fungus, *Ustulina vulgaris*, causes a disease of the heart-rot type in trees of temperate climates. W. H. Wilkins has made several studies of the means of infection, and in the latest paper (*Trans. Brit. Mycol. Soc.*, 23, Pt. 1, 65–85; May 1939) he concludes that conidia of the fungus are the most probable means of infection in Nature. They are produced in abundance, are easily dispersed, they germinate readily at the temperature of normal climate, and their germ tubes penetrate most kinds of timber quite readily. The author, moreover, came to the conclusion in an earlier paper that ascospores could not infect timber under natural conditions. The conidia are about 7·3μ × 3μ; they germinate readily between 5° C. and 30° C., and between relative acidities of pH 2 and pH 9. Oak wood is not readily penetrated, and the fungus seems to enter green wood more easily than seasoned timber. The paper contains other details of spore longevity and germination, and has adequately paved the way for further studies upon control of this particular heart-rot.

White Mould Disease of the Daffodil

The fungus *Ramularia Vallisumbrosæ* attacks the leaves of all varieties of Narcissi, and often assumes epidemic proportions in districts where daffodils are grown for flower production. Taxonomic characters and the life-history of the parasite have been studied by P. H. Gregory (*Trans. Brit. Mycol. Soc.*, 23, No. 1, 24–54, May 1939), who also has a further investigation in progress upon control of the malady. Sunken grey lesions appear on the leaves, and later produce conidia, which can re-infect other foliage. The fungus makes small sclerotia when the dormant period deprives it of the green parts of its host. Sclerotia have not been found in the bulb, and the organism appears to depend upon the production of conidia from sclerotia in spring, for re-infection from year to year. This fact should be important in control of the disease, for dead infected leaves could be removed. Isolation and re-inoculation experiments from conidia upon the leaves and from sclerotia have confirmed the essential features of the life-history. *R. Vallisumbrosæ* was first described by Cavara in 1899; but *Cercosporella Narcissi*, described by Boudier two years later, appears to be synonymous. Spore characters of the fungus warrant its inclusion in either of the genera mentioned, but the retention of the earlier name is proposed in the present paper.

Long-Wave Phase of Earthquakes

CONTINUING his work on this phase of earthquakes, Stoneley (*Mon. Not. Roy. Astro. Soc.*, Geophys. Supp., 4, No. 7, 562; June 1939) has made an analysis of the times of transit of the phase as given in the International Seismological Summary for fifteen well-observed earthquakes, and has shown that this gives a frequency distribution which is strongly double-humped. The maxima correspond to travel-rates of approximately 0·420 and 0·467 minutes per degree, and these refer to the onsets of the Love-wave and Rayleigh-wave phases which are usually denoted by *LQ* and *LR* respectively. Significant differences in the relative frequency of *LQ* and *LR* in different shocks are shown to occur for earthquakes in the same epicentral region, and these seem to indicate, according to the author, differences in the type of dislocation at the focus. It is pointed out that the ratio of the velocities is 0·90, which is in fair agreement with the predicted ratio of 0·92.

Scattering of Protons by Protons

R. G. Herb, D. W. Kerst, D. B. Parkinson and G. J. Plain (*Phys. Rev.*, 55, 998; 1939) have investigated very carefully the scattering of protons in hydrogen for angles between 15° and 45° and proton energies between 0·86 mev. and 2·4 mev. Full experimental details are given in the paper. Rather elaborate work is necessary to determine the absolute scattering cross-sections for comparison with Mott's theoretical calculations. The scattering at 15° agrees well with this theory for all energies, but at larger angles and high energies the observed scattering is much larger than the theoretical. It is 43 times as big as the theory predicts at 45° and 2·4 mev. energy. G. Breit, H. M. Thaxton and L. Eisenbud (*Phys. Rev.*, 55, 1018; 1939) discuss the theoretical significance of these and other recent experiments on proton proton scattering. The calculation of experimental corrections is discussed at length, and the results are then analysed in terms of the nuclear forces. No evidence was found for a nuclear *p* wave, and a good fit was obtained with an *s* wave and an interaction potential of 'square well' shape with a radius $= 1 \times e^2/mc^2$: $2{\cdot}8\ 10^{-13}$ cm. A potential curve of 'Gaussian' form could also be made to explain the results with appropriate choice of parameters.

Spectrum of Comet 1939*d*

A COMMUNICATION has been received from F. Hinderer, Babelsberg, through *Zirkular der Astronomischen Nachrichten*, which describes the spectrum of this comet. Using the Babelsberg reflecting prismatic camera with a dispersion 240 A./mm. at the $H\gamma$ line on April $18^{d}\ 20^{h}\ 43^{m}$ U.T. and also at $21^{h}\ 04^{m}$ U.T. an extraordinarily fine detail of structure was revealed. In the head there was a continuous spectrum with very strong emission
bands. These were clearly and sharply differentiate
and the edges of the single bands were visible.]
the violet end of the spectrum the emission hea
4200, 4050 and especially 3885 were the stronge
members of the cyanogen bands. In the first to t
fourth carbon bands (C_2), approximate wave-lengt
5635, 5540, 5585, 5129–5165, and 4685–4737, tl
strong heads of these were largely responsible for t
yellow colour in the integrated light of the come
In addition, there was an emission at about 4300 a
also an emission on the red side of the first carb
band. As the direction of dispersion and that of t
tail are in close coincidence, little can be said abo
the spectrum of the latter. Certainly, in accordan
with the usual experience in cometary spectra, t
bands mentioned above in the spectrum of the he
are absent in that of the tail, although the fir
emission bands between 5635 and the red lim
of sensitivity of the plate is found again in the ta

Rate of Rotation of the Earth

IN a paper entitled "The Rotation of the Eart
and the Secular Accelerations of the Sun, Moon a
Planets" (*Mon. Not. Roy. Astro. Soc.*, 99, 7; M
1939) H. Spencer Jones derives important results f
the accurate prediction of eclipses, if the tabul
error of the moon's longitude is known. It has be
established that the fluctuations in the longitud
of the sun, Mercury and Venus run closely parall
to those of the moon's longitude, for which reason
these fluctuations have been attributed to a comm
cause—a variation of the adopted unit of time pr
vided by the rotation of the earth. The variations
the rotation of the earth have been attributed to tid
friction, and also to changes in the moment
inertia of the earth, due to some redistribution
matter in its interior. If changes in the moment
inertia of the earth take place, the effects on t
longitudes of the sun, moon and planets are pr
portional to the respective mean motions of the
bodies. In the case of tidal friction, a change in t
angular momentum of the earth occurs and this mu
be compensated by a corresponding change in t
angular momentum of the moon's orbital rotatio
The effect on the longitude of the moon is too sm
to be predicted by theory. Observational data co
firm the view previously mentioned that the secul
accelerations are proportional to the mean motio
but the results for Venus do not cover a long enou
period to determine the secular acceleration of t
planet with great accuracy. It is interesting to noti
that the effects of tidal friction are less at prese
than the average effects over the past 2,000 yea
In addition, de Sitter's suggestion that large a
sudden fluctuations in tidal friction take place h
not been confirmed. The results obtained can
summarized as follows: Let ΔL, Δl_1, Δl_2 be t
corrections required to the mean longitudes of t
sun, Mercury and Venus, respectively, as given
Newcomb's Tables, and let T be expressed
centuries measured from 1900·0. A quantity
defined as the *fluctuation* in the moon's longitude,
obtained from the moon's observed longitude,
which certain corrections for Brown's Tables a
applied. Then:

$$\begin{aligned}\Delta L &= 1{\cdot}00'' + 2{\cdot}97''\,T + 1{\cdot}23''\,T^2 + 0{\cdot}0747\,\beta\\ \Delta l_1 &= 4{\cdot}96'' + 13{\cdot}08''\,T + 5{\cdot}10''\,T^2 + 0{\cdot}310\,\beta\\ \Delta l_2 &= 2{\cdot}26'' + 5{\cdot}39''\,T + 2{\cdot}00''\,T^2 + 0{\cdot}112\,\beta.\end{aligned}$$

KENYA'S PASTORAL NEEDS

1929, an agricultural commission under Sir Daniel Hall reported on the grave condition to ich certain native reserves in Kenya had been uced as a consequence of overgrazing and soil sion, and recommended an immediate reduction livestock and an increase in agriculture as means ountering a serious and growing menace to the stence of the country. In 1931, Sir Frank Stock- e reported that an increase in agriculture and sequent reduction of area available for grazing re accentuating the dangers of erosion. In 1933, Kenya Land Commission recommended an ension of the cropped area, using dry-farming thods, in order to increase production in densely pulated reserves. In 1936, Sir Alan Pim's report Kenya directed attention to the danger of extend- ; the cultivated area without suitable precautions ng taken to maintain fertility, and to the absence any definite policy with regard to soil erosion. 1937, both Sir Frank Stockdale and the recently pointed soil conservation officer (Mr. C. Maher) ressed the view that the overworked land needed omplete and prolonged rest without which much it was irretrievably doomed. They further recom- nded the development and intensification of agri- ture to compensate for loss of production from sted' land.

This summary of the recommendations of some of consulting 'physicians' who have attended Kenya the last ten years of its decline is given (in more tail) in Dr. Pole-Evans's account of a visit to the lony last year.* It will be noticed that all the er physicians recognized that the worst affected rts needed rest, but proposed to maintain pro- ctive capacity by throwing an additional burden to other parts, that is, by extending agriculture. at the productive capacity of the native reserves st be maintained at a certain minimum in the immediate interests of the inhabitants is the burden of these physicians' arguments. Dr. Pole-Evans is more forthright in his recommendations. He is a South African ecologist who lacks the bedside manner of the official reporter or commissioner. He considers that the situation is so grave that the complete rest which should have been given years ago is now imperative and must be given regardless of economic and political obstacles, if a greater future disaster is to be avoided. The remedy he proposes is simple on paper; it has been used time and again in history to rest exhausted land while keeping it under human control, and it has rarely failed. It consists in restoring the natural grass cover and utilizing animals in suitable numbers to keep the grass in good condition. It means a general reversion to less productive pastoral farming with greatly reduced stock in densely populated native reserves. Dr. Pole-Evans admits the value of supplementary measures of soil conservation—afforestation, terracing, strip-cropping, etc.—but they are practically useless unless the foundations of native society are grounded in pastures. The population can only support itself on a predominantly pastoral basis if administrative intelligence and action are concentrated on the problem of growing luxuriant grass on exhausted land in a semi-arid climate. The solution of that problem will demand all the resources of science backed by wise and far-sighted administration, and Dr. Pole-Evans's report is a plea that the necessary help and encouragement of the right kind be given before it is too late.

The report is depressing in the extreme, but it carries deadly conviction. One wishes that it could be read and its implications understood by every member of parliament. We might then get the beginnings of a Colonial policy which takes account of the harsh—the very harsh—realities of Nature that will determine policy in the end.

G. V. J.

Report on a visit to Kenya. By Dr. I. B. Pole-Evans. Pp. 36+18 tes. (Nairobi: Government Printer, 1939.) 2s. 6d.

THE ROYAL SOCIETY OF CANADA

Annual Meeting

HE annual meeting of the Royal Society of Canada was held at the University of Montreal the new Botanical Building during May 22–24. A ge attendance of fellows from all parts of Canada d an opportunity of seeing this splendid new velopment of a botanical garden in Montreal with laboratories, greenhouses and large park still in progress of completion as a works project financed civic and Government authorities and under the ection of Frère Marie-Victorin of the University Montreal.

The presidential address was delivered by Dr. ctor Morin, who spoke on "La Chanson Française travers les siècles", with interpretations of songs the "Quatuor des Alouettes". This address was ceded by the introduction of new fellows and by presentation of medals awarded by the Society. The Flavelle Medal was awarded posthumously to the late Prof. J. Playfair McMurrich in recognition of his distinguished work in anatomy. Dr. Wilfred Bovey received the Lorne Pierce Medal, and the Tyrrell Medal was presented to Dr. E. Z. Massicotte. A unique social feature of the meeting was the Operetta-dinner held in the ballroom of the Mount Royal Hotel, at which the fellows and their wives were the guests of the City of Montreal. This fanciful dinner-play was written by the president of the Society, Dr. Morin, as a reconstitution of the feasts given by the 'seigneurs' of olden times. Parodical rhymes on gastronomical subjects adapted to the music of well-known operas of the French repertory were sung by artists in cook's and maid's costumes, as the several dishes of the dinner were served.

At the concluding general meeting, Dr. H. M. Tory was elected the new president of the Society.

Section III (Chemical, Mathematical and Physical Sciences) was held under the presidency of Prof. S. Beatty, who delivered the presidential address on "Generalisation as a Principle of Mathematics". Three new members were elected to this section, Prof. H. N. Brocklesby, Prof. M. F. Crawford and Prof. G. Herzberg. In all, 120 papers were presented and the section split into the three subdivisions to facilitate the giving of the papers during the time of the meeting.

Prof. E. F. Burton spoke on a number of papers contributed by his co-workers, among which special mention should be made of the recent results obtained by Johns, Wilhelm and Grayson Smith on the flow and viscosity of liquid helium, in which it was proved, by using glass capillaries ranging from 0·025 cm. to 0·0036 cm. in diameter and with lengths varying from 2 cm. to 26 cm., that normal laminar flow was obtained for He I with a viscosity of the order of 10^{-5} c.g.s. units, while for He II, the flow could be expressed as the sum of a laminar flow plus an additional pressure-independent flow. The laminar portion obeyed Poiseuille's law and gave a viscosity of the order of 10^{-5} c.g.s. units. The new electron microscope constructed by A. Prebus and J. Hillier and photographs obtained with it indicating high resolving power were described by Dr. Burton. Among the papers presented by Prof. J. A. Gray, one in collaboration with J. S. Marshall and A. G. Wood contained results on the scattering of β-rays using metallic foils, which were in contradiction to those obtained by other observers using expansion chamber methods. Dr. D. C. Rose described an electromagnetic pick-up device used with a cathode ray oscillograph for investigating vibrations in aeroplanes during flight. A new method of observing the Raman effect in small amounts of liquid with short exposure times was presented by Prof. M. F. Crawford and H. L. Walsh.

A description of the methods now being used to determine the upper earth structure from data obtained by registering the seismic waves from rock bursts occurring in mines was given by Dr. E. A. Hodgson. Other papers on field results of geophysical investigations were given by Dr. A. A. Brant, Prof. L. Gilchrist and Prof. D. A. Keys. The results of an analysis of meteorological data by A. Thomson showed that the average winter temperature was 4° F. warmer in Manitoba and Saskatchewan for the period 1919–1938 than for the period 1884–1903, which was explained by the increase in the temperature of the air-masses moving in from the Arctic circle.

Among the fifteen papers presented by Prof. O. Maass and his associates, particular interest was taken in those dealing with the measurements of viscosity, opalescence, specific heat, density and solubility relations of various liquids and vapours in the critical temperature region. The influence of intense mechanical stirring on the temperature at which the disappearance of the meniscus takes place shows that a wide range of over-all density gives identical critical temperatures. Prof. E. W. Steacie presented eight papers dealing with various aspects of photosensitized decomposition. Prof. R. H. Clark and his collaborators contributed fourteen papers, among which special mention may be made of the results obtained on activators of zymase. The plant hormones activate live yeast but have little accelerating effect on zymin. Another paper interest was on the mechanism of the flotation galena in the presence of xanthate which is appl in the mining industry in Canada. Prof. H. Hibb spoke on the results obtained in his laborato carried out with various collaborators, on lignin a other wood products.

In the mathematical and astronomical secti M. S. McPhail and Prof. R. L. Jeffery spoke Stieltjes integrals with applications to fractio integrals. The profiles of hydrogen lines in spectrum of *H.D.* 190073 by C. S. Beals and investigation into the hydrogen line contours in spectra of solar stars by K. O. Wright were given Dr. W. E. Harper. Dr. A. V. Douglas, D. C. W and D. E. Guignard described an investigat on the profiles of hydrogen lines in two class stars.

Prof. J. A. Gray was elected president of section and Prof. J. K. Robertson secretary.

In Section IV (Geological Sciences) the president address by Dr. M. E. Wilson outlined the devel ment of ideas about the Canadian Precambrian discussed certain Precambrian problems. Eighte papers were presented. Two papers dealt wi Sudbury, one by Dr. H. C. Cooke, in which so new ideas about the general geology of the distr were given, and the other by Dr. A. B. Yates c cerned with the ore deposition. Dr. H. C. Gunni and J. W. Ambrose outlined the results of five ye detailed investigation of the so-called Timiskamin Keewatin contact in Rouyn-Harricanaw Ar Quebec. The whole succession of volcanic a sedimentary rocks is apparently conformable a the investigations show the need for compl revision of our conceptions of Archean strat graphy and structure in this part of the Canadi shield.

The palæontological papers included descriptio of a Helderber fauna from the eastern townships Quebec by D. T. H. Clark, and some species of Ne Triassic ammonites by D. L. H. McLearn. Dr. J. Wilson presented an interesting paper on the Esk north-east of Great Slave Lake, N.W.T. T information was gained chiefly from the study aerial photographs.

Dr. H. W. Fairbairn presented a paper on t fracture hypothesis of quartz orientation in tect nites. Dr. M. B. Baker discussed the floor of t Palæozoic rocks in Canada.

The presidential address of Section V (Biologi Sciences) was delivered by Dr. J. M. Swaine Ottawa on "Scientific Research as the Key Progress in Agriculture".

The programme comprised seventy-two papers, which nineteen came before the medical subsectio and twenty-nine were botanical.

Dr. N. H. Grace reported upon the relative physi logical activity of the members of a series of naphth acids when applied to plant cuttings, showing th those with an even number of carbon atoms in t side chain are the more active. Drs. E. Gord Young and R. W. Begg found certain small prop tions of copper, calcium, magnesium, and iron to required in bacterial culture media. Factors affecti stomatal movement in the dark were described J. H. Whyte. That increased permeability of t host accompanies increased susceptibility to pa sites and diseases in plants was shown by F. Thatcher. The importance of boron for normal c division, enlargement, and maturation in plants w cribed by J. G. Coulson and R. O. Lachance, le studies related to hardiness of plants were orted, by Messrs. J. Levitt and D. Siminovitch. B. Thomson discussed the structure of the pollen e of Austrotaxus and its phylogenetic significance, wing it to be a highly specialized derivative of usual conifer type, and C. N. Haldenby described distribution and origin of horizontal resin canals Coniferæ. A series of papers by Frère Marie-torin was devoted to various taxonomic and ributional studies of the plants of Quebec and of e, interesting contributions to the problem of floras being made, particularly in papers by . Rousseear and Gauthier.

n the field of genetics, a definite relationship ween sterility and chromosome segregation with nslocations was demonstrated in wheat crossed by P. Thompson, and the actual causes of failure of d-setting in certain intergeneric cereal crosses e described in another paper by the same investi-or. F. H. Peto gave an account of the production fertile amphibolypoid plants from sterile hybrids Triticum species, and A. Glaucum, by temperature l colchicine treatments, with cytological studies of processes involved. Certain chromosome muta-s in oats were shown by H. G. F. Sander to olve loss of all parts of one chromosome, and dies on the chromosomes of Trillium by G. B. son and H. B. Newcombe gave data which cannot dily be fitted to any existing theory of crossing r but suggest a new partial hypothesis.

Features of the morphology of the circulatory tem of Amia, particularly in relation to an air-athing mechanism, were described by V. C. nne-Edwards, and the presence of a vessel of tal nature connecting the hypophysis and the othalmus in the frog was reported by E. Horne igie. The latter also demonstrated wide and portant differences in the vascular richness of hypothalamic centres in the rat. Various studies on the white whale were reported by V. D. Vladykov, who also discussed sexual dimorphism in the speckled trout. F. E. J. Fry had a paper on density of lake trout populations. An account of differential growth rates and of regeneration in the hind limb of the frog was offered by A. Emerson Warren. A study of temperature relations of the numerous species of midges (Chironomidæ) occurring in a lake was described by R. B. Miller.

B. P. Babkin and associates showed that ergosterol and parathyroid hormone effect gastric secretion in the dog chiefly by depressing its nervous phase. Early cessation of growth in rats on a rich fat diet was found by R. G. Sinclair and traced to the masking or suppression of synthesis of essential fatty acids. The effect of guaiacols on the respiratory passages was described by E. M. Boyd. Authentic notochordal tissue in a dermoid cyst of the ovary was reported by J. L. Riopelle. The structure and development of certain renal tumours led P. Masson to believe that the metanephros is not mesodermal but is derived from the neural crest; while his associate, P. Simard, found a constant neuroinsular complex in the mammalian apparatus. Drs. A. Scott and A. M. Fisher gave an account of the effects of certain chemicals in inactivating insulin and showed by moving picture film that each insulin crystal has two parallel square surfaces relatively close together, connected by four oblique quadrilateral surfaces. James Craigie showed that the Guarnieri inclusion bodies are probably not the intracellular colonies of a virus. The chemotactic attraction of staphylococci for leucocytes from mouse spleen was found by J. W. Stevenson and G. B. Reed to vary inversely with pathogenicity, while Alma Howard reported an inverse relationship between chiasma frequency in chromosomes and susceptibility to mammary gland carcinoma in mice.

THE AGRICULTURAL EDUCATION ASSOCIATION

Annual Conference at Belfast

HAT science can do much to help agriculture was the theme of several speakers at the Annual nference of the Agricultural Education Association ich was recently held at Belfast. Both Lord igavon (Prime Minister) and Sir Basil Brooke inister of Agriculture) referred with pride to the ievements of the Education and Research Divisions the Northern Ireland Government at the official ner of welcome, and reiterated the opinion that cation, both general and technical, is a sound estment. The Association, which met under the irmanship of Mr. W. B. Mercer, had a long pro-mme of scientific papers, interspersed with visits the Agricultural Research Institute at Hills-rough, with its experimental farm of 500 acres, Plant Breeding Station and Veterinary Research boratory at Stormont, and farms of the Irish Peat velopment Company at Maghery.

Dr. H. H. Corner directed attention to recent work 'pine' disease in sheep, which he declared was valent in the highlands of Scotland, the border counties, parts of Wales and in Devonshire. 'Pine' is an anæmic wasting disease due to a condition in which the iron of the food cannot be utilized by the blood: the presence of numerous parasitic intestinal worms is a secondary condition. Following the success of Underwood in Australia, who in 1934 showed that cobalt was the potent element in the utilization of iron compounds in enzootic marasmus, cobalt was tried in the treatment of 'pine' in the Cheviot region with great success. One ounce of cobalt chloride sprayed into and well mixed with one hundredweight each of steamed bone flour, and common salt, provided an easy means of preventing the disease, for the mixture could be set out in boxes for the animals to eat whenever they felt inclined. The cost was twopence a sheep per year.

Mr. James Mackintosh, as the result of two years experimental work with large numbers of cows in the south of England, suggested that a 20 per cent reduction might safely be made in the amount of protein now being fed to dairy cows. He suggested a standard of 0·5 lb. protein equivalent per 10 lb. of milk of average quality as a safe standard for farm practice.

Prof. R. G. Baskett, in a paper dealing with the firmness of fat in bacon pigs, stated that the back fat of pigs receiving de-germed maize meal had a significantly lower iodine value than that of pigs receiving half their ration in the form of maize meal.

Mr. H. Trefor Jones, in a paper on smoke pollution, said that in a town the size of Leeds domestic chimneys alone contribute to the atmosphere the equivalent of nearly a ton of sulphuric acid per acre per annum : in the industrial districts of the West Riding of Yorkshire, however, the sulphurous fumes are contributed chiefly by industrial chimneys and smouldering pit heaps. Most of the damage to crops is done during the dormant season : winter-sown crops like wheat and winter vegetables are the chief sufferers, whilst it is unsafe to spray potatoes with copper preparations even under conditions of mild pollution. In confirming or disproving cases of alleged smoke damage, and in explaining differences in productivity of the various parts of affected fields, the estimation of the sulphate content in the soil had proved very useful. Sulphate figures in excess of 0·020 per cent for grassland, and 0·030 per cent for arable land indicate smoke pollution.

Prof. S. P. Mercer had a good word to say for Yorkshire fog grass under certain conditions in Northern Ireland, advocated shorter leys combi with August sowing, and stated that rushes could very largely controlled by two cuttings a year two successive seasons. Dr. A. E. Muskett descri a laboratory method which allows seed disinfecta to be tested for efficiency in ten days at any tim the year. Radiation for 20 minutes with a qu mercury vapour lamp is used to promote sporulat of the fungus, thus making easier the examinat of the seeds at the end of the test. Dr. J. Car stated that until recently eelworms had not bee serious pest in Eire, but that root eelworm of potat was spreading and that the bulb strain of *Anguillul dipsaci* was beginning to attack onions, a crop wh during the last few years had undergone a remarka increase in Eire. Mr. R. Chamberlain described extraordinary but successful measures adopted Northern Ireland to stamp out the chrysanthem midge, measures which included the scheduling an area within which no living chrysanthemum pl could be kept, and the intensive inspection of premises in the area.

Other papers read at the meeting included c tributions on aspects of education by Mr. S. J. Wri and Mr. J. Getty : a paper on the flax-grow industry, by Mr. W. J. Megaw, peat land recla tion, by Mr. J. C. Baird, and a general acco of the agriculture of Northern Ireland by Mr. Morrison.

UNION BETWEEN HOST AND PARASITE IN HIGHER PLANTS

On this subject, Schumacher and Halbsguth have recently published an interesting and suggestive paper[1]. Their observations are based on extensive studies of species of Cuscuta and Orobanche on a wide range of host plants ; with the union of Cuscuta and its host, particularly, they have made use of techniques which permit the recognition of protoplasmic connexions, usually freezing the material, cutting on the sliding microtome and then transferring immediately to iodine potassium-iodide solution. Afterwards the walls were swollen and the connexions stained by a modification of Meyer's pyoctannin method.

In all cases they find (contrary to some earlier observations of Mrs. Thoday[2]) no direct connexion between the sieve-tubes of host and parasite ; the sieve-tubes of the parasite, indeed, are not found differentiated in the close neighbourhood of the point of union in the haustorium. From the haustorium, in Cuscuta, hypha-like cells ramify from the parasite penetrating the phloem tissue ; where these cells end in the neighbourhood of a sieve-tube they may develop a comb-like expansion of which the teeth close on the sieve-tube, so that these cells make very good contact with the sieve-tube, of which the wall is often much compressed. In the walls of these hyphæ, which are rich in protoplasm and often multinucleate, very numerous plasmodesma-like structures are found which seem to end free on their surface, but these 'plasmodesma' are never found on the comb-like ends, which seem definitely constructed to facilitate exchange between host sieve-tube and parasite.

In Orobanche these hypha-like cells are usually replaced by a densely plasmatic tissue, with prominent, usually single, nuclei ; these cells mult rapidly, they surround and compress and fin obliterate many of the sieve-tubes ; but the sieve-t up to the point of obliteration remains full of conte and presumably continues to transfer material fr host to this secretory type of haustorial tissue.

The authors conclude that their observati suggest that the transfer of food from host to para must take place across the walls of contiguous c the permeability of host sieve-tube presuma increasing, whilst the absorptive properties of haustorial secretory tissues may also be accentua at the point of union. The distribution of the pr plasmic connexions suggests that food transfer is their role. It is argued they may help the invad haustorial cells to orientate themselves in the host a in accordance with such perceptive functions, authors record the presence of similar structure the outer wall of epidermal cells, notably of tend But their figures suggest that these structures rather large for typical protoplasmic connexions it must be left for further work to clear up possible correlation of these epidermal features w plasmodesma or, on the other hand, with the w secreting channels described by Dous and Zieg speck[3]. These vertical wax-secreting channels deserve further scrutiny in view of Madeleine Mey observations[4] that the wax distribution suggests movement along horizontal channels in the cutini layers of the outer wall.

[1] *Jahrb. wiss. Bot*, 87 (2/3), 324–355 (1938).

[2] *Ann. Bot.* (1911).

[3] *Bot. Archiv.*, 19 (1927) ; 20 (1928).

[4] *Protoplasma*, 30 (1938).

NEW FORENSIC SCIENCE LABORATORY

THE new Home Office Laboratory at Preston was opened on July 27 by Mr. A. L. Dixon, sistant Under-Secretary of State of the Home partment. The staff and equipment are provided the Home Office, which also meets the running sts during the initial period. The accommodation s been provided by the Lancashire Standing Joint mmittee. The Laboratory will serve the North-estern Area, which includes Lancashire, Westmornd and Cumberland and Cheshire.

The new Laboratory is conveniently arranged on e floor. The administrative offices are arranged a central hall, from which the various laboratory ctions are readily accessible. The Laboratory is rnished with modern equipment for carrying out emical (including microchemical), physical and ological investigations. There is also a fully uipped photographic section, including apparatus r microphotographic work.

This is the fourth laboratory to be established, hers being at Birmingham, Cardiff and Nottingm. Each laboratory is equipped to cover the range work which would satisfy all general requirements, it it would be impossible to equip each laboratory cover every possible case. This aspect is, however, rgely met by giving each laboratory some special ction, and in the case of the laboratory at Preston, e provision for dealing with chemistry problems made as complete as is reasonably possible. Thus reciprocal arrangements between these forensic ience laboratories (and in special cases certain overnment laboratories) it is possible to cover actically every phase of the work.

The principal function of the Laboratory is to give ientific assistance in the detection of crime to the lice in the area served by the Laboratory. The lice, however, have no control over the work hich goes on in the Laboratory; that work is solely der the control of the Director. He has only one ing to do—to find out what the various specimens bmitted (and in some cases his observations at the ene of crime) reveal from the scientific point of ew. It may well be that the results completely gative the police case and favour the defence. That no concern of the Director; he will state his findgs, which will be available to both sides.

In addition to the purely laboratory work, it is rt of the work of the Director to organize courses instruction which are available to the various tective forces in the area. This course includes e careful collection and preservation of materials be submitted to the Laboratory for examinaon.

The Laboratory, therefore, includes a museum in hich exhibits from various typical crimes will be llected and used for instructional purposes. lthough the new buildings have only been recently ened, the Laboratory was first started in September 938 in temporary premises with Dr. J. B. Firth as rector, and in this interim period on no less than 40 occasions have materials been submitted for amination and some 556 exhibits examined. These gures themselves will indicate in some measure that e new Laboratory with its more complete staff and uipment will be a great asset to the area which it designed to serve.

J. B. F.

SCIENCE NEWS A CENTURY AGO

Drainage of Lands by Steam Power

THE *Gentleman's Magazine* of August 1839 contains the following information: "The drainage of land by steam power has been extensively adopted in the fens of Lincolnshire, Cambridgeshire and Bedfordshire, and with immense advantage. A steam engine of ten horse-power has been found sufficient to drain a district comprising a thousand acres of land, and the water can always be kept down to any given distance below the plants. If the rainfall is excessive, the water is thrown off by the engine; if the weather is dry, the sluices can be opened and the water let in from the river. The engines are required to work four months in the twelve, at intervals varying with the season; where the districts are large, the expense of drainage by steam power is about 2*s.* 6*d.* per acre."

The Travels of J. D. Forbes in 1839

EARLY in August 1839, J. D. Forbes returned to Edinburgh after spending three months in south-east France, Switzerland and Italy. On his way south he visited Paris, meeting Arago, Cauchy, Elie de Beaumont and Niepce, and was particularly interested in Daguerre's pictures. He then travelled south by way of Dijon, Chalons and Lyons on the way to the department of Ardèche. From Montpezat he wrote of the district that "in a geological sense it is interesting in the highest degree, and I have four or five craters, just as well-defined and as recent-looking as Vesuvius, within a day's walk. . . . There are deep granite valleys divided by serrated mountains, through which here and there a cindery volcano thrusts his roasted head, while the valleys are clothed with chestnut and mulberry trees in the most exquisite manner". On July 5 he made an investigation of a meteorite which fell on June 15, 1821, "one of the very few which have fallen so near to intellegent spectators as actually to endanger their lives".

From the volcanoes of Auvergne, Forbes proceeded to Marseilles and then turned north to explore the little-frequented valleys around Monte Viso on the borders of Piedmont. He visited the village of St. Veran, 6591 ft. above sea-level, "the highest in Europe, except that of Soglio in the Tyrol", and attempted the circuit of Monte Viso. From these excursions he returned to Grenoble, and then having visited a brother at Geneva he travelled through some of the unknown valleys to the south, and then by way of Cogne and Ponte he reached Turin. On August 2 he visited the astronomer Plana, "overwhelmed with official engagements", and on the following day the geologist Sismondi.

Kent Zoological and Botanical Gardens

ON Thursday, August 8, 1839, "a party of citizens visited this delightful spot in a steamer, when about 650 gentlemen and ladies were regaled with a dejeuner, under a spacious pavilion erected in the gardens for the occasion. . . . The gardens are those at Rosherville near Gravesend. This piece of land, or the greater portion of it, consisting of seventeen acres, was taken into its hands by a company of gentlemen more than a year since, and by them it was made the object of a most extensive plan for the securing of its natural beauties and adding to it new and unusual attractions. . . . Clever use has been made of the excavation into the chalk cliffs . . . a further advance in the valley conducts to the botanical beds where it is intended to cultivate the rarest plants and flowers which the climate will allow. . . . Immediately next the perpendicular cliffs of these two divisions arrangements are to be made and are now in progress for the reception of wild beasts, birds and sea-fowl, etc." (*Mechanic and Chemist.*)

Thomas Tredgold

Tredgold, one of the founders of engineering theory and the author of the well-known definition of civil engineering embodied in the charter of the Institution of Civil Engineers, died in January 1829 at forty years of age, worn out by his exertions.

On August 10, 1839, the *Mechanics' Magazine* said, "To architects, engineers and persons concerned in any department of building the name of Tredgold must not only be familiar, but likewise respected and valued, and it is presumed not less so by many individuals in the higher walks of life. To all such it must be a matter of painful interest to be informed that the family of such a highly gifted man and martyr to science, consisting of an aged mother, two daughters in extremely delicate health, and a son of about thirteen years of age, are in very dependent circumstances. His friends have long cherished the hope that long before this time—for it is now ten years since his death—their situation might have attracted the favourable notice of government; but as this has not been the case, Mr. Habershon, one of his early friends and his biographer, with John Donkin, Esq., his joint executor, have commenced a subscription in furtherance of this laudable object."

Discovery of a Mammoth's Tusk

The issue of the *Athenæum* of August 10, 1839, states that at a meeting of the Bristol Philosophical Society "Dr. Fairbrother exhibited the tusk of a mammoth which had been found on the line of the Great Western Railway, near the spot where the city boundary crosses the line . . . in the lower part of a bed of gravel which reposes upon red sandy and marly beds, forming a part of the 'New Red Sandstone' formation. Its length is about 5½ feet, its circumference varying from 21 to 10 inches. It is curved in a form nearly circular and occupies an arc of about 140 degrees. Mr. Stutchbury supposes it to be a part only of the original tusk, which was probably 9 feet in length."

APPOINTMENTS VACANT

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant II under the Ordnance Board, Woolwich—Secretary (S.E.3), Ministry of Supply, The Adelphi, W.C.2 (quoting Appts. 01/S E.3) (August 11).

Assistant I at Air Ministry Headquarters—Under-Secretary of State, Air Ministry (S2A/B8019), Berkeley Square House, Berkeley Square, W.1 (quoting Ref. No B.229) (August 11).

Temporary Assistants Grade III (Male) in the Meteorological Office—Under Secretary of State, S.2.B (Met.), Air Ministry, Adastral House, Kingsway, W.C.2 (August 14).

Assistant Lecturer in Organic Chemistry—Registrar, University College of the South-West, Exeter (August 19).

Chief Assistant in the Chemistry Department—The Secretary, Robert Gordon's Technical College, Aberdeen (August 26).

Librarian in the University of Cape Town—Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (September 8).

University Chair of Chemistry at the Royal Cancer Hospital (Free)—Academic Registrar, University of London, Senate House, W.C.1 (September 15).

Assistant Engineer for the Malayan Public Works Service—Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/5731).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

University of Bristol. The Annual Report of the Agricultural Horticultural Research Station (the National Fruit and Cider Institu Long Ashton, Bristol, 1938. Pp. 296+9 plates. (Bristol · The versity.)

Mines Department. Seventeenth Annual Report of the Safety Mines Research Board, including a Report of Matters dealt with the Health Advisory Committee, 1938 Pp. iv+123+10 pla (London: H.M. Stationery Office.) 2*s.* net.

Nutrition of Children. By Eddie Williams. (Cardiff · Priory P Ltd) 10*s.* per 100.

The Bronze Axe · the Seven Stages of its Development in Bri (2000–500 B.C.). By W. Foot Walker. (Booklet No. 3.) Pp. 39. (H "Museum Aids".) 1*s.* 6*d.*

Air Ministry: Aeronautical Research Committee. Reports Memoranda. No. 1843 (3651) · Experiments on the Transition the Laminar Boundary Layer on a Flat Plate. By A. A. Hall G S. Hislop. Pp 27. 4*s.* net. No. 1855 (3675): Experiments o Riveted Wing in the Compressed Air Tunnel. By D. H. Williams A. F Brown. Pp. 4. 9*d.* net. No. 1857 (3562): A Possible Form High Speed Water Channel. By A. M. Binnie. Pp. 9. 1*s.* 6*d.* (London: H.M. Stationery Office.)

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N. No. 15: Leaf Movement on Release of Sap Tension. By Prof. Henry Dixon and J. S. Barlee. Pp. 175–180+plate 4. 1*s.* 6*d.* Vol. 22 (N. No. 16 Studies in Peat, Part 6: The "Water Phase" in Azeotro Extraction Solvents By J. Reilly and D. F. Kelly. Pp. 181–186. Vol. 22 (N.S.), No. 17 · Studies in Peat, Part 7: Water Distribut in Peat Wax Azeotropic Extraction Solvents. By J. Reilly, D. Kelly, J. Duffy and B. Coughlan. Pp. 187–194. 6*d.* (Dublin: Hod Figgis and Co., Ltd.; London. Williams and Norgate, Ltd)

Other Countries

Ceylon. Part 4: Education, Science and Art (D). Administrat Report of the Acting Director of Agriculture for 1937. By E. Rodr Pp. D93. (Colombo · Government Record Office.) 1 rupee.

Indian Forest Records (New Series.) Silviculture, Vol. 3, No. a Study of the Soils in the Hill Areas of Kashmir, an Investigat of Soil Profiles under Deodar, Blue Pine, Silver Fir and Chir. By R. C Moon Pp. 193–262. (Delhi. Manager of Publications) 1 rupees, 2*s.* 9*d.*

Publications of the Nizamiah Observatory Astrographic Catalo 1900.0, Hyderabad Section (Part 3), Dec. +35° to +40°, from Pho graphs taken and measured at the Nizamiah Observatory, Hyderab under the direction of T. P. Bhaskaran. Vol. 11 · Measures of R angular Co-ordinates and Diameters of 50,907 Star-Images on pl with Centres in Dec. +37°. Pp. xxviii+193 (Begumpet: Nizam Observatory.) 15 rupees; 20*s.* net.

Annales scientifiques de l'Université de Jassy. Première pa (Mathématiques, physique, chimie), Tome 25, Année 1939. Fasc 1. Pp. 340. Fascicule 2. Pp 341–698. Seconde partie (Scien naturelles), Tome 25, Année 1939. Fascicule 1. Pp 336. Fascicul Pp. 337-516. (Jassy: Université de Jassy.)

A Trip through the New Building of Mellon Institute. Sec edition. Pp. vi+20. (Pittsburgh, Pa.: Mellon Institute.)

U S. Department of the Interior: Office of Education. Know y School, Leaflet No. 51: Know your School Child. By Mary Dab Davis. Pp. iii+18. (Washington, D.C.. Government Printing Off 5 cents.

Cawthron Institute, Nelson, New Zealand. Annual Report, 19 Pp. 35 (Nelson Cawthron Institute.)

Advisory Committee on Education. Staff Study No. 1. Educat in the Forty-eight States. By Payson Smith, Frank W Wright associates. Pp. xv+198. (Washington, D.C. · Government Print Office.) 30 cents.

New York Academy of Sciences. Scientific Survey of Porto R and the Virgin Islands Vol 14, Part 3: Insects of Porto Rico the Virgin Islands—Hemiptera-Heteroptera (excepting the Mir and Corixidae). By Harry Gardner Barber. Pp. 261–442. (York: New York Academy of Sciences.) 2 dollars.

Classified List of Smithsonian Publications available for Distri tion, June 26, 1939. Compiled by Helen Munroe. (Publication 35 Pp. iv+35. (Washington, D.C.: Smithsonian Institution)

Brooklyn Botanic Garden Record. Vol. 28, No. 3: The Rose Gar of the Brooklyn Botanic Garden By Montague Free. (Guide No. Pp. 159–216. (Brooklyn, N.Y.. Brooklyn Institute of Arts Sciences)

U.S. Department of the Interior: Geological Survey Wa Supply Paper 796-G: Major Texas Floods of 1935. By Tate Dalrym and others Pp v+223–290+plates 54–62. 15 cents. Water-Sup Paper 823: Surface Water Supply of the United States, 1937. Part Ohio River Basin. Pp vii+375. 40 cents. Water-Supply Paper 8 Floods in the Canadian and Pecos River Basins of New Mexico, and June 1937, with Summary of Flood Discharges in New Mex By Tate Dalrymple and others. Pp. iv+68+9 plates. 20 ce (Washington, D.C. Government Printing Office.)

New York Zoological Society. Report of the Director of Aquarium. Pp. 22. (New York: New York Zoological Society.)

League of Nations. Information Section Essential Facts ab the League of Nations. Tenth edition, revised. Pp. 359+4 pla (Geneva: League of Nations; London · George Allen and Unw Ltd.) 1*s.*

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, AUGUST 12, 1939 No. 3641

CONSERVATION OF ANTIQUITIES IN BRITISH DEPENDENCIES

THE Trustees of the British Museum (Bloomsbury) are to be congratulated on the acquisition of the remarkably fine bronze head from outhern Nigeria, to which reference was made in NATURE of July 15, p. 106. Not only is this an utstanding example of the highly developed rtistic products of early West African culture, but lso it belongs to a class of objects to which dditions available for study in European collecions are likely to be restricted in number in uture. Since the beginning of the century, and rising possibly in a great measure from the publication of the bronzes and other artistic objects from Benin in the Pitt-Rivers collections, nterest in and appreciation of the merits of the arious schools of sculptural art native to African ulture has increased rapidly and become widespread. In consequence, a number of characteristic examples, and many of exceptional merit, have been brought to Europe by collectors. During the past twenty years it has been known that bronze heads of remarkable character have been found from time to time in the course of excavation at Ifé in the Yoruba country of Southern Nigeria; but the discovery there in 1938 of a number of such examples of the artistic skill of an ancient and forgotten people, of which this British Museum acquisition is one, has quickened interest in these and similar objects of "high antiquity, artistic merit, and uncertain cultural origin", and as a result has induced those n authority to take steps to secure that West Africa should not be denuded of such interesting and important relics of its past.

In January 1939 the Government of Nigeria made an Order in Council enabling the Governor of Nigeria to control the export of antique African sculptural works of art; and since then the native authority of Ifé has taken action to protect the antiquities in the area under its administration. Such interest on the part of a native administration suggests that the subsequent action of the Secretary of State for the Colonies, announced in "The Colonial Empire" (the statement recently issued with the estimates for 1939) by which he has instituted inquiries with a view to the enactment of legislation throughout West Africa to secure the protection of indigenous African objects of ethnological import or æsthetic interest, will receive strong backing from a quarter which might not have been anticipated. It should ensure that any legislation which may be framed as a result of the inquiry will not become a dead-letter.

It is interesting to note that the Colonial Office, which frequently in the past has been accused of inertia when matters of moment to the scientific pursuit of cultural studies have been at stake, is now ready to give due heed to their interest and importance when attention has been directed to them. In Mr. MacDonald's own words: "Wherever such discoveries have been made His Majesty's Government has a keen interest in revealing them, and in preserving them, both on account of their scientific and historical value to scholarship, and on account of the susceptibilities of the local people, who naturally tend to regard these evidences of their cultural origins with reverence and pride".

It is in accordance with this policy that the study of antiquities is fostered and their conservation has been taken actively in hand by the authorities in several of the dependencies under legislative enactment. In Palestine, for example, which for the student of early racial and cultural history, apart from its bearing on the origins of the Christian religion, now holds a foremost place among the regions of major interest and significance for scientific research, not only does the Government direct the course of investigation by the exercise of its authority, acting under skilled advice, but also through the Department of Antiquities is itself engaged in investigation. In addition to the archæological work which has been carried out under licence, the study of the past history of Palestine has benefited by the activities of the Department of Antiquities in the field.

The importance of Palestine in the historic development of modern civilization naturally tends to attract to it investigators from outside, drawn from all parts of the world; and Jerusalem, equipped as it is with University, Antiquities Department, and the headquarters of several national schools of archæological research, since the War, and since the termination of the British mandate in Iraq, has become by far the most important centre of archæological interest under British jurisdiction. It is, however, by no means the only one; and if it were only possible to ensure more adequate financial provision, both Malta and Cyprus in their respective fields of archæological and historical interest might make a fair bid to become not unworthy rivals of the Holy Land. In Malta in particular, remarkable prehistoric remains and culture present a number of problems to the archæologist, which still await solution. Here a notable step in advance has been taken by the foundation of a professorship in archæology at the Royal University of Malta, which it is hoped, in the words of Mr. MacDonald's report, "will prove a starting point for a more exhaustive development of Malta's archæological wealth". A survey of the monuments of the island is projected. This is a measure which has been too long delayed; and although the visitor to the island, who views the remarkable prehistoric structures which form one of its attractions and examines the archæological collections in the Museum, will appreciate the devoted service to archæological studies in Malta over many years of the late Sir Th. Zammit, the net result for the discerning is an uneasy feeling that too little support has been given to the investigation of culture that in its way is unique. It is indeed t be hoped that a better day is dawning. M MacDonald announces that the curator of th archæological section of the Museum has been o study leave in Europe, and after working on sit in England is proceeding to Rome and Athens.

Cyprus, an island rich in historic association as it is in antiquities, has in the past been muc hampered by financial considerations; and thes notwithstanding assistance from private sourc interested in the past history of the island, hav not been entirely overcome. The work of th preservation of the ancient monuments of Cypru nevertheless continues. In addition to the amoun spent from the funds of the Government of Cypru generous assistance has been given towards th work by Lord Mersey's Cyprus Committee and b the Carnegie Corporation. Among the mo important of the monuments to which attentio has been given are the Castle of St. Hilario Bellapais Abbey, and the fortifications of Famagusta. In this work the Cyprus authorities hav had the co-operation of the Office of Works, a official having been seconded from England to th Cyprus Department of Antiquities as superintendent of works, who has trained a Cypriot official to undertake this function after his ow return to England.

In the conservation of antiquities, however anything approaching safety is to be won only a the price of constant vigilance. In this connexion it is interesting to find that in *Antiquity* of June the editor, in directing the attention of his reader to a communication from Mr. Stewart Perowne dealing with two ancient city sites of remarkabl archæological interest examined by him in th Aden Protectorate, urges strongly the need fo the appointment, without delay, of a Director o Antiquities for the Protectorate. He supports hi argument by reference to the importance fo archæological studies of this area, as indicate not only in the results recorded by Mr. Perowne as well as those obtained by Miss G. Caton Thompson, Miss E. Gardner, Miss Freya Stark and others but also by pointing out the imminent dangers o spoliation, if future exploration is not properly supervised, and adequate measures are not taken to protect the monuments and house the smalle finds of archæological research. There can be n question that the editor of *Antiquity* is right i thinking that archæological opinion in Great Britain is with him in this matter.

THE CASE FOR LEY FARMING

The Plough-Up Policy and Ley Farming
By Prof. Sir George Stapledon. Pp. 170. (London: Faber and Faber, Ltd., 1939.) 2*s.* 6*d.* net.

THE alternate husbandry system of farming has been widely practised in the parts of Britain with high and well-distributed rainfall for many years, but its spread to the more southerly parts f the country has been very slow. Until wild white clover seed and basic slag became available in sufficient quantity and at reasonable prices ley farming was not, in fact, suitable for the drier districts, because of the slow establishment of he leys; it must be remembered that it is only during the last twenty years that these commodities have become readily available. There have been many advocates in recent years for the wider spread of alternate husbandry; but the leader in this campaign has undoubtedly been Sir George Stapledon. Now that the movement has suddenly eceived the great stimulus of the Government subsidy for ploughing up pasture and derelict land, t is only fitting that he should issue a statement of the case for ley farming and a description of the methods necessary for success. This book covers the ground admirably, for not only are the wider aspects discussed but also details of manuring and cultivating, seed mixtures and seed production, even rabbits and moles and all the new problems which present themselves to the farmer adopting alternate husbandry.

Great emphasis is placed throughout the book on the building up of fertility. This indeed may be said to be the central thesis, and it makes the work especially valuable as a corrective to ideas very generally prevalent. The Government subsidy s clearly an emergency measure, designed to render a greater area fit to carry arable crops if the need should arise; the object is to persuade the farmer to take the first step towards cashing the fertility which may be stored up in land which has not carried arable crops for seven years or more. If the land has been under good grass, including a due amount of clover, and has been sufficiently grazed over a long period it will certainly be in a fertile condition; but much of the area that will be broken up is in a semi-derelict state and is in no form to produce good arable crops. It may be that Sir George Stapledon has devoted less of his book to the former class than its area merits, but most writers and speakers do the reverse, so that this work will do much to restore balance to the general view of the problem. Sir George Stapledon is an unrivalled authority on the farming of the poorest types of land, and he looks further ahead than the immediate future; he does not think so much of producing human food from accumulated reserves (which may not exist) as of the steady improvement of the land. Thus he does not urge the immediate growing of corn on poor land, but the sowing of short leys, including crucifers as well as grasses and clovers; he insists particularly on the value of Italian rye grass for grazing in the early stages of improvement.

It might be thought that the plough-up policy will find its greatest scope in the grassland districts, but there the equipment and knowledge for arable cultivation are sadly lacking: in the drier, eastern half of the country facilities already exist and a wide extension of ley farming may be expected. Most of Sir George Stapledon's work has been done in the west and some modification of methods may be desirable in the east. Aberystwyth has achieved great fame by its breeding of new strains of grasses and clovers; but the suitability of all these strains for drier conditions has not yet been adequately tested. The seeds mixtures recommended in this book, however, do not consist solely of the new Aberystwyth strains, the general advice being to blend them with the cheaper commercial strains. Where there is adequate rainfall the sowing of long leys on bare ground, rather than under a cover crop, is sound practice, convincingly demonstrated by wonderful examples of new leys at Cahn Hill and elsewhere; a luxuriant growth of leafy herbage is obtained in the first summer and it cannot be said that a year has been lost. But in a droughty summer, such as is common in the east of the country, there is very poor growth during the first summer, and lack of ground-cover invites the ingress of weeds. Uncertain rainfall makes it difficult to plan grazing far ahead and in drier districts there seems little future for special purpose leys, as recommended in this book; that greater efficiency can be got from them cannot be denied, but extreme variation in growth from year to year will probably make most farmers aim for a good all-round pasture, suitable for hay or for grazing at various times of the year as the exigencies of the moment may require.

It seems incredible that a book containing so much valuable material and one so stimulating can have been written and published in the short time since the Government subsidy for ploughing-up was announced; despite the rush in which the work must have been done there are very few ambiguities or misprints and the style is Sir George Stapledon's usual clear and bracing one. In his preface he promises his readers a "proper book" on ley farming, written at his leisure; that will be eagerly awaited, but meanwhile the prese book will prove extremely valuable. It very easy to read, definitely practical throug out, and has appeared at a most opportu moment.

THE LEADER TO PERFECT HEALTH

The Englishman's Food
A History of Five Centuries of English Diet. By Prof. J. C. Drummond and Anne Wilbraham. Pp. 574+16 plates. (London: Jonathan Cape, Ltd., 1939.) 12*s*. 6*d*. net.

DIET is neither frivolous knowledge nor a curious science; it is the leader to perfect health. So, in similar words, wrote Thomas Muffett in 1655; the sentiments are as true to-day as then, when at long last the subject of diet is beginning to be understood.

A picture of the changing character of the English diet during the past five centuries against a background of social and economic history would have been of absorbing interest if compiled by a mere historian. It gains greatly in definition and is much enhanced in its educative value when the author, or one of them, is among the most knowledgeable experts of the modern school of dietetics, so that the reader is assured of higher criticism of an unusual degree of scientific accuracy interspersed among the historical facts on almost every page.

All through history and in all lands the rich have eaten too much and the poor too little. In the light of modern knowledge what matters most is whether that food has been of the right kind to combat disease, and perhaps it is from this point of view that the book is most interesting. It is divided into five periods, covering Tudor England and the four subsequent centuries: for each of these there is information relating to the meals of the people, to their health, with special reference to scurvy and rickets and to other pertinent matters.

In Tudor times, according to foreign visitors, the Englishman of every class fed better than his counterpart on the Continent. The peasants suffered badly when harvests failed, but in good years they were well nourished.

In the seventeenth century, men who had made fortunes out of trading ventures, in particular the East India Company, invested in land, and farming became a national concern. Previously the profits of the wool trade had been so tempting that even arable land had been sacrificed to grazing, bringin about a local shortage of corn; but now throug out the century the acreage under corn steadil increased, bringing down the price to 27*s*. a quart so that bread was cheap, though there were, course, disturbing fluctuations in times of ba harvest.

Farmers began to grow turnips and learnt ho to store them during the winter packed in dry so or sand. About 1664 an effort was made to encourage the cultivation of potatoes, which ha already become so popular in Ireland and wer rapidly forming the staple food of the peasantr Fellows of the Royal Society were asked to plan the tubers in order to have a cheap food available fc the necessitous poor. The art of gardening developed rapidly in England, and fruit and vegetable became available in greater variety and quantit as witnessed by Evelyn's Diary. Very little progress was made in meat production, and much the stock was slaughtered on the approach winter.

In the eighteenth century, the rapid growth the towns brought new problems partly connecte with transport over bad roads, and it was not unt canals were constructed in the latter half of th century that the problem was eased. Foodstuf were required on a scale larger than they coul be brought to the towns and there was a marke deterioration in the quality, particularly in thos likely to be bought by the poorer people. Th trade in food began to be commercialized. Th public demand for a white bread led to the additio of alum to flour and other grosser forms of adulteration. Meat came slowly to the towns, being sol from fair to fair and coming on foot even all th way from Anglesey to London. Before sale, cattl were kept in the vicinity of London and fattene for the city markets. Much of the meat wa tainted: young people were warned by D Truster to refrain from "smelling to the mea whilst on the fork". Fish and poultry also cam on the market.

England was opulent during the first half of th century and a rise in the standard of living of th working people was favoured both by the cheapnes food and the appearance of cheap fabrics, andles and other products of new industries within e reach of their purses. The picture changed on after the accession of George III; there was disastrous sequence of bad harvests from 1764 ntil 1775 and the wars with America and France nded to keep prices high.

In the nineteenth century, the conditions orsened so far as the poor man was concerned. the towns, during the first half of the century, e greater part of the nourishment came from read, potatoes and strong tea. The consumption f tea was ever increasing and was nearly 4 lb. er head in 1871. The drinking of large quantities f hot fluid tended to reduce the intake of other ore nutritious foods—a glass of cold beer would ave contained far more real food. There is a imilar problem in Norway to-day, where large uantities of hot 'black' coffee are drunk, so educing the consumption of milk.

In the rich man's house the same period witessed the growth in popularity of the typical nglish breakfast which has lasted a century, hough there are signs that it is to-day being bandoned.

The nineteenth century also saw a deterioration n physique—at least this is the grim heading of hapter 22. The decline in breast-feeding of hildren, the prevalence of rickets, bad teeth, and bove all the displacement of grinding corn etween stones by roller mills, all had their effect. The intake of vitamin B dropped to one third of what it had been and there was widespread deficiency in other vitamins. In the authors' words, "the opening of the 20th Century saw malnutrition more rife in England than it had been since the great dearths of medieval and Tudor imes".

The few reformers, chief among whom was Seebohm Rowntree, found it difficult to awake the public conscience, and it was not until it was discovered during recruiting for the South African War, and still more during the Great War, how very large a percentage of would-be recruits was below the standard, that alarm was aroused. Even then other conditions were blamed in preference to defective diet. The discovery of the vitamins and the realization of their importance in the dietary gave an entirely new aspect to the science and practice of food and nutrition.

One of the chief post-War changes has been a general increase in the standard of living and a change from cereals to meat, milk, fruit and vegetables. The consumption of fruit and vegetables has nearly doubled, that of bread has halved. Latterly, progress has gone apace though there is still all to do: that it has been effective is demonstrated by the figures, announced at the time of writing, relating to the youths of 20–21 called up for the militia. The number of those in the lower categories is barely 10 per cent and some 20,000 more have been passed than was anticipated.

Generally speaking, Britain is becoming food conscious though not to the extent that prevails across the Atlantic. She owes much to her American cousins for what they are teaching her in this respect—indeed they have saved her from the somewhat tardy action of the medical profession.

This brief survey indicates the theme which runs through the book—it is elaborated at every turn with all kinds of information, and it would be possible to abstract from it the story of rickets or milk or other subject.

The book is stimulating beyond words; any reader of it must surely become a disciple for the cause of better feeding of our people. It is partly no doubt a question of poverty, but by no means entirely so.

Whilst much can and must be done by feeding school children, there is even more to be achieved by education. Probably, as a whole, the English are still the worst cooks and the most improvident housekeepers in Europe—a French working-class family was formerly said to be able to live on what its opposite number in England wasted, and there is still much truth in the gibe. The public must be made to realize that their health depends on their food and the way it is cooked and that health should have first call on the scanty pennies, even before the cinema or the football pools, on which ten million people spent £50 million pounds last year.

The man of science has shown a sad lack of imagination in his nomenclature of the vitamins. The use of A, B, C, D, E, etc., conveys nothing to the man in the street, who cannot possibly be expected to memorize their functions. They might at least be given names which indicate that they are antiscorbutic or antirickotic or provirility or something else. Their appreciation by the public is being retarded by the inability to talk about them by appropriate names. Our literary friends must cease their smiles at our impotence and come to our assistance—a nation which finds names for its racehorses should not be defeated by a few vitamins.

Drummond and Wilbraham will be widely read; it would be good for the nation if its sale exceeded that of the most popular novel. It should stimulate the body scientific to more work. We ought to know a lot more about the inner make-up of our foodstuffs—such as the difference between flesh, fish and fowl, the distribution of inorganics, on the chemical side; or the result of various deficiency factors on the biological side.

E. F. ARMSTRONG.

MAGNETIC OBSERVATIONS OF SUNSPOTS

Magnetic Observations of Sunspots, 1917-1924
By George E. Hale and Seth B. Nicholson. Part 1. Pp. iii + 91 + 8 plates. Part 2. Pp. ii + 692. (Papers of the Mount Wilson Observatory, Vol. 5, Parts 1 and 2.) (Washington, D.C.: Carnegie Institution (Publication No. 498), 1938.) 10 dollars.

IN these two volumes the late Dr. G. E. Hale and his colleague Dr. S. B. Nicholson give a connected account of the instrumental developments, and the observations, that proved the existence of strong local magnetic fields at the sun's surface. This account occupies fifty-seven pages of volume I. The remaining thirty-four pages contain tables giving the daily classification of every sunspot group observed at Mount Wilson from January 1, 1917, to January 1, 1925, and the maximum magnetic field-strength observed in each group. The second volume reproduces the Mount Wilson daily sketches of the sun's surface, showing the sunspot groups with their various members, and indicating the polarity and the approximate magnetic field-strength of these members. An examination of these sketches cannot but impress the reader with the wealth of results on sunspot magnetic fields that Hale and his fellow-workers have accumulated; they form a rich mine for theorists in solar physics, whose task in this field is, as yet, scarcely begun.

The general account of the work begins with a brief description of the state of solar observation, and of opinion on sunspots, in the eighteen-eighties, and of the successive steps that led Hale to develop the spectroheliograph and the tower telescope as a means of gathering something of "the rich harvest" which "lay open to the spectroscopist who would apply high dispersion to a study, not merely of sunlight, but of the light of isolated features of the sun's surface, such as sunspots". The foundation of the Mount Wilson Observatory gave him his opportunity to build first the 60-ft., and then the 150-ft. tower telescope, associated with auxiliary apparatus of the finest quality. The discovery by Hale and Ellerman of hydrogen vortices over sunspots impelled Hale to suggest, in 1908, that such vortices might be associated with electric currents, which would produce magnetic fields; he described how, by studying the polarization of the light, the Zeeman effect on the spectral lines of light from sunspots might be investigated, and announced his intention to make such observations.

Supported by laboratory investigations on the Zeeman effect, Hale's observations of the Zeem effect in sunspots were brilliantly successful: so a regular daily routine of magnetic observatio on sunspots was developed. The magnetic intensi and the direction of the magnetic lines of forc over different parts of spots and in the surroundi area, were determined. The first great discove was that sunspot groups usually consist of tw members, single or multiple, of opposite magnet polarity; "only about 15% of all groups observe fail to show at least a tendency towards bipol structure". At any one time (except near sunsp minimum) the polarity of all the leading spots bipolar groups in the northern hemisphere of th sun is in general the same, and opposite to th polarity of the leading spots in the souther hemisphere.

In 1913, at the first sunspot minimum after th observations had begun, came a second great an much more astonishing discovery: the system polarities of the spot-groups of the new cycle wa opposite to that of the spot-groups previousl observed: some error was suspected, but th scores of checks applied did not shake the validit of the evidence, and the reversal of polarity wa afterwards observed again in 1923 and 1933. Thi showed that the "old" sunspot cycle of abou eleven years is only half of the true 22-yea "magnetic sunspot cycle".

The magnetic field-strength was found to var roughly in proportion to the area of the sunspot from a maximum of about 4,000 gausses to value of the order 100 gausses in the smallest spot observable with present instruments. The field strength decreases, on the average, from a max mum at the centre of the umbra of a spot to a ver small value at points not far outside the oute boundary of the penumbra; at the spot-centr the lines of force are approximately radial, an thence they decline more and more until at th edge of the penumbra their inclination to the sun' surface is only 25° or less.

The authors conclude their general discussio with the following words: "Although man theoretical investigations of the internal state o stars like the sun have been made, including tw important papers by Emden and Bjerknes tha call for the existence of very different types o vortex phenomena, much time may elapse befor a satisfactory rational explanation of the magneti effects described in this volume can be found Such an explanation must take into account th striking phenomena of the solar atmosphere show the spectroscope, the spectroheliograph, and e spectrohelioscope, as well as the minute Zeeman ects that reveal the general magnetic field of e sun. Various geophysical phenomena, in-ding magnetic storms, the aurora, and those ociated with the transmission of radio messages, are also involved. Indeed, we may reasonably hope that some of the most fundamental questions of physics, chemistry, and astronomy may be illuminated by an intensive study, both observational and theoretical, of the problems of solar magnetism."

S. CHAPMAN.

THE CHINESE PEASANT

asant Life in China
Field Study of Country Life in the Yangtze
lley. By Dr. Hsiao-Tung Fei. Pp. xxvi + 300 +
plates. (London: George Routledge and Sons,
d., 1939.) 12s. 6d. net.

"I VENTURE to foretell," says Prof. Malinowski in opening his interesting preface to this book, hat 'Peasant Life in China' by Dr. Hsiao-Tung i will be counted as a landmark in the develop-ent of anthropological field-work and theory." ter he quotes Sir Denison Ross in a statement which he defines the position of this work in ientific literature and says "I regard this treatise quite exceptional. I know of no other work ich describes at first hand and with intimate derstanding the full story of life in a Chinese llage community. We have had works dealing ith statistics, economic studies and novels full of cal colour—but in no book have I found the swer to every enquiry, which the curious ranger might make". Commendation could not ll go further. These authorities, each selecting mention a quality and aspect of this piece of ld-work, which offers to him a special appeal, phasizes its two-fold interest for the reader. On e side the book is a first-rate study of social nditions, which though drawn from a limited ea, may be taken as applying with local modi-ations to a preponderance of the population of ina immediately before present Japanese aggres-on; on the other side it is a practical demon-ration of the contribution to be made by thropological studies in the field towards a anned approach to the solution of the problems, litical, social and administrative, which arise om cultural contacts, when Western civilization pinges on other, and in a material sense, less vanced forms of civilization.

Dr. Fei has taken as the scene of his operations aisienkung, a village south of Lake Tai in the angtze plain in eastern China. The country is a twork of canals and waterways, communications ing mainly by boat. The density of population aches the remarkable figure of 1,980 per square ile, this calculation, however, being based on nd surface only, whereas the gross density of e whole province (Kiangsu) is about 896 per square mile. The main industry is agriculture (rice cultivation) in a system in which the unit of social and economic organization is the expanded family. The returns from rice cultivation, over and above family subsistence requirements, were not adequate to meet family expenditure. They were supplemented by the production of silk as a domestic industry. The village, in fact, was in the centre of the silk-producing area of China. Unfortunately, the fall in world prices of silk has brought disaster to the industry, and the district, like many others, is face to face with the great agrarian problem of China, namely that the cultivation of the land, unsupplemented by other resources, will not support the peasant population.

Dr. Fei reviews in detail, "microscopically" as he puts it, the traditional social and economic system of this village as a working organism, and indicates the changes which have been forced upon it by disintegrating factors, both external—world economic and social conditions—and internal, due to efforts to ameliorate conditions within the village itself. Of these the most important is the endeavour to raise the standard of silk production and the institution of a village silk factory. Of the changes in custom due to the economic situation, the most striking is the curtailment, or complete cessation of all ceremonial and festive occasions over a period now of ten years duration. One result, for example, is not only the postponement of marriage to a later age, but also a modification of the character of the marriage system itself on the ground of the expense involved in the customary marriage ritual. The introduction of a co-operative factory and wages, which were previously unknown, have had a number of social repercussions, but not the least serious, both in the silk industry and in agriculture, where labour-saving methods of cultivation have been introduced, has been the creation of a class of unemployed labour, especially among the female population.

The village described by Dr. Fei has now been overwhelmed by the Japanese advance; but the author is nevertheless confident that China, as ever before, will eventually rise superior to her trials.

THE REALM OF BIOCHEMISTRY

(1) Outlines of Biochemistry: the Organic Chemistry and the Physicochemical Reactions of Biologically Important Compounds and Systems
By Prof. Ross Aiken Gortner. Second edition. Pp. xx+1017. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 30*s.* net.

(2) Organic and Bio-chemistry
By Prof. R. H. A. Plimmer. Sixth edition. Pp. x+623. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 21*s.* net.

(3) Biochemistry for Medical Students
By Dr. William Veale Thorpe. Pp. viii+457. (London: J. and A. Churchill, Ltd., 1938.) 12*s.* 6*d.*

IT is welcome to have under review at the same time three such excellent books on biochemistry dealing with different stages through which students in this science will be expected to pass.

The first two have passed the first edition, and Gortner's book is the second edition of the well-known text-book which has been brought up to date and amplified in accordance with modern needs.

The second book, by Plimmer, is the sixth edition of this well-known treatise and has also been amplified and brought up to date.

The third book is a student's text-book which has been written by a newcomer in this field, a deals with such matters as may be required the medical student.

Time was not so very long ago when biochem istry was treated as a section of physiology, a so far as science was concerned remained in relatio to organic chemistry a mass of empirical da which seemed to bear little or no relation one the other.

The books under review indicate that t physiological side of biochemistry is rapid diminishing in importance and the subject is bei based more and more strongly on organic chemist with its strictness of formulæ and diction. fact, there seems to be no hope of ever reachi any knowledge of what underlies the chemistry life unless biochemistry is approached from t pure science of organic chemistry. It is pleasa to note that in the three books under review t basis of organic chemistry is held in mind conti nuously and wherever possible the line followed that of established reason rather than of empir cism. Plimmer's book, and that by Gortner, a text-books of the science which deal in detail wit the whole subject; that by W. V. Thorpe contai a wealth of interesting detail. It restricts itself t that which the medical student requires, and t student who has acquired the knowledge containe in this book will not have laboured in vain.

J. F. T.

THE MANIPULATION OF GASES

Experimental Methods in Gas Reactions
By Dr. A. Farkas and Dr. H. W. Melville. Pp. xv+390. (London: Macmillan and Co., Ltd., 1939.) 30*s.* net.

THIS treatise will become a standard work and a necessary reference book for all physicists and chemists engaged in conducting experimental researches with gases. Its usefulness is enhanced by the fact that the authors have had actual practical experience with many of the devices and apparatus described, and are therefore well qualified to point out the limitations, defects and advantages of alternative methods of procedure. The arduous labour of collecting from scattered sources information hitherto imperfectly catalogued has resulted in a valuable contribution to science in a very practical form. The references are very numerous, the diagrams clear, and the printin especially of the formulæ, admirable. The math matical relations quoted in the text have in man cases been deduced from first principles, an theoretical questions of sufficient fundament importance have not been left unexplained.

In the preface the authors state: "The book designed mainly to give a reasonably complet account of the methods of investigating all typ of gaseous reactions together with sufficie theory, in order that there should be the minimu gap between theory and practice. While it intended that the beginner will benefit from t work, the text is arranged in such a way that may serve as a book of reference for those chemis and physicists engaged in dealing with g reactions, with high vacua, or with any investig ions where a knowledge of the preparation and handling of gases is required". They also explain hat there is no chapter on macro-gas analysis, he reason being that there are several excellent books on that subject.

The first chapter is devoted to an account of the elements of the kinetic theory of gases from he modern point of view. This happy combination of theory with practice—a characteristic of the work throughout—has very much enhanced the attractiveness of the reading. The second chapter gives an exhaustive account of apparatus for the control of pressure and temperature. It includes a description of the various types of vacuum pumps and pressure gauges, and has a section on aps, valves and lubricants. There is, however, no mention of the recent work in America and in Great Britain on phosphoric acid lubricants. This s the only omission of importance which we have found.

The third chapter deals with the preparation and analysis of gases, and includes directions for preparing the two forms of hydrogen and deuterium. The section on micro-gas analysis includes analysis by low-temperature distillation, and the estimation of *ortho-* and *para*-hydrogen, deuterium, etc. The fourth chapter, on photochemical technique, deals with absorption spectra, sources of radiation, methods of controlling radiation, light filters, and the measurement of radiation intensity.

The fifth and last chapter deals with the wide subject of experimental methods for the investigation of gas reactions. It includes explosive reactions, and optical methods of investigation, and the great variety of catalysts are described. The section on catalysts is particularly valuable in its examination of the different forms in which metallic catalysts may be used, and in its warnings on the dangers of poisoning and sintering.

Throughout the book useful guidance concerning manipulation and the construction of apparatus has been given. The authors are to be congratulated on a comprehensive and able piece of work.

D. L. C.

REGNUM ANIMALE

Caroli Linnaei Systema Naturae
A photographic Facsimile of the First Volume of the Tenth edition (1758). Regnum Animale. Pp. viii+824. (London: British Museum (Natural History), 1939.) 10*s*. 6*d*.

THE first volume of the tenth edition of Linnæus's "Systema Naturae", published in 1758, is now universally accepted by zoologists as the starting point for the application of the rule of priority in the scientific naming of animals. This particular edition was selected for the purpose because it was the first in which Linnæus consistently applied a binomial nomenclature to the species, while, on the other hand, it was the last to be published during his lifetime. It is probably safe to assume, however, that only a small minority of zoologists have ever had an opportunity of handling a copy of this somewhat rare book. Even the reprint of it published by the German Zoological Society in 1894 has long been out of print and seldom appears in catalogues of secondhand books. The Trustees of the British Museum have, therefore, rendered a service for which zoologists ought to be grateful in publishing a photographic facsimile of one of the copies in their library. The particular copy which has been used for the reproduction can be identified because care has been taken not to expunge the marginal notes and library stamps which it carries, a precaution that may prove one day to be important in the case of a work where much may turn on the spelling of a word or the position of a comma.

Even those who find the endless legal arguments as to the 'correct' names of animals little to their taste may discover much that is of interest in this old book. Linnæus, although he was much less of a zoologist than a botanist, had a broader conception of systematic zoology than we have to-day. His "Systema Naturae" was meant to be something more than a mere enumeration of species and their diagnostic characters; it was to be a summary of all that was known about them. Appended to many of the species are notes, condensed as only the Latin language can condense them, on the bionomics, ecology, distribution, and uses of the animals dealt with. For example, under "*Felis catus*" there is a delightful little paragraph giving (one imagines) a portrait of a privileged member of the family sitting by the stove in the old Linnæus house in the Botanic Garden at Uppsala, "tranquilla, ore molat, caudam erigit; excitata agillissima scandit, irata fremit . . . Murum Leo, in praedam intenta caudam movet . . . os instante tempestate manu lavat, dorsum in tenebris electrisat; in altum acta decedit in pedes" and then, when Linnæus has been kept awake at night, he writes "clamando rixandoque misere amat". But "odore ambrosiaco" must be ironical.

W. T. CALMAN.

THE ROYAL SWEDISH ACADEMY OF SCIENCE

BICENTENARY CELEBRATIONS

BY DR. J. RAMSBOTTOM, O.B.E., PRESIDENT OF THE LINNEAN SOCIETY

THE inaugural meeting of the Royal Swedish Academy of Science (Kungl. Svenska Vetenskapsakademien) took place on June 2, 1739, and the celebration of its bicentenary is to be held in Stockholm during September 23–25.

The Academy was founded mainly on the suggestion of Captain Mårten Triewald, who enlisted as supporters for a scientific academy publishing in Swedish, Jonas Alström, Baron Sten Carl Bjelke, Carl Wilhelm Cederhielm, Baron Anders Johan von Höpken and Carl Linnæus. A meeting was called at the Riddarhuset (House of Nobles) to form an "Economic Scientific Academy for the promotion of useful sciences"; the name "Swedish Academy of Science" was adopted, however, on the advice of Anders Celsius. The first president, chosen by lot, was Linnæus, then thirty-two years of age; the first secretary was von Höpken, an influential young nobleman who later filled in turn the highest offices of State. Von Höpken was responsible for drawing up the proposed statutes adopted at the inaugural meeting, and confirmed later by the King, who permitted "Royal" to be added to the title of the Academy. Linnæus was president only for the first four months and each of the original members succeeded him, sooner or later, in office. Under his presidency, thirty new members were elected, many of them men whose support he valued.

TWO OF THE STAMPS ISSUED BY THE SWEDISH POST OFFICE TO MARK THE BICENTENARY CELEBRATIONS OF THE ROYAL SWEDISH ACADEMY.

Subscriptions at first were in cash and in kind, Linnæus's presentation of a copy of his "Hortus Cliffortianus" and two Chinese books, on rice and silkworms, starting the present rich library. The printing of the *Transactions* was planned, with a device for the title-page of an old man planting a palm tree, and the inscription "För Efterkommande"; an original sketch for this is in th possession of the Linnean Society of London. O relinquishing office, Linnæus delivered a forma oration, "On Curiosities in Insects", setting a example followed by all succeeding presidents.

In 1747, the Academy was granted the privileg of publishing the Almanack and State Calendar, privilege several times renewed, and which is sti its chief source of income.

The Academy was immediately successful, an by 1746 its membership had reached one hundred a number to which the Swedish membership wa later formally limited and it was only this yea that it was agreed that in certain circumstance the number may be increased to one hundred an thirty. The prestige of the Academy led to th election of many of the most prominent men i the country, but though it was realized that muc was to be gained socially and financially by thi it was insisted upon that there should be real an active participation by all those elected. Th earliest statutes expressly ruled that if any membe "contrary to expectation" had not for two year sent in any work or done anything to promot the welfare of the Academy, such a member "bein superfluous" should, after two years, lose his sea and his vote in the deliberations. Obviously suc a rule was tricky to apply, and motions to effec it were occasionally shelved. However, five members were expelled in 1748, and 1783 saw the las of such expulsions.

Early in its history, the Academy undertook th building of an astronomical observatory for whic the city of Stockholm contributed the site and th State made a grant; the establishment wa removed to a new observatory at Saltsjöbaden ten miles south-east of Stockholm, in 1931. Peh Wilhelm Wargentin, the famous astronomer an statistician, became director of the Observatory o its completion in 1753; he had served as secretar of the Academy since 1749, and with an enormou capacity for work he was able to continue in offic until his death in 1783, having an assistant, provided from a private source, only in the last seve years.

After Wargentin's death, the Academy suffere a period of decline doubtless connected with th difficulty of finding an efficient and energeti successor. Various expedients were tried in orde to lighten the labours of the principal secretary ut it was not until the celebrated chemist Jöns akob Berzelius took on the post in 1818 that atisfactory progress was resumed.

Elections were made in the eighteenth century vithout regard to a properly balanced representaion of the different branches of learning. Different roposals were put forward to alter this, and in 1798 it was agreed to divide the members into even groups. The stated object of the Academy vas the promotion of useful sciences, and the first wo groups, National Economy and Agriculture and Trade and Commerce accounted for a quarter f the members. Berzelius with his organizing ability and broad views soon brought about hanges. In 1821 he had the two 'practical' groups ombined and the Natural Science and Medicine groups increased from four to seven with the object f making the Academy purely scientific. This lassification lasted until 1904, when a revision was ecessary owing to the task of awarding two of he Nobel prizes—the aim being to give more rominence to chemistry and physics. He also ad the rules for electing members revised. Each group had to submit "a well-thought-out and wellounded proposal" which was placed before a full meeting of the Academy. Berzelius was insistent hat it was the duty of members to keep in touch vith the progress of research, and the annual estival of the Academy (March 31) was chosen or the delivery of reports on the different branches f science. The reports during Berzelius's long enure of office were augmented and published, he imself being responsible for chemistry, and for hysics also until 1839. The series was translated nto French and German and was of the greatest mportance; but the task of preparation grew eavier, and shortly after Berzelius's death in 1848 t was found impossible to continue them. Not nly did Berzelius lay the foundation of the present onstitution of the Academy, but also by obtaining a fixed annual grant for the library and greatly xtending its exchanges insured its present minence.

Like all such national societies, the Academy ecame possessed of large museum collections, vhich gradually became too extensive for the uratorial facilities it could afford. When thereore Gustav von Paykull presented his large oological collections to the Crown in 1819, and he King entrusted their care to the Academy, he Academy presented its own zoological colections to the State. Thus began the Naturistoriska Riksmuseum which, though a national useum, is under the supervision of the Academy. n 1841 the botanical, mineralogical and ethnoraphical collections were also transferred to the useum. Recently the last-named have been eparated off as an independent institution—Statens etnografiska museum—which, however, is still supervised by the Academy.

A bequest by P. J. Bergius in 1790 of his estate of Bergielund just outside Stockholm for the purpose of establishing there a model botanical garden scarcely achieved its object because of lack of funds for ninety years or so. Then owing to the growth of Stockholm the area was included within the city boundaries with a consequent increase in value; the eighteen acres were sold and a site of more than sixty acres purchased about a mile north of the city and the present Bergian Garden established together with a School of Gardening. The president of the Academy for 1939–40, Prof. Robert E. Fries, is director of the Botanic Garden.

Among other institutions administered by the Academy are the Nobel Institute for Physical Chemistry set up in 1905 with S. A. Arrhenius as director until his death in 1927; this was replaced in 1933 by the Nobel Institute for Theoretical Physics with C. W. Oseen as director: the Kristineberg Marine Zoological Station, the Mittag-Leffler Foundation for Mathematics, the Physical Institute, the Abisko Natural Science Station and the Committee for the Protection of Nature.

The Academy usually meets twice monthly, except in summer, at Novra Djurgården, a district which is commonly known as Vetenskapsstaden (Science City) and which may be compared in some ways with South Kensington. The annual festival is traditionally held in the Riddarhuset, and is usually attended by members of the Royal Family.

To mark the celebrations, the Swedish Post Office has issued four special stamps, two with a portrait of Linnæus and two with that of Berzelius—one of each is illustrated here. The portrait of Linnæus is apparently taken from the Academy's painting by Roslin and that of Berzelius from the one by Södermark.

The preliminary programme announces that the delegates and guests will meet on Saturday afternoon, September 23, at the Academy building and afterwards visit the institutions at Vetenskapsstaden. In the evening there will be an informal dinner. On Sunday afternoon, the bicentenary festival will be held in the Stockholm Concert Hall in the presence of H.M. the King and other members of the Royal Family. In the evening there will be a banquet in the Stockholm Town Hall. On Monday the Stockholm Observatory at Saltsjöbaden will be visited, tea will be taken at the Royal Palace and in the evening there will be a gala performance at the Royal Opera House.

Delegates have been sent a pamphlet on the history of the Academy prepared by Dr. Arne Holmberg, the Academy's librarian. I have had free use of this in compiling the above account.

THE WYPERFELD (MALLEE) NATIONAL PARK, VICTORIA

By Sir James Barrett, C.B., C.M.G.

THE Wyperfeld National Park is situated about 300 miles north of Melbourne in the midst of the country known as the Mallee, which occupies about one fifth of the area of the State of Victoria. The soil of the Mallee varies greatly; but much of it, when cleared of the Mallee eucalypts, has proved excellent wheat country. The clearance was due to the invention of the stump jump plough and the roller. It varies greatly in quality, being in some places almost entirely sandy and in others fertile red soil. All of it is very liable to wind erosion, unless special precautions are taken to preserve both belts of eucalypts and some surface vegetation, and so far these precautions have not been taken in general.

At some geological period the whole of the area appears to have been a gulf of the sea into which such rivers as the Murray, the Murrumbidgee, the Goulburn and other Victorian rivers poured their waters, carrying with them silt from the Alps. This gulf has been filled up. The rivers have for the most part fallen to small proportion or are actually dying. I am informed that bores put down go through 200 feet of lake deposit before the marine deposits are reached.

The Wimmera River, once a large stream, running north from the Grampians, enters at Jeparit a large lake called Hindmarsh and then another—Lake Albacutya—and finally passes nort for many miles through the Park itself and lose itself in sandy country. It has flowed in this wa usually about once in fifteen to twenty years. saw it in 1922–23 when the water for a year o two covered the lower 12 feet of the giant eucalypt on the river bed; it gradually evaporated an became saline and then dried altogether. At th present time the only available water is from on well provided with a windmill which, so far, ha given a good supply.

The large eucalypts are found only in or near th river bed. The annual rainfall, which is capriciou is something less than 9 inches and the evaporatio is enormous. There are quite a number of ope spaces with good soil well grassed but flooded whe the river resumes control. It is on these areas tha the cattle, the emu and the kangaroo feed in th main but not exclusively. The sandhills ar enormous, but I have not seen any evidence of an considerable movement.

The biological interest of this arid region o 82,000 acres is the fact that it is well stocked wit animals which, since its reservation and with protection, have greatly increased. The black-face kangaroo, found only in the Mallee, is abundant emus are plentiful but constantly shift from plac to place. It is probably in Victoria the last hom of that wonderful bird—th mound builder, called the lowar which incubates its eggs in th vegetative centre of mound which it builds and which in on case I measured was 18 ft. in diameter and 4 ft. high (Fig. 2 The parents evidently watch th mounds but, after hatching, th young birds fend for themselve With protection they have increased in numbers and in thei fearlessness of man.

But the major interest whic led to the reservation was th fact that it is the home of vas numbers of the parrot and cockatoo family, which apparentl nest in the large eucalypts an feed in the desert away fro the river. The Regent parr and the Major Mitchell cock too, the disappearance of whic

FIG. 1.

WYPERFELD FROM ONE OF THE HIGHER SANDHILLS. *Eucalyptus rostrata* ON A FLAT NEAR THE DRIED-UP WATERCOURSES.

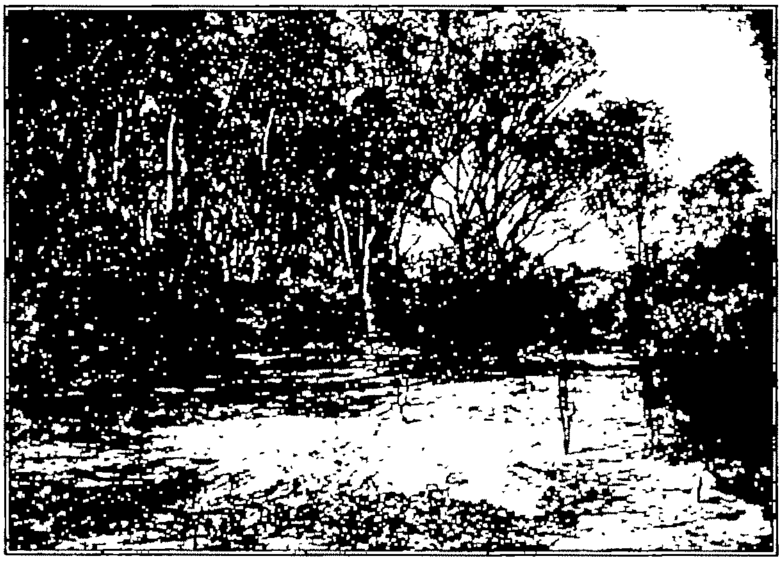


Fig. 2.

Eucalyptus rostratus WOOD WITH *Acacia* IN BACKGROUND AND LOWAN'S NEST IN FOREGROUND.

as feared, have become bundant.

The birds drink at the trough rovided at the well, but so far o one has seen the kangaroos t this source; yet a tame angaroo I have in Melbourne lrinks greedily. Precisely how hey obtain sufficient water in he Park is, so far, unknown to s.

Of reptiles there are only the tumpy tailed lizards, a few tree-limbing lizards, but rarely a nake.

I may add that during the ecent heat burst, the temperaure to the north of the Park eached 119° F. Many magpies lied, a few parrots were lost, but he kangaroos, though exhausted nd collapsed, managed to survive.

The Park is leased to a cattle grazier at a low ental, but in return he acts as curator and is well nformed of the habits of its inhabitants. A clause n the lease provides that if a fire occurs in the Park his lease may be cancelled. So far no fire has occurred, but during the recent disaster a fire outside the Park was just stopped on the boundary.

The profound interest of the Park lies in the act that in the arid though very beautiful reserve he animals have adapted themselves to these dry onditions and show no desire to leave it. It hould be added that no complete or adequate biological survey has yet been made. There are ndications that some of the smaller marsupials may be found. Such a survey can only be made by esidence in the Park and a careful search made, specially at night, with a powerful searchlight.

We are indebted to three Ministers of Land for the reservation, which was not easy to secure, namely, the late Mr. Owan, Mr. Bailey and the present Minister, Mr. Lind.

BOTANICAL CHARACTERISTICS

By Prof. J. S. Turner, University of Melbourne

The Park, so far as it has been investigated, seems to be composed of two distinct types of vegetation, each with its own soil environment. First, there is the vegetation along the outlet creek from Lake Hindmarsh. Along this creek is a chain of lakes, usually empty, of which Brambruk is one within the Park itself. Along these dried-up water courses there are two eucalyptus communities: 1) the red gum, *E. rostrata*, which is the more moisture-loving of the two; (2) the black box, *E. bicolor*. The forests formed of these trees are very open and the floor is grassed. Both communities are found elsewhere in Victoria.

The second main type of vegetation is of greater interest and constitutes what is locally known as 'desert'. It is made up of wind-blown sandhills of comparatively recent origin but not, at present, mobile. These sandhills are entirely distinct from the sand ridges found in the settled regions of the Mallee. In these more settled parts, the original vegetation was largely the Mallee eucalypts, but in the 'desert' these trees are much less frequent.

In spite of the inhospitable character of the sandhills and the very low rainfall, the 'desert' area carries a large number of typical Australian plants. The family Myrtaceæ is represented by Eucalyptus, Leprospermum and Melaleuca; Leguminosæ by Acacia; Proteaceæ by Hakea and Banksia; Epacridaceæ by Leucopogon and Astroloma; Casuarineæ by Casuarina; and Coniferæ by Callitris.

The sandhills are frequently capped by species of Callitris, *C. verrucosa* being probably the commonest. These pines are, however, dwarfed, and the sandhills cannot be compared to the pine ridges in other parts of the Mallee. Below the pines occur a large number of tall shrubs and small trees; for example, *Leptospermum coriaceum*, *Banksia ornata*, *Casuarina Muelleriana*, which last species has a restricted range but is abundant in the Park.

Acacia spinescens is a very spinous shrub. *Astroloma conostephioides* has conspicuous brilliant red flowers. The two genera Pimelea and Hibbertia, which are very widespread in Victoria, are both represented here by very handsome species, *P. stricta* and *H. virgata*. These two species differ from most of those in the Park, in that their leaves are not sclerophyllous. The vegetation does not nearly form a complete cover on the sandhills, but it is sufficient to prevent wind erosion.

As in deserts in other parts of the world, this area bears a large number of minute annuals with a very short life-cycle. The number of these species in Wyperfeld will probably be found to be very large. The family Compositæ is particularly well represented. *Toranthus Muelleri*, *Brachycome pachyptera* and *Gnaphalodes uliginosum* are all extremely minute annuals found in the Park. Most of these species spend a dry season as seeds and pass through their short life-cycles soon after periods of heavy rain, and they are consequently easily missed by investigators of the flora.

GEOLOGICAL CHARACTERISTICS

By Dr. E. S. Hills, University of Melbourne

The rocks of the Mallee are marine, estuarine, fluviatile and lacustrine sediments laid down in and near the margins of a former marine gulf during Cainozoic times. This marine bight, which has been named the Murray Gulf, came into existence in Oligocene times, and from then on to the end of the Pleistocene it was gradually filled with clays, limestones, marls and sands. The thickness of these ranges up to a total of more than 2,000 ft. and they rest upon a depressed basement of older rocks, chiefly Palæozoic granites, schists, sandstones and conglomerates, which have been penetrated in bores. The limestones, which are Miocene age, are overlain by impervious clays the Mallee, and are important aquifers for artesi and subartesian water.

The superficial deposits are sands, gypsum a local freshwater ostracodal limestones, of fluviati and lacustrine origin. The sandy soils deriv from these deposits have been heaped by the wi into long regular sand ridges, trending east-we with areas of irregularly arranged 'Jumbled' san hills in places. In their virgin state, these sa ridges are fixed by a cover of vegetation, but whe this has been cleared, extensive sand drift has sin taken place. There is evidence that the regul sand ridges, which have been formed under t action of the dominant westerly and north-wester winds, have grown in stages. Buried soil horizo of 'travertine' limestone indicate that periods relatively high rainfall have alternated with dri periods. The present (or immediate past) tin appears to be a relatively wet period.

Apart from the minor undulations due to t sand ridges, the surface of the Mallee exhibi broad ridges and troughs, some miles in widt the trend of which varies from north to nort west. These are of tectonic origin, reflecti buried faults or warps in the underlying bas ment complex. Uplift across the lower course the Murray resulted in the formation of lake which have now been trained, and in these a other old lake basins extensive deposits of gy sum, locally known as copi, were laid dow These now constitute an important source of th mineral.

OBITUARIES

Dr. W. J. Mayo

TO the surgeon, and especially to the surgeon in the United States of America, the death of Dr. W. J. Mayo on July 28 at the age of seventy-eight years is a major historical event. Born in 1861, in the State of Minnesota, he spent his life and did his work in the small country town of Rochester; and there with his brother Charles, who died two months ago (see NATURE of July 15, p. 103), he built up the Mayo Clinic the expansion of which has been very great. In early life he conceived the idea that patients could best be treated by groups of medical men among whom could be found specialists in every disorder. This idea was revolutionary at the time; and although in operation it may best be suited to American conditions, not only did it underly the practical success of the Mayo Clinic, but it has also influenced wider opinion because medical men from all over the world were attracted to the experiment. In Rochester was to be found an organization almost fanatically devoted to t interest of the patient, to the exclusion both financial considerations and of personal profession renown. For from the beginning of the clinic pa of its profits were set aside to be devoted to researc not only in clinical subjects and the fundament clinical sciences, but also in such related sciences chemistry and physics. The two brothers and the early collaborators deliberately sacrificed wealth and chose to regard as their reward the knowled that their Institution was making substantial co tributions to medical progress. As funds accumulate they were to expand their efforts, always governe by the same general principles, to postgradua education; and their system of training young me broadly and encouraging specialization only after sound basic experience has been watched wit interest by the medical academic world, and h frequently been utilized by medical schools both i America and in Europe; for one of the man xcellences of the clinic has been its readiness to xpound its technical methods and the results obtained by them to visitors of any nationality. There is no doubt that the inception and later the guidance of this great experiment in group practice were controlled by Dr. Mayo; and the success which has attended his aims stamps him as a man of singular vision, broad outlook, indomitable perseverance, possessed of administrative powers of the highest order.

In the practice of his craft, Dr. Mayo was in the first rank. His personality and sincerity at once gained and ever afterwards retained the confidence of his patients; as an operator he could be cautious or bold as the occasion demanded, and with his enormous experience and thought for individual patients those who worked with him came to rely mplicitly on his surgical judgment. His chief nterests lay in the surgery of the alimentary and biliary tracts, and to these he made many substantial contributions. He was sedulous in promoting the advancement of surgery in the United States, and to this end interested himself actively in the founding and governing of the American College of Surgeons and the American Surgical Association. This disnterested devotion to surgery was honoured by earned bodies all over the world.

As must men whose energies are devoted to the control of great enterprises, he kept himself somewhat apart. But he was a warmhearted and generous helper of his juniors, for he knew better than most, and lived to see himself right, that to justify his conceptions the organization which he built, almost with his own hands must live on after he relinquished active control.

J. R. LEARMONTH.

Prof. R. W. Reid

PROF. ROBERT W. REID, emeritus regius professor of anatomy in the University of Aberdeen, the Nestor among British anatomists, died in Aberdeen on July 28, aged eighty-eight years. He was born in the manse of Auchindoir, Aberdeenshire, in 1851, and after graduating in medicine in the University of Aberdeen, became demonstrator of anatomy in St. Thomas's Hospital, London, in 1873, being almost the first medical man to be attached to a London hospital as anatomist. In 1889, he succeeded Sir John Struthers as professor of anatomy in the University of Aberdeen. He held this chair for thirty-six years, retiring in 1925.

Reid was the sole survivor of the anatomists who founded the Anatomical Society in 1887; he became president of the Society in 1910. He was elected a fellow of the Royal Anthropological Institute in 1886. His first important contribution to anatomy was entitled "Observations on the Relation of the Principal Fissures and Convolutions of the Cerebrum to the Outer Surface of the Scalp"; this appeared in the *Lancet* of September 27, 1884, and it contains a description of a base line—spoken of to-day as "Reid's Base Line". Two other important papers on topographical anatomy were published by him in the *Journal of Anatomy*—one on the relationship of nerve roots to vertebral markings; the other on the position of the chief nerve trunks.

Soon after being appointed to Aberdeen, he established in connexion with his department an anthropological bureau to register the physical characters of the students who entered and to keep a record of their growth changes. Reports from the valuable data thus collected have appeared in the *Journal of the Royal Anthropological Institute*. Records are still being kept, and no doubt will provide the material for further papers dealing with the anthropology of the Scottish student. Another great service he rendered to the prehistory of Scotland by the preservation and study of the remains of the strange people who first appeared in Aberdeenshire early in the second millennium B.C. His own physical features were so similar to theirs that one had reason to regard him as a descendant of these early Bronze Age settlers in the north-east part of Scotland. The Anthropological Museum of the University of Aberdeen, in which these unique specimens are preserved, owes more to Prof. Reid than the "Illustrated Catalogue of Specimens from Prehistoric Interments found in the North East of Scotland" which he wrote in 1924. In acknowledgment of what he did for this Museum and for the University, his friends and pupils endowed a lectureship in connexion with it—known as the Reid Lectureship. He was the moving spirit and the purse-bearer—that brought into existence the Anatomical and Anthropological Society of the University of Aberdeen. In person he was retiring, almost morbidly modest, charitable and very hospitable.

Dr. W. A. Potts

DR. WILLIAM ALEXANDER POTTS, who died on July 23 in Birmingham at the age of seventy-three years, was a familiar figure to those interested in psychological medicine and latterly also to those interested in criminology.

Potts started his scientific career at the East Riding Mental Hospital, Beverley, but left this branch of work to go into general practice, where he remained for fully twenty years. After this he became medical adviser to the Birmingham Mental Deficiency Committee and so his more scientific side became concentrated on the mentally defective. Since 1919 he had been very helpful in an advisory capacity to the police courts in Birmingham, particularly when they were dealing with cases of mental deficiency. He was also medical adviser to the Barr Park Colony and consultant to the Royal Albert Institution. He was chairman of the Special Schools After-Care Committee in Birmingham. He carried out a considerable amount of work lecturing and teaching, and collaborated with Shuttleworth in his "Mentally Deficient Children".

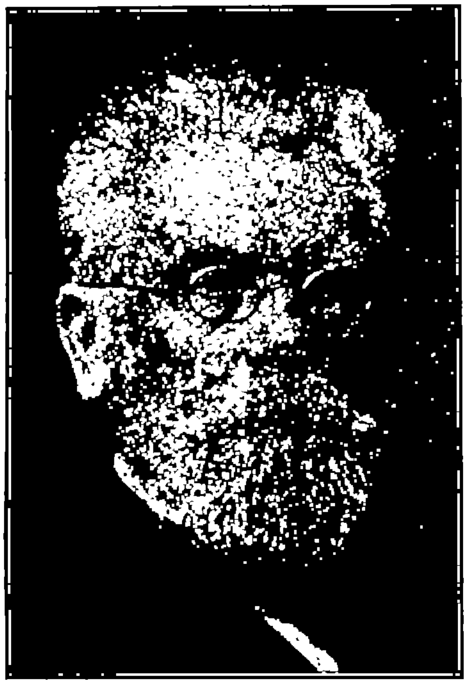
He was a most charming personality and always had a ready smile and a helping hand for the young man.

WE regret to announce the death of Mr. H. P. Hollis, a former president of the British Astronomical Association, on August 7, aged eighty-one years.

NEWS AND VIEWS

Prof. F. Vejdovský

DESPITE the disturbed political situation and international tension, Czech men of science and their friends intend, if possible, to celebrate next October the ninetieth birthday of one of Bohemia's most distinguished living sons, Prof. František Vejdovský, who was born on October 24, 1849. After studying at the Charles University of Prague, and already as a young man winning fame as a zoologist, he was elected professor of zoology, comparative anatomy and embryology in the Charles University in 1892, retiring as professor emeritus in 1921. During his long life, Vejdovský has not only been very active as a teacher and leader among Czech zoologists, he has also, by his own researches and those of his numerous pupils, contributed largely to the advancement of many different branches of zoology. His own work covers a very wide field, but it has dealt mainly with the morphology, development and systematics of various Invertebrata, and with cytology—especially spermatogenesis, fertilization and problems connected with the centrosome and the chromosomes. On these and other matters he has published some ten large treatises, and more than a hundred other memoirs in Czech, English, American, French and German periodicals.



PROF. F. VEJDOVSKÝ

IN his own country, Prof. Vejdovský has long been held in the highest esteem, and his accomplishments and his personal kindliness have endeared him to a wide circle of friends and correspondents abroad. Few men attain the age of ninety years, and fewe still can look back upon so long a lifetime spent i the wholehearted pursuit of science for its own sake Prof. Vejdovský has lived through the classica periods, of Darwinism and Mendelism, and ha actually seen the rise of modern cytology—to whi he contributed an honourable share—and he ha hitherto survived the prolonged ordeals which hi nation has suffered during this century. All tru men of science everywhere must therefore offer hi respectful congratulations on his approaching birthday, and wish him and his people that peace and future happiness which, by their steadfast devotion to science and civilization, they so richly deserve.

Petrus Camper, F.R.S. (1722-1789)

THE fifteenth volume of the *Opuscula Selecta Neerlandicorum de Arte Medica*, which has recently been published under the able editorship of Dr. B. W. T. Nuyens, of Amsterdam, contains the illustrated travel diaries in Dutch and English of the three visits to England made by Petrus Camper, who was not only one of the most eminent Dutch medical men in the second half of the eighteenth century, but was also a botanist, zoologist, mineralogist, palæontologist and draughtsman of distinction. The first visit, in 1749, three years after his qualification, was chiefly undertaken for the purpose of attending the lectures of William Smellie, the father of British gynæcology, and of taking lessons in drawing at the Royal Academy. During his stay in Great Britain he made the acquaintance of many of the leading scientific men of the day, including Sir Hans Sloane, Sir Joseph Banks, F. W. Herschel, John and William Hunter, John Smeaton, Mead and Cheselden. He attended the meetings of the Royal Society, of which he was made a fellow in 1750, visited the hospitals and museums and showed the keenest interest in contemporary scientific novelties. He did not confine his attention to London, but visited Oxford, Cambridge, Bath, Bristol and Birmingham, where he made the acquaintance of Withering and James Watt. In the next two visits which he paid in 1752, when he was professor at Franeker, and in 1785, a few years before his death, his energy and enthusiasm still appeared to be unabated, and his time was profitably spent in a congenial scientific atmosphere.

New Technical Branch for the Royal Air Force

OFFICIAL confirmation was given recently of a decision to form a separate technical specialist branch of the Royal Air Force. It has become increasingly obvious that, owing to the technical complexity of the problems relating to service aircraft and their equipment, it is necessary to allocate personnel to engineering and technical duties, allowing them to devote their whole time to such work and arranging various courses of training for them. Up to the present, the policy of the Royal Air Force has always been that all officers must enter the "General Duties Branch", and devote their time to a complete training in flying for, at least, many years of their time as junior officers. Later they can express a wish to take up specialization in technical work, but they are still required to maintain proficiency in flying. Thus the process of becoming a technical specialist is a slow one, and in a service in which the retiring age is, possibly necessarily, set fairly early, as flying is primarily a young man's job, the officer choosing these branches always finds himself at a disadvantage, either for promotion within the service, or in respect of his ability to obtain employment in the technical side of aviation upon retirement. Also the break in continuity of training and accumulation of experience is usually considered to be unwise, and many young engineers, both from the universities and works apprenticeships, have undoubtedly been deterred from entering the Royal Air Force by this reason.

In spite of the enthusiastic membership of the university air squadrons the number of technical graduates offering themselves for University Commissions in the Royal Air Force has always been relatively small. The new branch should remove these disadvantages. Entrants for commissions are now offered direct entry into technical work, without having to spend several years in acquiring proficiency in flying. They are to be recruited from university graduates in engineering or natural science, and student apprentices from works who have acquired theoretical knowledge up to a university degree standard. The retiring age limit may well now be extended, as the work is not that in which the younger man necessarily excels, in fact the older man would be superior by reason of his accumulated experience. Prospects of promotion should also now be greater as there must be senior administrative posts within the new department.

Further Archæological Excavation in Syria

Sir Leonard Woolley's third season of excavation on the ancient site of Allalakh at Atchana near Antioch, as anticipated, has enlarged and added further detail to the picture of a great meeting place of the civilizations of East and West at an entrance gate to western Asia; but at its close it held out promise of an even greater field of discovery still to be explored. Of this a glimpse may be afforded when the numerous cuneiform inscriptions retrieved in the season just past have been submitted to inspection. Sir Leonard in his preliminary report (*The Times*, August 2 and 3) opened with an account of the further excavation of the earlier palace, which preceded that of the fifteenth-century Hittite king, Nig-me-pa. This earlier building, cannot, Sir Leonard thinks, be much later than the time of Hammurabi, and he assigns it tentatively to the eighteenth century B.C. The structural features, which point to its use in part for administrative and business purposes, in part as a royal residence, convey the impression of a sense of dignity and propriety, combined with an unusual appreciation of space and air, particularly noticeable in the arrangement of the upper residential chambers, with a loggia giving an extensive view over the city, and an approach by newel stairs, of which the first two flights are nearly perfectly preserved. It was, however, from a private house of the fifteenth century that the much desired further evidence was obtained of the contact with Crete, for which mainly the excavation of Atchana was undertaken. This now took the form of a fresco, which is exactly similar to a scheme of decoration found at Knossos, and a 12-wick lamp in red porphyry in the form of the capital of a column, which at Knossos would be hailed, Sir Leonard says, as a typical, but unusually fine, example of Minoan art.

It was, however, towards the close of the season's work that the most striking discovery was made, which, as Sir Leonard says, "goes far to complete the picture of the ancient city of Allalakh". This was a temple, which throws light upon the religion of the people, and gives examples of their major arts. Though the clearance of this part of the site has only just begun, it is already evident that here are the superimposed remains of at least four temples, of which the latest may date to about 1200 B.C. and the earliest to the fifteenth century. They had been richly adorned with sculpture. Although as yet it has not been possible for Sir Leonard to give more than the most summary of accounts, the record of finds is amazing in both number and interest. Among the more arresting finds are the remarkable sculptured lions, the bronze spearhead, deemed to be a cult object, and most remarkable of all, the hidden statue of a king or god in white limestone with its fifty lines of cuneiform inscription, of which the decipherment will be awaited with keenest anticipation. Such a mass of evidence of the character of Hittite art, and of so early a date—at least of 1200 B.C. and possibly even of the fifteenth century—is indeed an unexpected, but more than welcome find.

Excavations at Ezion-Geber

Recent excavation at Tell el-Kheleifi on the Gulf of Aqabah, Sinai, by the American School of Oriental Research at Jerusalem, not only has confirmed the indications of the importance of this site in early times as a meeting place of a number of trade routes, afforded by investigations in 1938, but also has revealed that it was the centre of an extensive industry for the smelting and refining of copper and iron from the mines of the adjacent Arabah. The site has been identified with the great port of King Solomon, Ezion-Geber "which is by Elath on the shore of the Red Sea, in the land of Edom". No longer, however, does it stand by the sea. The prevailing northerly winds have brought sand to silt up the head of the gulf, so that the shore is now half a mile away. The importance of the city as a commercial centre was indicated in the first season's excavation by a number of finds, of which the most important is held to be a large broken jar, on which had been incised two letters belonging to the early South Arabic script. This is assigned by stratigraphic evidence to approximately the latter part of the eighth century B.C. The letters are the earliest known to be definitely datable from a scientifically controlled excavation. Dr. Nelson Glueck, director of the School, in a preliminary account of the excavations carried out in May–June, 1939 (*Illustrated London News* of August 5) records the discovery of an ingenious and complicated system of flues and channels in the thick and high walls of sun-dried brick of the first city, which is so constructed as to utilize the draught of the prevailing winds from the north for the furnaces of an elaborate complex of smelting and refining plant—the largest yet discovered in the ancient Near East. This system would appear to have been the governing factor in determining the site for the first city; and so well bonded were the bricks that many of the walls still stand almost at their original height after nearly three thousand years. Among smaller finds from the third city were Egyptian amulets, of which one was a small cat, a form characteristic of the cult of the goddess Bast of Bubastis, and another was the Uzat eye of Horus.

Jenner and Napoleon

At a recent meeting of the Section of the History of Medicine of the Royal Society of Medicine (*Proc. Roy. Soc. Med.*, **32**, 877; 1939), Dr. J. A. Nixon said that the world-wide eminence of Edward Jenner found no better illustration than his ability to secure the liberation of British prisoners from countries with which England was at war. One of the best known of these prisoners was the Earl of Yarmouth, the model of Thackeray's Marquess of Steyne and Disraeli's Marquess of Monmouth, on behalf of whom Jenner addressed in 1803 the following appeal to the National Institute of France: "The Sciences are never at war. . . . Permit me then as a public body with whom I am connected to solicit the exertion of your interest in the liberation of Lord Yarmouth". In 1805 Jenner addressed himself directly to Napoleon requesting that two of his friends, Mr. William Thomas Williams and Dr. John Wickham, both men of science and literature, might return to England. According to Baron, the well-known biographer of Jenner, it was either on this or a similar occasion that Napoleon exclaimed: "Jenner! Ah, we can refuse nothing to this man." Jenner was also successful in obtaining the release of Sir George Sinclair, who had been arrested as a spy at Göttingen. Besides helping to liberate Englishmen detained on the Continent, Jenner issued certificates stating that travellers abroad were known to him and were undertaking a voyage in pursuit of science or health or other affairs entirely unconnected with the war, and were in his opinion entitled to protection and freedom.

British School of Archæology at Athens, 1935-36

Although the Annual of the British School at Athens no longer provides a general view of the activities of the School and its students—information which now must be sought in a separate publication—its contents continue to record the more important operations of its members. The volume for 1935–36 (London: Macmillan and Co., Ltd., 1939. 42*s*. net), however, opens with an account, very fully illustrated, by Dr. Alex. Philadelphus, director of the National Museum of Athens, of the Anavysos Kouros, a remarkable example of archaic art, in fact "one of the most perfect and almost the last link in the long chain of Apollos or kouroi that have come down to us", probably dating at about 530 B.C. This statue, which was recovered in fragments from an antique dealer in Paris, had been smuggled out of Greece by sea a few years ago from Anavysos, near Laurium. Of the remainder of the contents of the volume the greater part is given up to the excavation of the cave of Trapeza on the plain of Lasithi in eastern Crete. This cave was first discovered by Sir Arthur Evans in 1896, who refers to it as containing objects mainly of the Hellenistic period, but also a faience figure of Bes and fragments of gold leaf, which afterwards found a parallel in the Early Minoan jewellery at Mokhlos. Apart from mention by Taramelli and Bosanquet, it received no attention from archæologists until 1935, when it was visited by members of the School. In 1936, between May 4 and 19, it was excavated by Miss Money-Coutts, Mr. and Mrs. J. D. S. Pendlebury and others. Judging from the finds, the contents of the cave originally must have been rich. Although metal was comparatively rare, gold, silver, bronze (or copper), and lead were all represented. The deposits in the cave, however, had been much disturbed by treasure hunters, and in one spot only were they intact. It has, therefore, been possible to study the pottery found for the most part on stylistic evidence only, and to reconstruct the history of the cave accordingly. It would appear to have been occupied as a habitation site in Late Neolithic, and to have been used for communal interment from Early Minoan II until the end of Early Minoan III.

The Cyclotron and Biological and Medical Research

Dr. G. E. Harrison, lecturer in physics, in the University of Birmingham, has been elected to a Rockefeller Foundation fellowship in natural science which will enable him to spend a year at Berkeley University, California, studying under Profs. J. H. and E. O. Lawrence. The object of the visit is to acquire first-hand knowledge of the application of neutrons to biological and therapeutic research, in which the Profs. Lawrence have opened up a new field the exploration of which seems likely to be of first-rate importance in the treatment of disease. Berkeley University, where Prof. Lawrence constructed his cyclotron and has developed his own technique, is unique in facilities for the production of neutrons and artificial radioactive substances. When the large cyclotron which Prof. Oliphant is building for research in nuclear physics in the Physics Department of the University of Birmingham is completed, this University, in which the Physics Department and new Medical School are in close proximity, will be in an exceptionally favourable position for the promotion of the therapeutic and physiological investigations which Prof. Lawrence at Berkeley and Prof. Hevesy at Copenhagen have so strikingly originated. It is hoped that on his return from California, Dr. Harrison will organize and direct research in these subjects in the University of Birmingham.

The Ontario Research Foundation

THE report of the Ontario Research Foundation for the year 1938 (Sessions Paper, No. 48, 1939. Pp. 36. Toronto: King's Printer, 1939) refers to the extension of the soil survey of the central part of Southern Ontario eastward to the Quebec border. The Department of Agriculture has also determined the general relations between the performance of certain varieties of apple, and climatic and soil conditions in the apple-growing sections of the Province. The Department of Pathology and Bacteriology has continued its studies of bovine mastitis. Attention has been focused on the prevention of human infection by pasteurization of milk, and experimental work was continued during the year on *Brucella Abortus*. Studies relating to the sheep nose fly were continued during the year as well as on the parasites of game and fish. The Textiles Department has been responsible for investigations on causes of fabric fraying and the quantitative and consistent measurement of this tendency. They have also been responsible for testing work on the fastness to light of dyestuffs used in the Canadian textile industry, and have commenced a study of the fundamental and physical characteristics of single silk fibres. The testing work and control work of the department, particularly in connexion with rayon merchandise, have also increased. The facilities of the Department of Engineering and Metallurgy for the investigation of products associated with air-conditioning have been extended, and were put to considerable use in the year. A study of the resistance of metals and alloys to abrasion and wear has developed to a stage which permitted a new programme of work to be prepared, and results of tests on suitable metals have been collated.

THE Department of Chemistry in its investigation of paint failures in the Paint and Varnish Laboratory has continued to yield information essential to understand the problem of protective finishes, and a fundamental investigation of the processing of drying oils is in progress. Other work on a low cost plastic moulding powder prepared from wood meal has overcome the difficulties due to the absence of some properties which are essential to commercial success, and a low cost powder is now available which can be moulded commercially. Interpolymerization of styrene and other organic chemicals has been studied in the cellulose and plastics laboratory and a new series of interpolymers developed which are notable in their resistance to swelling in commercial solvents. During the year an Analytical Laboratory was established to serve as a central laboratory in the Foundation for analytical problems. The Paper, Printing and Adhesives Laboratory has worked mainly on packaging and adhesive problems due to difficulties through odours and moisture. In the Department of Biochemistry work on the production of lactic acid and other chemicals by the action of micro-organisms has been conducted, as well as pilot scale tannery operations to improve the vegetable chrome process for the manufacture of sole and belting leather which was developed in 1937, and in addition to improving the colour of the leather it is hoped to improve still further its durability under normal wearing conditions. Attention is also being given to the development of spue on finished leather, and a complete report on the technology and economics of pectin production has been prepared for one of the large apple growers of the Province.

"Nomenclator Zoologicus"

WE have received a sample part of the "Nomenclator Zoologicus", edited by Dr. S. A. Neave, of which the first volume is about to be published by the Zoological Society. The work, which will be completed in four volumes, aims at giving "as complete a record as possible of the bibliographical origins of the name of every genus and subgenus in zoology published since 1758, the date of the tenth edition of Linnæus' 'Systema Naturæ', up to the end of the year 1935". Up to 1850, not only the generic but also the specific names are indexed in Sherborn's monumental "Index Animalium". Since that date, however, the scale of zoological publication has increased so vastly that a continuation of "Sherborn" would be a task of overwhelming magnitude. Even in the all-important matter of generic names the systematist has been compelled to spend much time and labour in tracing their origin and in trying to avoid re-inventing old names for new genera. The "Nomenclator Animalium generum et subgenerum" published by the Prussian Academy of Sciences, begun in 1926, was designed to remedy this state of affairs, but it has been making its appearance in so leisurely a fashion that, although already thirteen years out of date, it is not yet completed. Dr. Neave, who has had the assistance of the specialists on the staff of the British Museum (Natural History), as well as of many other zoologists in Great Britain and abroad, hopes to complete publication by the end of 1940. Apart from cross-references and variations in spelling, he and his collaborators have collected about 192,000 generic names, of which at least 5,000 have escaped inclusion in former nomenclators and in the "Zoological Record". No doubt many omissions remain to be discovered, and zoologists are asked to send a note of any they may find so that they may be included in a supplementary list at the end of the last volume.

Forestry in South Africa

WE welcome the issue of the first number of a new forestry publication appearing in the *Journal of the South African Association* (No. 1, Oct. 1938, Pretoria, published by the Association, April and

October, 1938). The number opens with a fitting memorial to the late Mr. J. P. Bekker, administrator of the Transvaal, who was keenly interested in forestry, and one of the earliest advocates of extensive afforestation in the Transvaal. The most important article, which alone would make this number of the *Journal* of high value, is the "Historical Sketch of the Development of Forestry in South Africa" by N. L. King, chief management officer, Division of Forestry. To those interested in forestry progress in the Dominion, a perusal of the paper is recommended. There is a strange omission, however. The author, although he alludes to the early settlers who landed at the Cape in 1652, makes no reference to the fact that they imported in the seventeenth century the oaks and poplars.

The new journal contains several articles of technical interest to South Africa. In connexion with the important questions of erosion and desiccation in Africa, now receiving serious attention, the brief note, accompanied by some startling photographs, by Colonel Deneys Reitz, M.P., on "The Forests of Northern Zululand" is arresting. Colonel Reitz depicts areas of forest which he knew fifteen years ago with the present state of affairs. "In those days this area consisted of open savannah plains plentifully interspersed with park-like groves of timber. In addition there was the extensive Mongosi Forest and several other valuable forests at Mpatu, Mocsi and elsewhere. . . ." The author shows that the greater part of the groves and the forest areas have now disappeared to make 'gardens', that is, cultivation. Among other articles of interest is one by F. S. Laughton on the "Raising of Transplants of Indigenous Tree Species for Open-Rooted Planting" and a paper by S. P. Sherry entitled "The Rate of Growth and Health of the Southern Pines in the Midland Conservancy".

Control of the Chrysanthemum Midge

A law case of interest to chrysanthemum growers was heard at Littlehampton on July 3 when a nurseryman was prosecuted by the Ministry of Agriculture and Fisheries for failure to comply with a notice requiring him to take certain measures for the extirpation of the chrysanthemum midge from his premises. The chrysanthemum midge is a serious pest of greenhouse chrysanthemums in North America, and during the past two years it has been found to exist in a few nurseries in England. The control measures to be adopted, if the pest became established in Great Britain, would add greatly to the cost of growing chrysanthemums. For this reason drastic measures are enforced with the view of eradicating the pest where it has been found and preventing its spread to other nurseries. It is in the interests of all that outbreaks should be speedily discovered and notified to the Ministry. Growers of chrysanthemums are advised to watch their plants carefully and to send to the Ministry specimens of plants attacked by any insect with which they are unfamiliar. An illustrated leaflet (Advisory Leaflet No. 286), which gives a full description of the chrysanthemum midge and its habits, may be obtained on application to the Ministry at 10 Whitehall Place, London, S.W.1.

Modification of the Steiner Composting Process

The present-day shortage of organic fertilizers has naturally led to special attention being paid to methods of composting. Recently a claim has been put forward by Miss Maye Bruce, of Sapperton, Gloucestershire, that she has developed a modification of the Steiner process which results in a more rapid decomposition of the waste material and a more valuable product from the fertilizing point of view (*J. Min. Agric.*, 46, No. 3, 295; 1939). A layer of charcoal is spread over a foundation of rubble, and a wall, about 4 ft. high, of wood or brick built round it. Garden refuse of a non-woody nature is then thrown on, particular value being attached to stinging nettles. Unslaked lime is sprinkled when the first and third foot levels are reached and animal manure, if available, is applied at the second foot level. The unique part of the method, however, lies in the recommendation that the further addition of six herbal essences, namely, nettle, yarrow, camomile, valerian, dandelion and oakbark, together with pure run honey, in a solution of 1 part in 10,000 adds greatly to the value of the compost. The heap should be covered with about 6 in. of soil and protected from rain, and after six weeks in summer, or twelve in winter, the refuse becomes a rich, friable and sweet smelling heap of compost. Further information as to how to make and use these essences can be obtained from Miss Bruce, who is also willing to forward them at a nominal charge to cover packing and postage.

Electric Heating of Domestic Hot Water Supply

The important paper on "The Application of Electric Heating to Domestic Hot-water Supply Systems" read to the Institution of Electrical Engineers and to seven local centres is published in the *Journal* of the Institution of July. In the discussion, Mr. A. E. McKenzie, engineer to the Wimbledon Corporation, said that in the three towns supplied by his undertaking, there are 38,000 consumers taking electricity and 17,633 electric water heaters. This gives one water heater for every 2·15 houses, or approximately 46 per cent saturation. In addition, there are a large number of publicly owned heaters. In Wimbledon, all self-contained water heaters are cleaned out once in two years, and four improvers are employed continuously on this work. All the heaters in a street are cleaned at the same time, thereby cutting maintenance costs down to a minimum. Taken over a period of years, the cost of cleaning such heaters, both large and small, averages 1*d*. per month. As the numbers increase, it is hoped that this cost will soon fall. The problem of 'scaling' is more serious with the small heaters than with the big ones. Most of the scale is deposited at the top of the outlet pipe and at the anti-dripping device which is immediately over it. There is no necessity to remove any of the electrical connexions. This enables the heater to be renovated less than half the time and at less than half the t formerly necessary. A strong case can be made for the claim that the electric water heater is re trustworthy than any other type. At Wimbledon re are 5,000 of the self-cleaning type installed and re has not been a failure. Serious accidents due electric water heaters are practically unknown. ring the severe weather last winter, only twelve ters were put out of action, all of which functioned mediately the ice was melted in the supply es.

Californian School of Education

To have directed one of the foremost schools of ucation in the United States from 1898 until 33, to have presided during those thirty-five years er the training of nearly three thousand of the duates whom it has sent out to all parts of the ited States and beyond, many of them to occupy ategic positions in the educational world as prosors, research workers and school and college cutives, and to crown this life's work by presenting with a new 500,000-dollar building paid for out of proceeds, judiciously invested, of spare-time nings during all those years—to few is it given in ir declining years to look back on so satisfying achievement. It is commemorated in a pamphlet ently issued by Stanford University in connexion h the opening of the University School of Educan Building—the gift of Dean (emeritus) Cubberley d his wife. A noteworthy feature of the School ce the Great War is the importance of the summer arter, during which most of the students are ool executives or teachers, contacts between om and the School faculty have proved highly mulating. The summer is indeed regarded as the st important quarter of the university year for truction in the field of education. The delightful mmer climate of the Santa Clara Valley is one of School's most valuable assets. An article by the sent Dean emphasizes the conception that prosional study in education should have a foundation scholarship in the social studies and in psychology d human biology. "The school has been one of most static of the social institutions. . . . iversity schools of education have responsibility developing new conceptions and techniques of ucation which are more adequate for modern iety," so that the school system may develop in people "the vision, the creativeness, the initiative, critical-mindedness, the understanding, and the cipline which will . . . give expression to the nocratic social ideals."

useums of Norwich

THE Museums Committee of the City Council has t issued a report covering ten years' development 29–1938) in the museums of Norwich. It has n a period of noteworthy progress, partly on ount of the value and number of gifts and bequests de to the museums, but mainly on account of the vances made in museum arrangement and appeal. e exterior and amenities of the Castle Museum, with its Norman keep and magnificent Norman doorway, have been attended to following the advice of H.M. Office of Works, and great reorganization has taken place in the collections exhibited within. It was a wise move to reduce the excessive space formerly given to exhibits, often reduplicated, of British birds, in order to allow a more balanced representation of the animal kingdom; and the creation of dioramas of representative stretches of Norfolk scenery with the appropriate flora and fauna adds greatly to the instructiveness and attraction of the collections. In the Art Galleries the valuable paintings of the Cotman period are undergoing restoration where this has been found to be desirable, and a scheme of redecoration has been followed by successful experiments in the rearranging of the pictures themselves. In other directions the museums show that they are keeping in pace with modern developments, and none of these is more gratifying than the success of the collaboration with the Education Authority for regular visits of school classes to the various museums.

Public Health Statistics of India

THE annual report of the Public Health Commissioner to the Government of India for 1936, in two volumes, has recently been issued (Government of India Press, New Delhi, 1938. Vol. 1, Rs. 2, or 3*s*. 6*d*.; vol. 2, Rs. 1, annas 10, or 2*s*. 9*d*). The state of the public health of the civil population in British India is surveyed in vol. 1. The mid-year estimated population was 281,866,639—an increase of 3½ millions over 1935. The death-rate was 23, and the birth-rate 35, per 1,000, and the infantile death-rate per 1,000 live births was 162, compared with 164 for 1935. The deaths from cholera numbered 160,000, some 57,000 less than in the previous year, and those from plague were only 13,000, less than half the figure for 1935; but the deaths from smallpox numbered 104,805 or 14,000 more than in the previous year. Deaths recorded under 'fevers' decreased by 4 per cent, but small percentage increases were recorded in respiratory diseases and the diarrhœa and dysentery group. Deaths recorded from hydrophobia numbered no fewer than 2,470. In vol. 2, the general health statistics of the British Army in India and of the Indian Army are considered. The general health of the troops seems to have been well maintained, though admissions to hospital among the British were a little higher than in the previous year. The incidence of the enteric group of fevers is the lowest ever recorded, and is particularly striking among the Indian troops. There has been no corresponding reduction among the civil population, but rather an increase. The decrease of enteric fevers in the Army must, it would seem, be ascribed to more general and better anti-typhoid vaccination, and to a more careful search for, and elimination of, carriers.

Child Welfare Organization

THE League of Nations has published the annual report on child welfare prepared by the Child Welfare Information Centre (London: George Allen and

Unwin, Ltd., 4*s*.). The report gives *inter alia* a general account of the measures adopted in China, with a summary of the work being done in the province of Kwang-si, the most advanced province as regards the organization of social services. Information on the United States and the United Kingdom is very complete. The report should prove useful to all who are interested in the social development of various countries and the measures adopted to protect the mother and child.

Safeguarding Water Supplies

A MEMORANDUM setting out the precautions necessary in the administration of a water supply undertaking in order to maintain the wholesomeness of the supply has been sent by the Minister of Health to all water undertakings ("Memorandum on the Safeguards to be Adopted in Day to Day Administration of Water Undertakings". Mem. 221. H.M. Stationery Office). These precautions are those that have long been recognized as good practice in water administration, and include care in the selection of workmen so as to exclude possible infection through carriers, particularly during repair work, inspection of gathering grounds, frequent and regular analyses of the water supplied, and the use of special treatment such as chlorination.

Research in the London Hospital

The Publications Committee, with Prof. Bedson as its secretary, has issued a volume of "Researches Published from the Wards and Laboratories of the London Hospital during 1938" (London: H. K. Lewis and Co., Ltd.; 7*s*. 6*d*. net). It includes thirty-seven papers dealing with a wide range of subjects—physiological, pathological, biochemical and clinical—which are evidence, if that were needed, of the active studies upon problems of health and of disease that are being pursued at this great medical school and hospital.

Studentships and Fellowships in Medical Research

The Medical Research Council invites applications for a fourth series of studentships and fellowships intended to encourage young British medical graduates towards becoming investigators in those branches of medical science which are concerned directly with disease as it occurs in human beings. Post-graduate studentships are offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive a stipend at the rate of £200 per annum, during a period not exceeding twelve months, for personal maintenance while undertaking approved courses of study in Great Britain such as may be regarded as best calculated to advance the student's training in methods of research. Research fellowships are also offered for candidates of similar qualifications who have already had some experience in the use of research methods. Each fellowship will be tenable for one year at the ordinary value of £250 per annum, and will be renewable in approved instan
at the rate of £300 per annum for a second ye
These fellowships are intended as probationa
appointments for research in clinical science
experimental pathology under suitable direction
Great Britain. Research expenses may be provid
in addition to stipend. Further information can
obtained from the Secretary, Medical Resea
Council, 38 Old Queen Street, London, S.W.1.

Announcements

Prof. A. J. Clark, professor of materia medica
the University of Edinburgh, and Prof. T. R. Ellio
emeritus professor of medicine in the University
London and consulting physician to Univers
College Hospital, have been appointed members
the Medical Research Council, in succession to Pr
H. S. Raper and Prof. J. A. Ryle, who retire
rotation on September 30.

Dr. Dean Burk, formerly chemist in the Bure
of Chemistry and Soils, U.S. Department of Ag
culture, has been appointed senior chemist in
newly established National Cancer Institute, U
Public Health Service, and associate professor
biochemistry at Cornell University Medical Coll
in New York City, where a study on tissue me
bolism fundamental to cancer will be carried
under the auspices of a grant made by the Natio
Advisory Cancer Council to the Department
Biochemistry headed by Prof. Vincent du Vignea
Collaborating in the investigations will be Dr. Fr
Lipmann, formerly research associate of Prof. O
Meyerhof and of Dr. P. A. Levene of the Rockefel
Institute, and lately with Dr. Albert Fischer at
Carlsbergfondets Biologiske Institut, Copenhagen.

Dr. Friedrich Karl Kleine, honorary profes
of hygiene in the University of Berlin and an exp
on tropical diseases, has recently been awarded
Shield of Nobility of the Reich by the Germ
Chancellor.

Prof. Ludwig Jost, professor of botany in
University of Heidelberg, has been awarded
Charles R. Barnes honorary life membership of
American Society of Plant Physiology.

The Autumn Meeting of the Iron and St
Institute will be held in Cardiff during Septem
12–15. Further information can be obtained fr
the Secretary, Iron and Steel Institute, 4 Grosve
Gardens, London, S.W.1.

The John Burroughs Association desires to get
touch with organizations throughout the world wh
have been formed in honour of John Burroughs,
American poet and naturalist, with the view of c
lecting opinions concerning an annual publicati
containing reports of such organizations and artic
on Burroughs. Communications should be addres
to the president of the Association, Dr. Clyde Fish
American Museum of Natural History, 77th Str
and Central Park West, New York City.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 291.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

eavy Cosmic Ray Particles at Jungfraujoch and Sea-Level

THE heavy ionising particles in the cosmic rays are rare that it seems unlikely that much information be obtained from experiments with cloud umbers. The only method at present available ich can yield quantitative results is the method of ect photography, which has been used recently several investigators mainly for investigating the clear disintegrations which the cosmic rays pro- ce[1,2]. On a plate which has been exposed for a ficiently long time is observed, in addition to a at wealth of phenomena associated with dis- egration effects, a large number of single tracks bably due to protons or slow mesotrons.

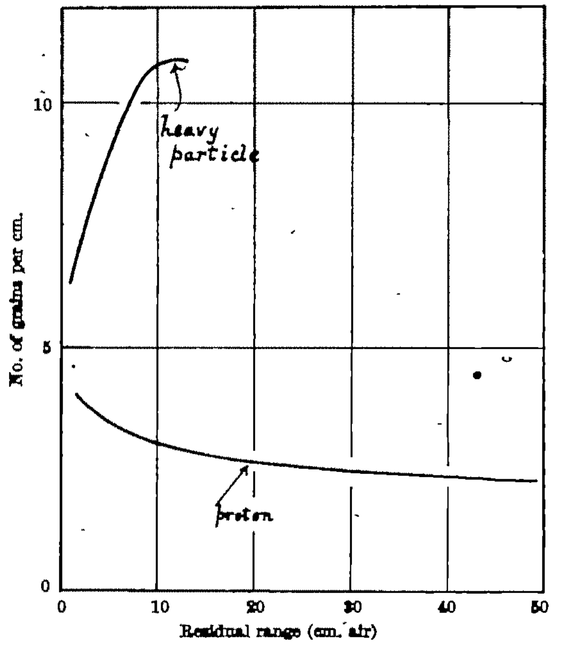
n approaching the problem of elucidating the ious processes taking place, the first question ich presents itself is that of the nature of the mary radiation responsible for the heavy tracks, l we have therefore made absorption measure- nts in lead and air. A set of Ilford half-tone plates ulsion 70 μ thick and sensitive to α-particles and otons), covered with different thicknesses of lead, ve been exposed to cosmic rays on the Jungfraujoch l in Bristol for a period of 230 days. We divide observed tracks into two classes according to ir length (that is, the length of the part of the ck appearing in the emulsion): (i) tracks less than cm. air equivalent and (ii) tracks greater than cm. air. A large fraction of (i) is due to radio- ive contamination, whereas all the tracks (ii) are cosmic ray origin. The results are given in the lowing table:

	No. of tracks greater than 10 cm. air per mm.^{2}	No. of tracks less than 10 cm. air per mm.^{2}
ungfraujoch, no lead	6·2 ± 1·0	20 ± 1·4
5 cm. „	8·4 ± 1·0	27 ± 2·0
18 cm. „	4·5 ± 1·0	16 ± 1·5
ristol, no lead	0·6 ± 0·2	11 ± 1·5
18 cm. „	0·25 ± 0·2	14 ± 2·0

t will be seen that radiation primarily responsible the long tracks suffers practically no absorption lead but is strongly absorbed in air. The short cks also indicate that the primary radiation giving to them is strongly absorbed in air but not in d. (Probably most of the short tracks on the stol plates are of radioactive origin, and we must ect an equal number of this origin in the Jungfrau tes.)

he results show that the *long tracks are neither duced by the electron nor by the mesotron com- ent*. Electrons would be strongly absorbed in d, whereas the mesotron intensity increases only a factor 1·7 between Bristol and Jungfraujoch. *heavy tracks are therefore produced by a third ponent*. It seems likely that this third component consists of *neutrons*. Further support for this view is given by the experiments of Schopper[3]. Experiments with paraffin as absorber are in progress.

The grain spacing of the tracks is in agreement with that of artificially produced protons. Most of the long tracks are probably protons; but it cannot be excluded that some of the shorter tracks due to cosmic rays are also α-particles, since on the half-tone plates there is little difference between the grain spacing of α-particles and protons. The distribution of tracks was found to be more or less isotropic. The plates were placed in a horizontal position, but no appreciable preponderance of vertical tracks was observed.



We have also observed numerous disintegration stars which will be the subject of a later investigation. Here we only wish to mention one particular case, similar to a heavy particle in a disintegration star observed by Schopper and Schopper[3], which is of interest in connexion with the question of nuclear fission. The star in question has five tracks: four of them are comparatively short (5–11 cm. air) proton or α-ray tracks. The fifth track is 14 cm. long and has an average grain density of about *three times* that of α-rays of 8 cm. range. Considering that there is very little difference between the grain density produced by protons and α-particles of the same range, we must ascribe this track to a heavy particle with a *very high effective charge*. Moreover, the grain density does not increase steadily towards the end of the range, as is the case for α-particles, but has a maximum at the beginning of its path and then decreases slowly, until at the end of its range it approaches that of an α-particle (see accompanying diagram). This effect is presumably due to capture of extra nuclear electrons.

We do not think it very likely that this track represents the mere recoil from the original cosmic ray particle. The recoil tracks in even very energetic disintegrations are very short, and besides, there is no reason why the recoil nucleus should have such a high effective charge. In all probability we are dealing here with a heavy, highly charged splinter, released by a highly excited heavy nucleus, a process which bears some similarity to the fission of the uranium nucleus.

W. Heitler.

At present at Royal Society Mond
Laboratory, Cambridge.

C. F. Powell.
G. E. F. Fertel.

H. H. Wills Physical Laboratory,
University, Bristol.

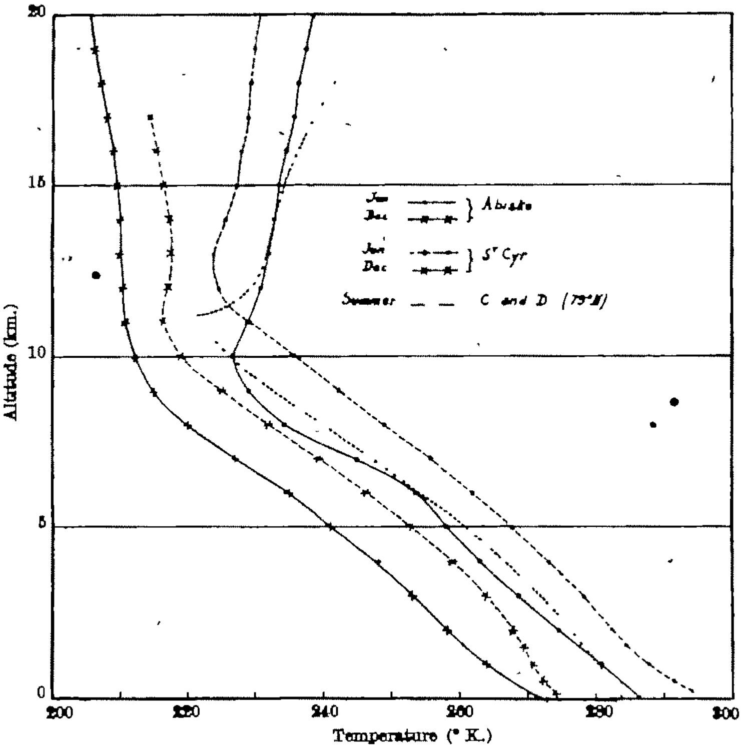
[1] Blau and Wambacher, *Sitz. Akad. Wien*, 146, 623 (1937).

[2] Schopper and Schopper, *Phys. Z.*, 40, 22 (1939)

[3] Schopper, *Naturwiss.*, 25, 557 (1937).

Temperature of the Stratosphere in High Latitudes

We recently directed attention[1] on the variation of the 'mean temperature' of atmospheric ozone, which appeared from the observations made by Barbier, Chalonge and E. Vassy at Abisko (Swedish Lapland, lat. 68° 20′ N.) between December 27, 1934 and March 6, 1935. From the end of December until the beginning of March, the temperature gradually increased by about 70° C. This great variation may seem surprising, as the stratosphere is known to have a rather constant temperature; but it should first be noticed that the mean temperature of atmospheric ozone involves altitudes not accessible to sounding balloons; a next, that the stratosphere has been investiga chiefly in low and middle latitudes.



Rolf[2], however, at Abisko between 1921 and 19 carried out a long series of measurements show that above the tropopause the temperature decrea slightly in January, while in June it increases i regular manner, as may be seen in the accompany graph.

For the sake of comparison, there are represented the same graph similar curves deduced from ra soundings made at Saint-Cyr (lat. 48° 47′ N.)[3]. cently published observations, made by Carmich and Dymond[4], suggest that this increase of tempe ture in summer is yet more marked (25° C.) in hig latitudes (about lat. 79° N.).

Thus, direct measurements point to an ann change in the temperature of the stratosphere, the higher the altitude, the greater the differe between the summer and winter temperatures. arctic countries, this change is much greater than lower latitudes. This was also noticed by Penndo

The measurements of the mean temperature atmospheric ozone, as they reach much higher regi in the stratosphere, are an extrapolation of balloon measurements, and strengthen the opin that this annual variation increases with altitu Thus the earth's atmosphere offers two arctic zo by turns very cold in winter and very warm summer.

Solar radiation would be resp sible for these variations. For is easy to estimate, for a given d the time when the higher layers of atmosphere are illuminated; tak also into account the obliquity of sun's rays, a strong correlation found between the illumination the mean temperature of ozone.

In addition, Gowan's calculatio though they deal with lower latitu (50° N.), show a large difference in higher layers of the stratosphere tween the actual temperature and temperature when the atmosphere plunged in darkness during a suffici time for equilibrium to be attain which is nearly the case in p night.

One of the consequences of the lated phenomenon is a possible expla tion, owing to the dependence of velocity constant of thermal dec position on temperature, of the decr ing ozone thicknesses at Abisko wh are shown by Dobson's curve[7].

A. Vassy
E. Vassy

Laboratoire de Physique (Ens.),
Sorbonne, Paris.
June 28.

[1] Vassy, A. and E., *C.R.*, 208, 1518 (1939).

[2] Rolf, B., *Med.-Stat. Met.-Hyd. Anst.*, 5 (1932).

[3] Unpublished material published by courtesy of the Office Nat Météorologique.

[4] Carmichael, H., and Dymond, E. G., *Proc. Roy. Soc.*, A, 171, (1939).

[5] Penndorf, R., *Veröff. Geoph. Inst., Leipzig*, 8, 181 (1936).

[6] Gowan, *Quart. J. Roy. Meteor. Soc.*, 62, Supp., 26 (1936).

[7] Dobson, G. M. B., *Proc. Roy. Soc.*, A, 129, 411 (1930).

terpretation of the Red-Shifts of the Light from Extra-Galactic Nebulæ

In his most recent contribution on this subject[1] ubble mentions a red-shift of + 0·231 A. This rresponds to a velocity of recession of approxiately 43,000 miles per second, nearly a quarter of e velocity of light ! The conviction grows upon one at these fantastic velocities are not real.

Alternative interpretations of the red-shift have en proposed, but have failed to provide an accept-le explanation. No one has taken account of the ot that a list of the available determinations of the locity of light shows a steady decrease of velocity th time, following a linear law, $c = 299{,}900 -$ 855 T, for the epoch 1900[2] (see Table 1).

TABLE 1.

T	c
1902·4	299,901 ± 84 km./sec.
1924·6	299,802 ± 30
1926·0	299,796 ± 4
1928·5	299,778 ± 20
1932·1	299,774 ± 11
1937·7	299,764 ± 15
1938·5	299,761 ± ?

This may be due to a 'fatigue' phenomenon : there e in Nature no inexhaustible stores of energy, no amples of perpetual motion. There are tremendous res of energy and the ensuing motion may continue thout perceptible alteration for periods almost yond reckoning, but neither lasts indefinitely. The ergy of a photon is not considerable and an exmation of the slowing-down may be sought in a crease of frequency as the light journeys through ace. It may be sought in the fact that the velocity propagation of a vibration depends on the physical operties (gravitational, electrical, magnetic, atomic, ermal and probably others) of the space through nich it is propagated, and that these properties are adually altering. Whatever its explanation, the wing-down is an observed fact.

Besides this, a satisfactory interpretation of the d-shifts must conform to the following further served facts :

(1) Strömberg, by measuring the aberration of ht from nebulæ of the Ursa Major I cluster, has own that the velocity of the light from this cluster the same as that of light from laboratory sources[3]. ght from all sources, near and far, reach therefore e eye with the same velocity, c.

(2) Planck's constant h is constant, for Adams d Humason[3] have shown that the relation $E\lambda = ch$ holds good for sources of light near and far, by mparing a grating and a prism spectrogram of the ission spectrum of the nucleus of *N.G.C.* 4151.

(3) The wave-length is constant during the light's urney : this assumption is accepted as correct when asuring radial velocities.

(4) The frequency n of a newly generated photon energy E is the same for all sources of light near d far, since (1) may be written $E = hn$, and it is admitted that the energy of a photon generated by an atom of the same element under the same conditions is the same in all sources near and far. For example, the energy of the photon giving the K line of Ca+ has the same energy whether generated in a remote nebula or on the earth.

It follows from the above that light leaves a remote nebula with a velocity $c_e > c$, and a wave-length λ_e given by the relation $c_e = n\lambda_e$ (2). During the light's journey, both c_e and n decrease until, when the light reaches the earth, they have become c and n' respectively, with $c = n'\lambda_e$ (3) and n' is less than n. Since $c_e > c$, from (2), $\lambda_e > \lambda$, the corresponding wave-length of light from laboratory sources, and $\lambda_e = \lambda + d\lambda$, which is the observed red-shift.

In Table 2, m_c is the luminosity of the fifth brightest nebula in each cluster (the clusters are so similar that this gives a precise measurement of distance) and $d\lambda/\lambda$ is the observed red-shift[1]. R is the distance in light years, from the relation $\log r = 0{\cdot}2\, m_c + 4{\cdot}803$; λ_e is the initial wave-length of the K line of Ca+, calculated from the red-shift, taking its earth value as $\lambda = 3933$ A.—it is the wave-length at both ends of the light's journey ; n' is the frequency of the light from the nebula when it reaches the earth, and c_e is the initial velocity of the light. The nebulæ are in order of increasing distances. The data relating to Ursa Major II are inconclusive : they have been derived from a single spectrogram of a single nebula only.

TABLE 2.

Cluster	m_c	$d\lambda/\lambda$	r light-years	λ_e of K line of Ca+	n'	c_e
—	—	—	—	($\lambda = 3933$ A.)	($n = 762{\cdot}2 \times 10^{12}$)	($c = 299774$ km./sec.)
Virgo	10·40	0·0041 A.	8×10^6	3949 A.	$759{\cdot}1 \times 10^{12}$	300990
Pegasus	12·88	0·0127	24	3983	752·6	303585
Perseus	13·48	0·0174	31·6	4001	749·1	305080
Coma	14·23	0·0245	44·6	4029	744·0	307090
U. Ma. I	16·12	0·0517	106·4	4137	724·6	315320
Leo	16·33	0·0653	117	4190	715·5	319360
Cor. Bor.	16·54	0·0707	129	4211	711·9	320960
(U. Ma. II	17·73	0·1403	223·4	4485	668·4	341850)
Boötes	17·89	0·1307	240·4	4447	674·1	338950

The slowing down of the frequency and of the velocity both follow linear laws : $n' (\times 10^{12}) = 762{\cdot}2 - 0{\cdot}4\, T$; and c_e(Km./sec.) $= 299774 - 173\, T$, where T is in millions of years.

Accordingly, 240 millions years ago, light travelled with a velocity approximately 13 per cent greater than now, and the wave-length of the K line of Ca+ was 4447 A.

Should the above be confirmed, our measurements of stellar radial velocities will require a correction depending on the distance.

M. E. J. GHEURY DE BRAY.

First Avenue House,
High Holborn,
London, W.C.1.
June 29.

---

[1] Hubble, "The Observational Approach to Cosmology".

[2] NATURE, 120, 602 (1927). A later list of observations appears in *Isis*, 25 (2), No. 70 (Sept. 1937).

[3] Reports Mount Wilson Obs., 1935–36.

Interrelation of Dissociation Energy and Inter-nuclear Distance for some Simple Di-Atoms in Ground States

HAVING recently suggested[1] that Dr_e^2 (D dissociation energy, r_e internuclear distance) is approximately constant for C—C linkages in solid carbon and in hydrocarbons, I find further that $x = Dr_e^2 n^{1/2}$

(n group number) tends to constancy, within experimental errors, for ground states of simple di-atoms of related type (for example, LiLi, NN and OO).

Using the relation $k_e r_e^6 = pD$ (k_e bond constant, p a constant product for di-atoms of related type[1]), it follows that $k_e r_e^6 n^{1/2} = px$. Fox and Martin[3] find $k_e r_e^6$ constant for C—C linkages: further examination shows that it also connects ground and excited states of the di-atom CC. In general, however, $k_e r_e^6$ seems more useful for correlating different states of a given di-atom, and this is suggested by the Morse-Clark function, which leads to $k_e r_e^6 n = py$, where $y = Dr_e^6 n$, for cases where the reduced mass does not vary greatly. This relation between k_e and r_e is essentially that already used with some success for hydrides and deuterides[4], and conforms with a suggestion made by Sutherland[5], to meet a well-known difficulty which appears in the Morse-Clark expression in the case of isotopic forms. The function y is closely constant in the KH period, where the reduced masses are nearly alike. For HH, HD and DD, x and y give equally concordant results.

Whilst x (or y) appear sensibly constant in appropriate periods, p is more susceptible to change in electron configuration: thus in ground states $p(\text{LiLi,KK}ss) = 9\cdot9$, $p(\text{OO,KK}pp) = 20\cdot9$, while $x = 30\cdot7$ volt A^{3} very nearly in both cases. Fox and Martin[3], in agreement with this, find $p = 20\cdot7$ for C—C linkages (KKpp type). However, for a given configuration in a given period of di-atoms, p varies with x (or y) in such a way that px (or py) is sensibly constant for excited as well as ground states, and may be equated to period constants of the type K_{σ}.

It is hoped that reliable and more general relations connecting D, k_e and r_e may emerge from this. The detailed results of calculation will be submitted for publication elsewhere.

I am indebted to Dr. J. J. Fox for much helpful discussion.

C. H. DOUGLAS CLARK.

Department of Inorganic Chemistry,
University, Leeds.
July 3.

---

[1] Clark, C. H. D., NATURE, 143, 800 (1939).
[2] Sutherland, G. B. B. M., *Proc. Ind. Acad. Sci.*, 8, 341 (1938).
[3] Fox, J. J., and Martin, A. E., *J. Chem. Soc.*, 884 (1939).
[4] Clark, C. H. D., and Stoves, J. L., *Phil. Mag.*, (vii), 27, 389 (1939).
[5] Sutherland, G. B. B. M., *Ann. Rep. Chem. Soc.*, 46 (1938).

Differential Threshold for Compression Modulus

WE have recently described[1] experiments in which it was shown that individuals differed but slightly in their capacity to distinguish by touch small differences in viscosity of highly viscous true fluids, and that an 80 per cent level of correct judgments corresponds to a viscosity difference of about 30 per cent.

We have now carried out similar experiments with rubber cylinders in which the compression modulus varied slightly*, the subjects being asked, as in the viscosity experiment, to select the 'softer' of two samples. For the rubber cylinders there are significant differences between individuals (χ^2 method) and further, those of our subjects regularly engaged in routine testing are superior as a group. Less educated and younger subjects are also superior, but it has n been possible to distinguish the separate effects education and age.

Taking the results for all ten subjects togethe our data may be summarized as follows:

	Pairs differing in compression modulus b per cent (means)					
	1·47	2·74	5·66	9·50	10·50	12·
Per cent correct	35	49	72	81	85	9
„ given as equal	25	20	11	11	5	:
„ given in reverse order	40	31	17	8	10	•

It will be seen that an 80 per cent level of corre judgments corresponds to a modulus difference (about 9 per cent, so that we conclude that differenc in compression moduli of approximately sol materials can be judged subjectively about thr times as accurately as can differences in viscosities highly viscous fluids.

Details will be published elsewhere.

G. W. SCOTT BLAIR.
F. M. V. COPPEN.

National Institute for Research in Dairying,
(University of Reading),
Shinfield, Nr. Reading.
July 4.

---

* The cylinders were manufactured for us by the Research Association of British Rubber Manufacturers.

[1] NATURE, 143, 164 (1939).

Vanadiferous Nodules in Worcester Clay

THE presence of dark nodules in the red Permi marls of South Devon has been recorded[1]. The nodules, which range from pin points to masses many pounds in weight, attain their maximu development one mile west of Budleigh Salterto They are surrounded by aureoles of green clay, co tain some 14 per cent of vanadium (estimated as V$_2$C and are radioactive.

We have found analogous structures in the Keup marls of Gregory's Bank, Worcester. They a mostly very small and, *in section*, consist usually of black centre ranging from a pin point to 0·8 cı diameter, the larger ones with a greyish centre a surrounded by a disk of green clay 1–2 cm. in di meter, the perimeter of which is sharply defin against the general background of red clay. T largest nodule found weighed 8 gm. and was eg shaped. Strata of green clay also occur in the Ba and contain numerous small black inclusions.

The green aureole contains ferrous iron and, as spectrogram appears identical with that of t adjacent red clay, it seems reasonable to conclu that it has been formed from the latter by reducti or removal of the ferric iron; but it is not cle how this has been effected. The black and gr centres contain some 5·6 and 8·6 per cent spectively of vanadium (calculated as V$_2$O$_5$), wi traces of titanium; but no nickel could be detecte Any radioactivity must be extremely weak as photographic plate was not appreciably affect after one month of direct contact.

J. NEWTON FRIEND.
R. H. VALLANCE.

Central Technical College,
Birmingham.
July 4.

---

[1] Carter, *Mineral. Mag.*, 609 (1931).

Co-operative Activation

A CONSIDERABLE number of examples of chemical reactions in organized condensed systems have been observed to occur with activation energies greater than those normally associated with the temperature range at which the reactions occur. These reactions are: (1) the denaturation of proteins, where activation energies of 50–150 k.cal. have been reported[1], (2) $CaCO_3.6H_2O \rightarrow CaCO_3 + 6H_2O$ [2], (3) $K_2SO_4.Cr_2(SO_4)_3 24H_2O \rightarrow K_2SO_4.Cr_2(SO_4)_3 12H_2O + 12H_2O$ [3] and (4) the production of detonation nuclei in solid explosives[4]. On the other hand, in many solid reactions there is no marked deviation from the Polanyi-Wigner equation, the rate in molecules per sq. cm. being given by $\nu.e^{-E/RT}.N$. Thus there is no very large deviation in the case of $Ag_2CO_3 \rightarrow Ag_2O + CO_2$ [5] or $CuSO_4 5H_2O \rightarrow CuSO_4 3H_2O + 2H_2O$ [6], and in exothermic solid reactions; the following figures bear out the same point.

	Temp. ° C.	Rates (mols./cm.² sec.)	
		Calc.	Exp.
Lead azide	270	$1 \cdot 2 \times 10^{13}$	$5 \cdot 3 \times 10^{13}$ [7]
Potassium azide	251	$2 \cdot 0 \times 10^{18}$	$1 \cdot 7 \times 10^{18}$ [8]
Nitrogen iodide	−19	$8 \cdot 5 \times 10^{14}$	$6 \cdot 6 \times 10^{14}$ [9]
Barium azide	115	$1 \cdot 8 \times 10^{17}$	$3 \cdot 1 \times 10^{16}$ [10]

In all these cases, the thermal decomposition is believed to be simple, the unit processes involving at the most the decomposition or the liberation of one or two molecules. For the decomposition of calcium carbonate hexahydrate, the discrepancy is 10^{23} and for chrome alum 10^{11} times. For the denaturation of proteins, the discrepancy is variable and sometimes much larger. It would, therefore, appear that the abnormal cases are those for which a large number of molecules or chemical bonds are involved in the unit reaction.

It is possible to explain the rapid rates of these abnormal processes as due to co-operative activation of a number of points n on the surface within a short time interval τ, the activation energy required at each point being E/n, where E is the measured activation energy. The magnification of the rate which is thereby attained depends, in a complex fashion, on the type of organization involved, on the number of points n which are activated, the number of points m out of which n are chosen, but is independent of the value of τ. For crystalline substances, $\tau = 1/\nu$, where ν is the frequency of lattice vibration $= 10^{13}$ sec.), but for colloidal substances in aqueous media τ may be so low as 10^{-8} sec.

If we consider the 100 face of a cubic lattice with four adjacent lattice points composing a co-operative group, then it can be shown that the rate of reaction is approximately 10^3 times greater than that for the process of activation of one point with the energy E. For five adjacent lattice points the magnification is approximately 10^4. If we increase either m or n appropriately, then the magnification can be increased to factors of the order of 10^{23}, which was found for the decomposition of calcium carbonate hexahydrate. In order to obtain magnifications of the correct order, it appears to be necessary to increase m, the number of lattice points out of which the n points are chosen. This would mean that the activated points are to be spread over a relatively wide area. Only in the case of detonation nuclei is there any evidence bearing on this point, and this indicates in lead azide and nitrogen iodide that the activated points are spread over an area relatively great compared with the ionic diameter.

For the denaturation of proteins, the process is depicted as the disruption of a small number of bonds within a small time interval of approximately 10^{-8} sec., out of a relatively large number distributed over the surface of the protein molecule, the activation energy for the breaking of each bond being E/n. If in this case m is 100 and n is 4, then the magnification will be 10^6 times. For the decomposition of hydrates, the co-operative activation is regarded as being spread over the surface of the crystal, activation occurring at key points in the lattice, the loss of water from these points which follows the activation being imagined to cause the breakdown of the lattice over a relatively wide area.

An alternative mechanism is one proposed by Eyring and Stearn[1], which ascribes the high rates of reaction to the occurrence of high entropy change on passing from the reactant to the activated complex. On the basis of this hypothesis, in the case of changes in the solid state, an abnormally high energy of activation should be found in those cases where there is a high degree of disorder produced during the reaction, that is, when there is an amorphous product, and a more normal value when the product was crystalline. There is, however, at the present time but little evidence bearing on this aspect of the matter.

W. E. GARNER.

Department of Inorganic and Physical Chemistry,
University, Bristol, 8.
July 7.

---

[1] These reactions have been summarized by Eyring and Stearn (*Chem. Rev.*, 24, 253 (1939)).

[2] Topley and Hume, *Proc. Roy. Soc.*, A, 136, 413 (1931).

[3] Cooper, J. A. (unpublished).

[4] Garner, W. E., *Trans. Farad. Soc.*, 34, 985 (1938).

[5] Spencer and Topley, *Trans. Farad. Soc.*, 27, 94 (1931).

[6] Topley, *Proc. Roy. Soc.*, A, 136, 413 (1932).

[7] Garner and Gomm, *J. Chem. Soc.*, 2123 (1931).

[8] Garner and Marke, *J. Chem. Soc.*, 657 (1936).

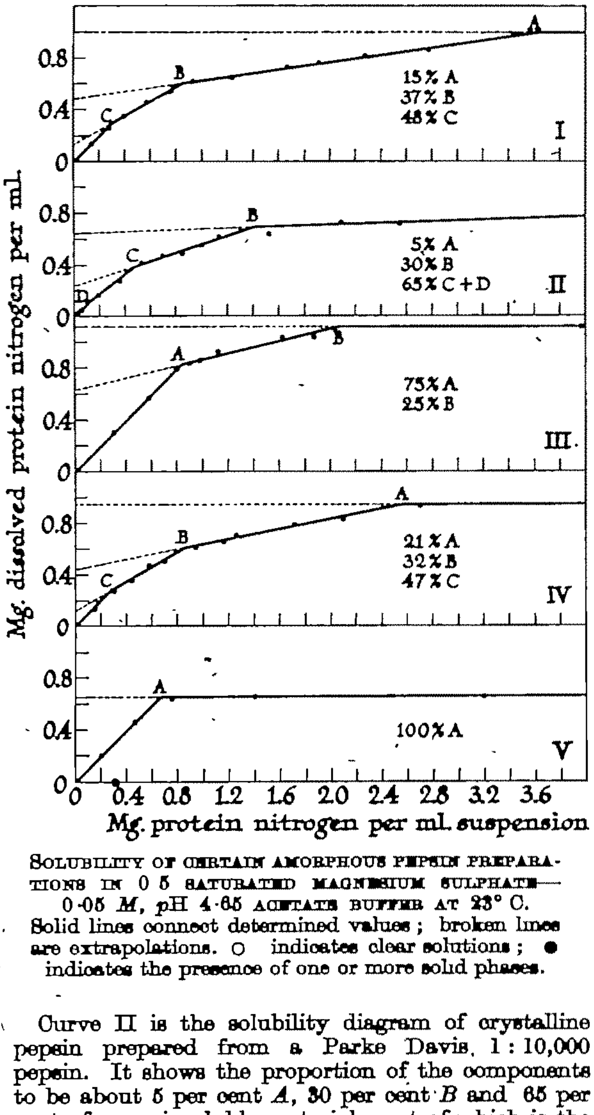
[9] Meldrum, F. B. (unpublished).

[10] Whohin, A. (unpublished).

Existence of Several Active Components in Crude Pepsin Preparations

THE original solubility measurements on crystalline swine pepsin led to the conclusion that the crystals consisted of a single pure protein or several closely related proteins[1]. Since that time, it has become apparent in this and other laboratories[2,3] that pepsins prepared from the various commercial products or from pepsinogen differ in solubility, specific proteolytic activity and stability. Solubility measurements have now been made on various partially purified pepsin preparations in order to determine the cause of these variations.

The results show quite clearly that commercial preparations contain more than one protein possessing peptic activity and that the differences between the various preparations are due to differences in the proportion of the components present. Curve I shows the solubility diagram of the total protein fraction from a commercial 1 : 10,000 Cudahy pepsin preparation. When analysed, as described by Kunitz and Northrop[4], this curve indicates that the preparation is a mixture containing 15 per cent of component *A*, having a solubility of about 0·6 mgm. protein nitrogen per ml. in the solvent used; 32 per cent of *B* having a solubility close to 0·35 mgm. protein nitrogen per ml., and at least one other component, *C*, having a solubility of about 0·15 mgm. protein nitrogen per ml. The average specific activity[4] of this Cudahy preparation was $0\cdot26\ [\text{P.U.}]^{\text{Hb}}_{\text{mgm. P.N.}}$. The experimental methods are not sufficiently precise to allow one to draw positive conclusions with regard to the shape of the curves for the less soluble components.



SOLUBILITY OF CERTAIN AMORPHOUS PEPSIN PREPARATIONS IN 0·5 SATURATED MAGNESIUM SULPHATE—0·05 *M*, *p*H 4·65 ACETATE BUFFER AT 23° C. Solid lines connect determined values; broken lines are extrapolations. ○ indicates clear solutions; ● indicates the presence of one or more solid phases.

Curve II is the solubility diagram of crystalline pepsin prepared from a Parke Davis, 1 : 10,000 pepsin. It shows the proportion of the components to be about 5 per cent *A*, 30 per cent *B* and 65 per cent of more insoluble material, part of which is the *C* component having a solubility of about 0·15 mgm. protein nitrogen per ml., the remainder being designated as *D*. The average specific activity of the preparation was $0\cdot23\ [\text{P.U.}]^{\text{Hb}}_{\text{mgm. P.N.}}$.

Curve III is the diagram of pepsin prepared from pepsinogen by allowing a solution of pepsinogen to stand 18 hours at *p*H 3·6 and 5° C. Under these conditions, a precipitate forms which was discarded. The soluble fraction contains about 75 per cent *A* which therefore precipitates first in spite of its higher solubility, and 25 per cent of other components, most of which is *B*. The specific activity of this preparation was $0\cdot34\ [\text{P.U.}]^{\text{Hb}}_{\text{mgm. P.N.}}$.

If these analyses are correct, then a mixture of o part of pepsin from pepsinogen (Curve III) and thr parts of Parke Davis (Curve II) should contain 22 p cent *A* and 30 per cent *B*, and the average specif activity should be 0·26. The solubility curve of th mixture should be very similar to Curve I. Curve I shows the diagram for such a mixture. The cur indicates 21 per cent *A* and 32 per cent *B*, and th determined specific activity was 0·25, in very go agreement with the expectation.

This result shows that components *A* and *B* for a mixture under these conditions. It cannot b determined with certainty whether *C* and *D* for mixtures or solid solutions since the first part of th curve, where these components appear, is not suf ciently accurate. Either a smooth curve (sol solution) or two straight lines (mixture) fits th results within the experimental error.

Component *A* has been isolated from certa Cudahy preparations of high specific activity. Th solubility, as shown in Curve V, is very near th predicted for *A* from Curves I and III. This prepar tion was strictly homogeneous in the Tiselius electr phoresis cell (we are indebted to Dr. L. G. Long worth for carrying out this determination) and h the migration velocity and specific activity close that found by Tiselius *et al.* for the homogeneo protein present in the preparation analysed them[5]. It has no isoelectric point, as measured the collodion particle method, if the determinatio are made on a fresh solution. On standing, no protein nitrogen appears in solution and the particl become positive at *p*H 1·5. The *A* pepsin has be crystallized. The crystals are indistinguishable form from those previously described. The no protein nitrogen may be removed from the crysta by washing at 10° C. with

$$\begin{cases} M/10 \text{ acetate } p\text{H } 4\cdot0 \\ 0\cdot6 \text{ saturated magnesium sulphate.} \end{cases}$$

The *A* pepsin is much more unstable than *B*, that 10 hours' heating at 55° C. and *p*H 4·6 com pletely destroys it and changes the diagram of Cudahy preparation like that shown in Curve I one similar to that shown in Curve II.

Solubility diagrams of pepsinogen were found al to indicate several components. One pepsinog component present in only small quantities yields unstable pepsin which is nearly twice as active the pepsin previously obtained.

VICTOR DESREUX
(Fellow of the Belgian American Foundatio
ROGER M. HERRIOTT.

Rockefeller Institute for Medical Research,
Princeton, New Jersey.
May 20.

---

[1] Northrop, *J. Gen. Physiol.*, 13, 739 (1930).

[2] Northrop, *J. Gen. Physiol.*, 17, 165 (1933). Herriott, *J. Gen. Physi* 21, 501 (1938). Agren and Hammarsten, *Enzymologia*, 4, (1937). Philpot and Small (unpublished results, see Tiseli *et al.*[5]). Steinhardt, *Cold Spring Harbor Symposia on Quantitat Biology*, 6, 301 (1938). Holter, *Z. physiol. Chem.*, 196, 1 (193 Northrop, *J. Gen. Physiol.*, 15, 29 (1932).

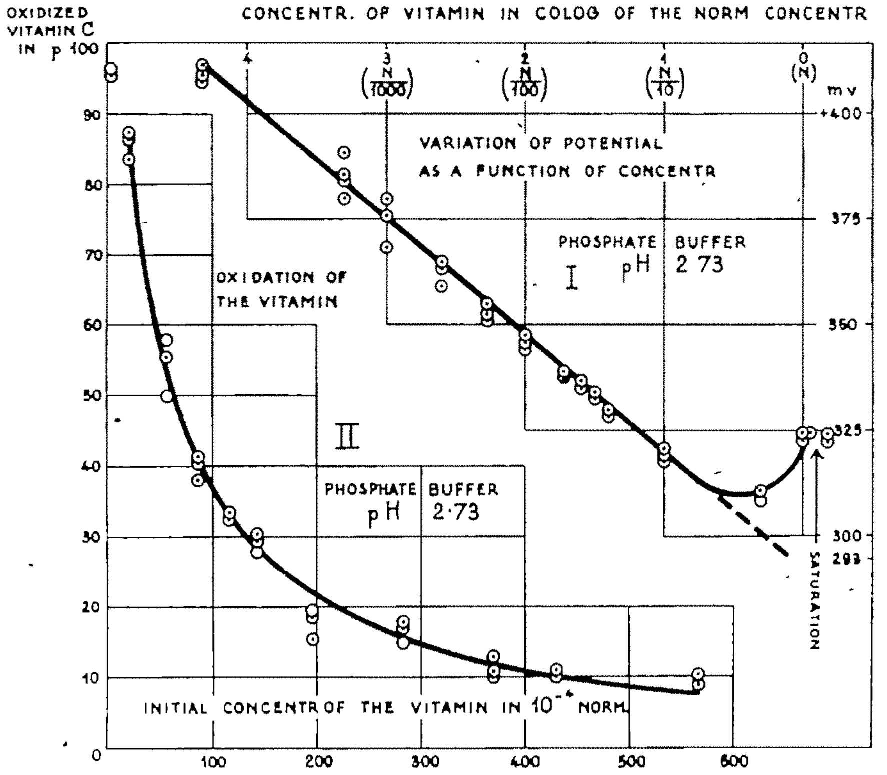
[3] Kunitz and Northrop, *C.R. Trav. Lab. Carlsberg*, 22, 288 (193 *Cold Spring Harbor Symposia on Quantitative Biology*, 6, (1938).

[4] The hæmoglobin method used in this work has been described Anson, *J. Gen. Physiol.*, 22, 79 (1938), and is a modification the previously described method (Anson and Mirsky, *J. G Physiol.*, 16, 59; 1932). The modified method gives results wh are 10–15 per cent higher than the old method and not lower reported by Anson. The specific activity of 0·35 now found the *A* component therefore represents an activity of about 0 by the method previously used.

[5] Tiselius, Henschen and Svensson, *Biochem. J.*, 32, 1814 (1938).

Platinum Potential of Vitamin C Solutions in Contact with Molecular Oxygen

THE platinum potential of solutions containing ological oxidation-reduction agents can be measured hen exposed to air by means of a relatively simple chnique[1].



CURVE I: SOLID LINE—EQUATION (2); RECTILINEAR PART OF SOLID LINE AND BROKEN LINE—EQUATION (1). VARIATION OF PLATINUM POTENTIAL AS A FUNCTION OF THE CONCENTRATION OF VITAMIN C.

CURVE II: SOLID LINE—EQUATION (3). VARIATION OF QUANTITIES OF OXIDIZED VITAMIN C AS A FUNCTION OF INITIAL CONCENTRATION. ON THE ABSCISSA: BOTTOM: CONCENTRATION OF VITAMIN EXPRESSED IN 10^{-4} NORMAL.

ABOVE: CONCENTRATION OF VITAMIN EXPRESSED IN COLOGARITHMS. ON THE ORDINATE; ON THE LEFT: AMOUNTS OF VITAMIN OXIDIZED, EXPRESSED IN PER CENT OF INITIAL CONCENTRATION. ON RIGHT: VALUES OF PLATINUM POTENTIAL EXPRESSED IN +MV.

We have established between the platinum potential E_1) and the concentration (C) of fresh solutions of corbic acid adjusted to a pH 2·7 (phosphate buffer) not pH 2·6 as stated before)[2], and exposed to air at 0° the following relations:

$$(1)\quad E_1 = 0\cdot 2925 \text{ volts} - \frac{RT}{2F} \ln C^{0\cdot 82} \text{ for concen-}$$

ations equal to or less than one tenth normal 7·6 gm. per litre);

$$(2)\quad E_1 = 0\cdot 309 \text{ volts} - \frac{RT}{2F} \ln\left(\frac{C^{0\cdot 82}}{(C^{1\cdot 17} + 0\cdot 52)^2}\right)$$

or all concentrations.

These equations do not take into account the versible reaction that seems to be very peculiar n this case. However, they express with a sufficiently ccurate approximation the ratio between the conentration of ascorbic acid in solution and the latinum potential of the same (see curve 1).

A study of the oxidation of vitamin in solution ept in contact with air, without stirring, for 24 hours at 37°, with a pH of 2·7 (phosphate buffer), gave the following equation:

$$(3)\quad (E_1 - 0\cdot 3534)\, 0\cdot 42 + \frac{0\cdot 00047}{0\cdot 3654 - E_1} = \log \frac{C_{\text{ox}}}{C_{\text{red.}}}$$

where C_{red} is the concentration of intact ascorbic acid, C_{ox} that of the oxidized vitamin, and E_1 the potential of fresh solutions at a temperature of 20°, as given by equations (1) and (2). The close agreement of the quantities of oxidized vitamin, both determined experimentally and calculated as a function of E_1 according to equation (3) (see curve II), shows that the values of E_1 were determined accurately.

Another argument in support of the relation set forth, between the dilution and the state of the ascorbic acid molecules, is given by Heintz[3]. This author has studied the infra-red absorption spectra of ascorbic acid present in the solid state and in 0·4 N and 0·1 N solutions (phosphate buffer, pH 2·7). Heintz finds that spectra of ascorbic acid present in the solid state and in the 0·4 N solution are similar; but that a marked change appears in the 0·1 N solution.

We call the potential E_1, as defined by equations (1) and (2), the potential of electronic affinity. This represents the tendency toward oxidation, that is, the reducing activity of ascorbic acid. The concentration of ascorbic acid checks its reducing activity, which determines the constant of the potential of solutions (pH 2·7 at 20°) near 0·4 *N*. In complex media, the vitamin activity can obviously be limited by factors other than its own concentration. In biological media with *r*H clearly above 16·2, the stability of ascorbic acid is due principally to this cause. In fact, it is known that the normal oxidation-reduction potential of ascorbic acid[4] corresponds to a *p*H of 7 with an *r*H of approximately 16·2, while the average value of the blood *r*H is[5] 20·8.

We wish to thank most cordially the Translation Service of the North Carolina State College, Raleigh, N.C., for help in the translation of this article into English.

N. BEZSSONOFF.
M. WOLOSZYN.

Clinique Infantile,
Faculté de Medecine,
Strasbourg.
June 20.

[1] Bezssonoff, N., and Woloszyn, M., *Bull. Soc. Chim. Biol.*, 21, 208 (1939).

[2] Bezssonoff and Woloszyn, *loc. cit.* The *p*H stability of the ascorbic acid solutions was ascertained by means of an antimony electrode system.

[3] Heintz, *C.R. Acad. Sci.*, 208, 1893 (1939).

[4] Borsook, H., and Keighley, G., *Proc. Nat. Acad. Sci.*, 19, 1875 (1933). Wurmser, R., *Actual. Sci. et Indus.*, 244, 56 (1935). Ball, E., *J. Biol. Chem.*, 118, 219 (1937).

[5] According to the potentiometric measurements of Vles, Reiss and Deloyers, *C.R. Soc. Biol.*, 108, 37 (1931). Outevskaya, *Bull. Biol. et Med. Exper. U.R.S.S.*, 5, 226 (1938). Rafalkes, Tzoutsoulkovskaya et Chmeerson, *Bull. Soc. et Med. Exper. U.R.S.S.*, 5, 191 (1938).

Ozonization of *O*-Xylene and the Structure of the Benzene Ring

A. A. Levine and A. G. Cole[1] ozonized *o*-xylene and were able to isolate diacetyl from the reaction product, while methylglyoxal and glyoxal were isolated in the form of the osazones by means of *p*-nitrophenylhydrazine. This result is of great importance for the theory of the structure of the benzene nucleus. In their paper, Levine and Cole give no evidence about the yield of the substances isolated. Therefore we have reinvestigated this reaction using another analytical method. We have transformed the decomposition products of the ozonides into the corresponding oximes and we have worked out a method for separating the oximes quantitatively.

O-xylene (solidification point − 27°) was ozonized in chloroform solution at − 25°, using oxygen with 2·5 per cent ozone until about the calculated quantity of ozone had been taken up. From the reaction product we isolated:

(1) The oxime of dimethylglyoxal melting at 233–234°, mixed melting point with an authentic sample (m.p. 234–235°) 233·5–234°. (2) The oxime of methylglyoxal melting at 150·5–151·5°, mixed melting point with an authentic sample (m.p. 152·8–153·1°) 152–152·5°. (3) The oxime of glyoxal melting at 170·5–171·5°, mixed melting point with an authentic sample (m.p. 172·5–173°) 171·2–172°.

The yield of oximes amounted to about 20 per cent of the theoretical yield calculated on *o*-xylene. The composition of the mixture was roughly determined as follows: 0·88 mol. of dimethylglyoxime, 2 mol. of methylglyoxime and 3·2 mol. of glyoxime, while the calculated ratio should be 1 : 2 : 3, if th
two Kékulé forms each contribute 50 per cent
the structure of *o*-xylene. It will be necessary
improve our analytical method before we can gi
the exact value for the molecular ratio of the oxime

The work of two independent groups of worke
now affords chemical evidence for the occurrence
o-xylene of two resonating Kékulé structures. Th
investigation is being continued from the quantitati
point of view; full details will be published in th
Recueil des Travaux Chimiques des Pays-Bas.

J. P. WIBAUT.
P. W. HAAYMAN.

Laboratorium voor Organische Scheikunde,
Universiteit, Amsterdam.

[1] Levine, A. A., and Cole, A. G., *J. Amer. Chem. Soc.*, 54, 338 (193

Photo-oxidation of Pyrrhole

FRESHLY redistilled pyrrole dissolved in wate
alcohol or acetone and mixed with $0 \cdot 5 \times 10^{-4}$
methylene blue rapidly takes up oxygen in the lig
but not in the dark. Pyrrole alone is not oxidize
The rate of oxygen uptake is a linear function
light intensity. Eosin, but not fluorescein, can
used instead of methylene blue. Tests with standa
optical filters showed the effective wave-lengths
be within the range of 5200–5800 A. On the ba
of 5500 A., the energy necessary to institute th
reaction is $3 \cdot 4 \times 10^{-12}$ ergs/molecule.

Two atoms of oxygen are taken up per molecu
pyrrole. There was no decarboxylation or deamin
tion. The methylene blue was removed by a minim
amount of charcoal and the solution evaporated
dryness. The residue was extracted with aceto
which on evaporation left crystals. These we
recrystallized several times from boiling benzen
The analysis was C, 49·1 per cent, H, 5·3 per cen
N, 14·1 per cent; m.p., 102·5°; yield, 58 per cen
Mixed melting point determinations showed th
the substance was not succinimide. On alkali
hydrolysis, it yielded 14 per cent ammonia nitroge
and 72 per cent succinic acid.

n-methyl and *n*-ethyl pyrrole are also oxidize
under the same conditions, but only one atom
oxygen is taken up per molecule.

FREDERICK BERNHEIM.
J. E. MORGAN.

Duke University Medical School,
Durham,
North Carolina.
June 29.

Crotoxin

IN May of last year[1] we announced that we ha
been able to purify and crystallize the chief tox
principle of rattlesnake venom, which we calle
crotoxin. Crotoxin contains the whole neurotox
and hæmolytic activity of the crude venom; bu
both have a 25 per cent greater activity than th
crude.

The following are the main points of evidence th
crotoxin is a pure and homogeneous substance:

(1) The analytical data[2] obtained from differe
samples of crotoxin at different times are the sa
(C: 50·77 per cent and 50·56 per cent; H: 6·41 p

nt and 6·47 per cent; N: 15·86 per cent and 4·90 per cent; S: 3·96 per cent and 4·03 per nt).

(2) Five recrystallizations of crotoxin did not alter neurotoxic and hæmolytic activity.

(3) The solubility curve of crotoxin at different nmonium sulphate concentrations[3] shows the raight line typical of pure substances[3].

(4) Gralén and The Svedberg[4] were able to show at crystalline crotoxin in the ultracentrifuge "be-yed in sedimentation and diffusion as a homoneous substance".

Recently Gosh and De[5] reported one experiment: solution of 100 mgm. of crude rattlesnake venom crete was saturated with sodium chloride. After anding for one night at 6° a precipitate was obtained hich contained 8–10 per cent of the original hæmotic and 2–2·5 per cent of the neurotoxic activity. rom this difference of the ratio of neurotoxic to emolytic activity in such a precipitate, the Indian thors conclude that our crystalline crotoxin cannot a homogeneous substance.

We see no reason to discuss such experiments ecuted with the crude venom secrete since we have ready shown how to crystallize the active principle rattlesnake venom, easily and in good yield.

K. H. SLOTTA.

Sao Paulo,
Brazil.

H. FRAENKEL-CONRAT.

Berkeley,
California.

---

lotta, K. H., and Fraenkel-Conrat, H., NATURE, 142, 213 (1938).

lotta, K. H., and Fraenkel-Conrat, H., *Ber. Dtsch. Chem. Ges.*, 71, 1076 (1938).

ohn, E. J., *Phys. Rev.*, 5, 349 (1925).

ralén, N., and The Svedberg, *Biochem. J.*, 32, 1375 (1938).

osh, B. N., and De, S. S., NATURE, 143, 380 (1939).

Cytology of the Common Male Fern in Britain

IN a paper which has just come to hand by Döpp[1], tological observations of some importance are given ith regard to the genus Dryopteris (= Lastrea = ephrodium) in Europe. In particular, and among ther things, apogamy is reported in "*D. paleacea*" om four localities in Germany and Switzerland and e chromosome number in one of these plants is ven as "*c.* 130" in contrast to the sporophytic umber for normal *D. Filix-mas* which was preiously found by the same author to be *c.* 160[2].

These observations are so closely cognate to a large ody of work which has been in progress for some ars on the British fern flora, that it may perhaps void a profitless duplication of effort, if the main ots which I have obtained for *D. Filix-mas* (*sensu ta*) in Britain are summarized in advance of the ain paper.

So long ago as 1855[3], a very shrewd field collector, ollaston, expressed the view that at least two of e varieties described for the male fern in Great ritain, namely, the varieties *Borreri* and *abbreviata* Newman, were worthy of specific rank. Newman's rietal names were regarded as synonymous with e varieties *paleacea* and *pumila* of Moore; but to nphasize the idea of specific distinctness Wollaston troduced two new terms, namely, *pseudo-mas* and *opinqua*[4]. These have never penetrated deeply to purely botanical literature, but they have been (and still are) widely used by amateurs and fern collectors in Great Britain. They are a commonplace of English pteridological handbooks of the older school (for example, Druery[5]) and are represented in the *L. pseudo-mas* var. *polydactyla* Wills and Dadds quoted by Dopp. By modern rules of nomenclature both *pseudo-mas* and *propinqua* are illegitimate, since priority rests with the names of Newman. In view of their historical importance, however, it is necessary that their meaning should be understood.

My own work on this subject began in 1936 with the discovery of an apogamous plant from central Ireland with *c.* 120 chromosomes. This plant was identified by Mr. Alston of the British Museum as *D. Filix-mas* var. *Borreri* Newm. The cytological findings were at that time so unexpected that field investigations were at once undertaken in order to elucidate them. In the three years which have elapsed, cytological observations have been made on nearly one hundred plants from more than twenty localities in England, Scotland, Ireland and Wales. In carrying out this field exploration, Wollaston's classification has been found to be of the greatest service and has indeed been the only one which could immediately be applied to the problem. The results are as follows:

(1) Wollaston's *L. propinqua* (= *abbreviata* Newm). has been obtained from England, Ireland and Wales. It reproduces sexually and has a gametic chromosome number of 40–41. This number I regard as haploid and the sporophytic number (*c.* 80) of this form as diploid.

(2) Wollaston's *L. Filix-mas* proper, the commonest hedgerow type in England, also reproduces sexually, but has a sporophytic chromosome number of *c.* 160 (as previously reported by Döpp)[2]. This number I regard as tetraploid; but the meiotic behaviour is not that of a recent auto-tetraploid.

(3) Wollaston's *L. pseudo-mas* (= *Borreri* Newm. = *paleacea* Moore) appears to be exclusively apogamous and therefore contains a potentially infinite variety of true-breeding strains. My own first plant with *c.* 120 chromosomes and presumably also those of Döpp ("*c.* 130") I interpret as triploids. Local populations of diploids, with *c.* 80 chromosomes and tetraploids with *c.* 160, all apogamous and with the morphology of *pseudo-mas*, have since been met with and there may be still higher polyploids to be discovered.

There is strong evidence to suggest that all three of Wollaston's types can hybridize; but I do not consider this to invalidate the conclusion that they could and should be regarded as three distinct species. I therefore agree with Döpp's desire to accord specific rank to *D. paleacea* though this is clearly only a part of a larger problem.

While further discussion must be left to the fuller statement, a word of appreciation may perhaps be allowed here for the abilities of a man like Wollaston who, with only the morphology to guide him, should have correctly divined these relationships, against the views of contemporary botanists.

I. MANTON.

Botany Department,
University, Manchester,
July 31.

---

[1] Dopp, W., *Planta*, 29, 481 (June 1939).

[2] Dopp, W., *Planta*, 17, 86 (1932).

[3] Wollaston, G. B., *The Phytologist*, 1, 171 (1855).

[4] Wollaston, G. B., *The Phytologist*, 6, 415 (1862).

[5] Druery, C. T., "British Ferns and their Varieties", London (1910).

Role of the Renal Innervation in Kidney Function

OBSERVATIONS have been made on the role of the renal innervation in kidney function. A dog's kidney was transplanted to the inguinal region by end-to-end anastomosis of the renal vessels to the femoral; the bladder and distal ureteral orifices were exteriorized. Convalescence was uneventful and both kidneys gave every tested physiological evidence of normal function. During antidiuretic, that is, normal, urine flows, the rate of urine flow and of glomerular filtration is greater in the transplanted kidney than in the untransplanted kidney of the same animal. Following administration of a large quantity of water or of a small dose of adrenalin, the above differences become strikingly reversed; this strongly suggests that the transplanted kidney has continued to be effectively denervated. It was demonstrated that phenol red, water and chloride secretion are pra tically identical in both kidneys *per unit volume glomerular filtrate*. Cogent evidence is present indicating that adrenalin normally acts indirectly the vas efferens of the glomerular vascular tufts, th is, only by way of the renal nerve supply, and th "pituitrin" acts directly on the tubules. The wo will shortly be published in full.

N. S. RUSTUM MALUF.
ROBERT W. CLARKE.

Laboratory of Physiology,
Yale University School of Medicine.

KENNETH W. THOMPSON.

Department of Surgery,
Yale University School of Medicine.
June 15.

Points from Foregoing Letters

Absorption experiments have been made in lead and air of the primary radiation responsible for the heavy particle component of the cosmic rays. It is shown by W. Heitler, C. F. Powell and G. E. F. Fertel that this primary radiation consists neither of electrons nor mesotrons, and it is suggested that the best working hypothesis is provided by the assumption that the heavy particles are produced by neutrons. An atomic 'explosion' has been observed in which one of the fragments consists of a highly charged nucleus with a very great specific ionization and showing marked effects due to 'capture and loss'.

A. and E. Vassy infer from computations of the mean temperature of atmospheric ozone, which agree with radio-sounding measurements, that in arctic countries the stratosphere is very hot in summer and very cold in winter; the higher the altitude, the greater the difference between the extreme temperatures.

M. E. J. Gheury de Bray states that the velocities of recession of extra-galactic nebulæ are so large as to throw doubt on their reality. An alternative explanation of the red-shift is proposed, based on the fact, shown by every observation made during the last half century (seven determinations), that the velocity of light decreases with time.

C. H. Douglas Clark has extended his work on the relation between dissociation energy and internuclear distance of carbon-carbon linkages to di-atoms of the HH, KH and KK periods in ground states. It is found that, with the aid of a relation due to Sutherland, this leads to new functions involving bond constant and internuclear distance, having characteristic values in given periods for di-atoms of similar electronic configuration. It appears that extension to excited states is possible.

G. W. Scott Blair and Miss F. M. V. Coppen have shown that the compression moduli of nearly elastic rubber cylinders can be subjectively distinguished with three times the accuracy obtaining in the case of the viscosity of truly fluid bitumens, and have found certain significant differences between subjects having different types of training.

Minute nodules containing vanadium have been found by J. Newton Friend and R. H. Vallance in the Keuper marls of Worcester. They are surrounded by a greenish aureole in the red marl and, in composition, resemble the larger nodules found in t red Permian marls of Budleigh Salterton.

In reactions in organized condensed systems, t rate of reaction is given by the Polanyi-Wign equation when but few molecules or chemical bon are involved in the unit process. In order to accou for the high rates of reaction met with in a numb of complex processes, comparative activation is su gested by W. E. Garner as a possible mechanism.

V. Desreux and R. M. Herriott have analys several commercial pepsin preparations by t solubility curve method. Measurements showed th at least three or four active proteins are prese which differ from each other in solubility, stabilit and specific activity. One of the active componen was isolated in solubility pure form and crystalliz The proportion of the components varied in t different commercial preparations.

N. Bezssonoff and Mme. Woloszyn give the equ tion of platinum potential as a function of concentr tion of ascorbic acid in fresh solution in contact wi oxygen. The potential becomes practically stab when the reducing activity of the vitamin is check by its own concentration. Inhibition of this activi by factors other than concentration explains t presence of intact ascorbic acid in biological med where the oxidation-reduction level is very high.

From the reaction product obtained by the ozoni tion of *o*-xylene J. P. Wibaut and P. W. Haaym isolated dimethylglyoxime, methylglyoxime a glyoxime in a molecular ratio of about 0·88 : 2 : 3 and a total yield of about 20 per cent calculated *o*-xylene. This result, which corroborates the qualit tive results of A. A. Levine and A. G. Cole, giv evidence for the occurrence of two resonating Kéku structures in *o*-xylene.

According to F. Bernheim and J. E. Morgan pyrro is rapidly oxidized in the presence of methylene bl and light. A substance of unknown structure is form which on hydrolysis yields succinic acid and ammoni

Cytological evidence is quoted by I. Manton reply to a paper by Döpp to show that the comm male fern (*Dryopteris Filix-mas*) in Britain real consists of three distinct species, one of which sexual and diploid, another is sexual and tetraploi while the third is apogamous and contains a varie of polyploid forms.

RESEARCH ITEMS

Aboriginal Races of India

B. S. GUHA in a racial analysis of the aboriginal peoples of India (*Science and Culture*, 4, 17, June, 939) points out that of the inhabitants of all India, 22¼ millions, in round numbers, are still in a primitive state, living by hunting, fishing and on forest produce, and forming 6¼ per cent of the entire populaion, but that if to these are added the fifty millions and more of the so-called "exterior castes", who are mostly detribalized primitive folk in process of entering the Hindu social system, the proportion becomes twice or even thrice this figure. Regionally hese tribes are grouped into three separate zones. 1) A northern and north-eastern division of about hree million people, scattered over a very large area of the sub-Himalayan region and the mounainous territory of Assam and north-eastern India, and merging into those of Burma and Yunnan. 2) A central division occupying small hills and plateaux traversing the entire breadth of the country from the Gulf of Cambay to the Orissan coasts, and omprising the Bhil, Gond, Kol, Oraon, Munda-Santal, etc. (3) The southern division, the smallest, ontaining little more than a hundred thousand people, spread over the hills of southern India, especially he extreme south-western strip. There is a rough parallel between the geographical distribution and the linguistic affinities of these peoples. Among the northern and north-eastern group the languages are of the Tibeto-Chinese family, with certain small exceptions. In the central division the languages poken belong chiefly to the Munda branch of the Austric family, though certain peoples have adopted Aryan and Dravidian tongues. The southern group now speak entirely Dravidian languages in corrupt forms; and in the absence of a linguistic survey here is no means of knowing whether any traces of heir original languages, Austric or other, survive. The same parallelism, however, does not exist in physical features, which show strains of Negrito, Proto-Australoid, a brachycephalic element with two ubdivisions, one being more primitive than the other, and fourthly a medium-statured dolichocephalic element chiefly distributed in the Assam hills and mixed no doubt with short-statured Palae-Mongols.

Negro Education in the United States

AN analysis of the statistics of negro education in he United States of America for the years 1933–4 and 1935–6 by David T. Brose and Ambrose Caliver U.S. Department of the Interior, *Bull.* 1938, No. 13) collects evidence of progress in dealing with one of he vital population problems of the country. Despite he depression, remarkable advance was made beween 1933 and 1936, as also in the two preceding decades, more especially in the number of public high schools and their enrolment. In 1915, 58 per cent only of the negro children were enrolled in school; in 1930, the percentage had risen to 84; and in 1936 it is probably greater. This increase repreents, among other things, a growing appreciation by the negroes of the value of education in the olution of their problems. It is now recognized among them that "the improvement of the rural and urban masses in health, honesty, labour and thrift is directly dependent on the public elementary school". Among definite results illiteracy has been reduced from 30 per cent in 1910 to 16 per cent in 1930. The number of elementary and secondary school enrolments in 1935–6 totalled 2,438,981, being 24·2 per cent of the total negro population of 18 States. This is a slight decrease from 24·5 per cent in 1931–2, but represents a slight increase from 81 to 82·8 per cent of the negro child population between the ages of five and seventeen years. The fluctuation between 1917–1936, probably due to economic causes, shows a definite upward trend for six years following on the Great War, a recession in 1924–28, followed by a sharp rise in the boom years 1929 and 1930, with a continued high percentage in the years of depression, due in part to lack of employment, in part to assistance from public funds. The number of schools in 1935–6 is public elementary, 24,405, public high schools, 2,305, the latter a great development from 64 in 1915–16.

Human Schistosomiasis and its Intermediate Hosts

DR. ALAN MOZLEY (*Trans. Roy. Soc. Edin.*, 59, No. 26; 1939) has described twenty-six species of freshwater molluscs from Zanzibar, Pemba and Tanganyika Territory as a preliminary to the study of the species concerned with the transmission of the parasite causing schistosomiasis in man. Although the infection is slight when compared with conditions in Egypt, yet its effects are considerable, and might, in the opinion of the author, be brought under control by extermination of the molluscs over infected areas. In Zanzibar and Pemba, 10–70 per cent of the natives are infected with *Schistosoma hæmatobium*, while in Tanganyika *S. mansoni* is the prevalent parasite. Mozley suspects that *Physopsis globosa* (Morelet) transmits *S. hæmatobium*, and was able to prove experimentally that *Biomphalaria pfeifferi* carries *S. mansoni*. He describes the general ecological conditions governing the life and distribution of freshwater molluscs in the area, noting that as a result of these conditions the distribution is strictly limited to a small proportion of the ponds, lakes and streams. He discusses control methods involving destruction of the molluscan intermediate host, recommends drainage, flushing and chemical means, but considers that plant poisons and biological control methods are not yet fully worked out. He is optimistic, however, that the disease could be stamped out in Zanzibar within five years, and over the whole area in a somewhat longer period.

Pleiotropic Gene-effects in the Rat

H. Grüneberg, 1938, and H. B. Fell and H. Grüneberg (*Proc. Roy. Soc.*, B, 125, 123–144, and 127, 257–277; 1939) have investigated the effects of a gene in the rat which, in the homozygous condition, causes the death of the individual. About the time of birth the rib cartilages become abnormal (formation of thick capsules around the cartilage cells, and a very active cell proliferation). These abnormalities give rise to secondary symptoms the intensity of which differs in different individuals. The abnormal thickening of the rib cartilages leads to a distortion of the thoracic basket and internal organs. Respiratory rib movements become impossible. As a consequence, emphysema of the lungs and sometimes compensating collapse in some regions of the lungs develops. Heart trouble occurs regularly as a consequence of the emphysema. Death occurs suddenly or slowly, depending on the type of cardiac failure which is induced, and not infrequently due to hæmorrhages into the lungs. Other deaths are caused by an inability to clean dirt from the nose which is normally brought about by sneezing. The presence of dirt prevents effective suckling, and starvation results. By reciprocal transplantation and tissue culture methods, it is shown that the abnormality of the cartilage is self-differentiating in post-embryonic life.

Vegetative Propagation of a Fern

The number of vascular cryptogams which can be propagated vegetatively is remarkably small, but a recent short paper by E. E. Kemp (*Gard. Chron.*, July 15) describes an unusual method of regeneration from isolated, swollen leaf-bases of the fern *Marattia fraxinea*. These organs, which persist on the plant after the leaves have fallen, were placed on the surface of a coco-nut fibre rooting medium in a propagating case with a bottom temperature of 80° F. Buds then formed on the abaxial surface, either upon the leaf-base itself, or upon one of the stipules. When the buds had produced several roots from the base, they were removed and grown separately, still in the propagating case. The method offers one of the most economical means of vegetative propagation, since the old leaf-base will continue to produce additional buds until its stores of food become exhausted.

Smut Fungi of India

A paper by B. B. Mundkur (*Trans. Brit. Mycol. Soc.*, 23, Pt. 1, 86-121, May 1939) gives the results of a critical re-investigation of forty-four collections of Indian smut fungi in the Herbarium Cryptogamæ Indiæ Orientalis of the Imperial Agricultural Research Institute at New Delhi. Only twenty-five species are represented in the collections, but seven of these are now described for the first time, and five are new taxonomic combinations. The new species are *Ustilago polytocæ*, *U. barberi*, *Sorosporium pennisetii*, *S. avmatii*, *Sphacelotheca dinebræ*, *S. sahayai* and *Tilletia ajrekari*. The collections are not exhaustive, for 110 species of smut fungi are recorded for India. These new species are, however, parasitic upon plants which are peculiar to that region, and it is gratifying to see such progress in their critical determination as is revealed by the paper under review.

Solubility of Cements

A publication by the Department of Scientific and Industrial Research, "The Solubility of Cements", (Building Research Technical Paper No. 26. London: H.M. Stationery Office, 1939, 6*d*. net), describes some investigations made for the Joint Sub-Committee on Special Cements of the Institution of Civil Engineers and the British Committee on Large Dams. The report deals with the deterioration of cements when exposed to certain types of waters, especially soft waters common in many mountain areas, and tests made with five types of cement show that the extractio tests on ground set cements, developed originally i Sweden, afford a simple measure of their susceptibilities to attack adequate for practical purposes.

Physics Research at Harvard

Vol. 4 of Series 2 of *Contributions from the Physica Laboratories of Harvard University* for the year 193 includes fifty-four papers which have appeared in th *Physical Review* and other scientific periodicals up t March 1938. About 18 per cent of them are from th high pressure laboratory of Prof. Bridgman in whic the physical properties of substances at pressures o the order of 45,000 atmospheres are being investigated about 11 per cent from that of Prof. Van Vleck whic deal with magnetic susceptibilities and dielectri constants; 9 per cent from that of Prof. Pierce whic deal with vibrations and supersonics, and others fro the laboratories of Profs. Bainbridge, Oldenberg an Street dealing with mass spectra, molecular spectra radioactivity and cosmic rays respectively. I addition, there are papers by other members of th staff and by seven fellows either of Harvard o national research fellows, and Dr. E. H. Hall ha two papers on the four transverse magnetic effect which he has measured with greater accuracy tha has been possible hitherto. With the staff availabl at Harvard a wide field of research can be covered and the amount of work done is impressive.

The Absolute Ampere

Since the decision of the International Committe on Weights and Measures in 1927 that the materia standards for all electrical units should approximat as closely as possible to the absolute theoretical units the standardizing laboratories of the world have bee determining with the precision now available th values of their concrete standards in terms of th absolute units. The International Ampere was defined at the London International Conference in 190 as depositing 0·001118 grams of silver per second The precise measurement of current depends i practice on the use of a potentiometer, a standar ohm and a standard cell, which each laborator possesses. The comparison between the ampere s measured and the absolute ampere as measured b some form of current balance has been made i several of the most important national laboratories That made recently at the Bureau of Standards b H. L. and R. W. Curtis and C. L. Critchfiel is described in Research Paper R.P. 1200 of th Bureau. By means of an improved form of Rayleig balance, they find that the Bureau Internationa Ampere is 0·99986 absolute amperes, which agree exactly with the result obtained at the Nationa Physical Laboratory three years ago for the N.P.L. International Ampere.

Balloon Experiments in High Latitudes

H. Carmichael and E. G. Dymond (*Proc. Roy. Soc.* A, 171, 321; 1939) have now published the result of their balloon experiments made near the geomagnetic pole in North-West Greenland (see Nature 141, 910; 1938). The primary object of the experiments was the determination of cosmic ray intensitie at high altitude, and two forms of apparatus wer used: a coincidence counter set which transmitte wireless signals during its flight and which did no need to be recovered, and a photographic recordin ersion of the 'ticking' quartz fibre electroscope. The alloon technique was based on that of Regener, and everal flights were made with both sorts of apparatus p to about 20 km. The results, when compared ith those of other workers at lower latitudes, indicate hat there is practically no increase in the cosmic adiation incident at the top of the atmosphere between eomagnetic latitude 50° and the geomagnetic pole. ince cosmic rays of low energy, between $3 \cdot 10^7$ and $\cdot 10^8$ ev., would be admitted in increasing numbers y the earth's magnetic field in this region, it must e concluded that no rays of low energy reach the arth from outer space. They may, perhaps, be cut ff by some external magnetic field such as that of the un. The expedition obtained a good deal of aero-gical data from the flights made by the apparatus nd incidentally with pilot balloons. The stratosphere ind speeds found on this summer expedition were ery low and the apparatus often descended near its tarting point. The tropospheric wind speeds showed well-defined maximum at about 9 km., probably ust below the tropopause. A meteorograph flight howed a well-marked tropopause at 11·2 km. and n unusual rise of temperature in the stratosphere.

eflectivities in the Ultra-Violet

G. B. Sabine (*Phys. Rev.*, 55, 1064; 1939) has ade an investigation of the reflecting power of a umber of evaporated metal films in the wave-length egion from the visible to λ 450 A. Aluminium has high reflecting power down to λ 2000 A., which falls ff steadily at shorter wave-lengths. Below 1200 A. is exceeded as a reflector by several metals. Silver, e is well known, reflects very little in the neighbourood of 3000 A. Below this its reflectivity rises again. ts value in the region of 1000 A. is about 10 per ent, and is higher than that of most metals. Platinum the best mirror found for wave-lengths less than 200 A., and its reflectivity from 1200 A. to 400 A. aries from about 15 per cent to about 8 per cent. ata are also given in the form of reflectivity curves r Pb, Mn, Be, Fe, Pd, Ni, Ti, Au, Cd, Zn, Te, Mo, r, Bi, Mg, Cr, Sb, Cu.

eneral Analysis

This striking analogies between apparently unlated branches of mathematics led the late E. H. oore to assert that there must be a general theory, hich he called general analysis, underlying these articular theories and unifying them. His first ttempt to develop such a theory was of a postutional nature. This is fully accessible in his published apers. His second attempt, of a more constructive pe, occupied him from 1915 until his death in 1932; ut it has hitherto been described only in fragmentary rm and in scattered papers. The American Philophical Society has now undertaken to present a full count of the theory. The first part appeared in 35, and dealt with the algebra of matrices. The cond part, the fundamental notions of general alysis, appeared this year. There are two more rts still to come, generalized Fourier series and odular spaces, and the characteristic value problem general analysis. The work has been carried out R. W. Barnard, who has revised Moore's notes d provided an introduction to each chapter, so as render as easy as possible the comprehension of hat must, in view of its generality, necessarily be a ghly abstract theory.

Fission of Rotating Bodies

R. A. Lyttleton has published a paper (*Mon. Not. Roy. Astro. Soc.*, 99, 7; May 1939) replying to K. E. Edgeworth's criticism of some of his views (see Nature, July 8, p. 81). Lyttleton points out several inaccuracies in certain dynamical principles in Edgeworth's paper, and a few of these are worthy of notice. Edgeworth believes that in the rapid and continuous transition of a satellite from a circular to a parabolic orbit the kinetic energy at a selected point on the latter orbit must be considerably greater than that possessed in its original circular orbit. Lyttleton shows that this is incorrect; the energy of escape varies inversely as the distance apart of the components and the kinetic energy in circular motion is half the kinetic energy in parabolic motion at the same distance. Using the figures which were given in Edgeworth's paper, the amount of energy possessed by the satellite in the circular orbit is about four fifths the energy that it has in the parabolic orbit—not a great difference and considerably less than Edgeworth estimated. In addition, it is shown that the direction of the force required to produce parabolic velocity should be nearly perpendicular to the direction drawn by Edgeworth in his paper. This force is actually radial in direction and is due to pressure, and no mention of this pressure is made by Edgeworth. Lyttleton next shows that the process of fission described by Edgeworth is open to serious doubt. When Jeans suggested the mechanism of the initial development of the pear-shaped figure in 1928, it was not then generally recognized that the pear-shaped figure is ordinarily unstable, and in point of fact the pear-shaped series of figures does not come into existence. Irrespective of this, the details of the process of fission developed by Edgeworth are open to doubt. In particular, why should the spiral arm just extend to Roche's limit, and why should the velocity be such that the tip of the arm does not come within the limit again and suffer disruption? These and other objections seem to impair very seriously the validity of Edgeworth's criticism of certain views advocated by Lyttleton.

Twelve New Southern Variables

Mr. J. B. G. Turner has given a brief description of his discovery of twelve southern variables with the Victoria 24-inch telescope, Cape of Good Hope (*Mon. Not. Roy. Astro. Soc.*, 99, 7; May 1939). The plates taken for parallax determination consist of upwards of twenty-five, divided nearly equally among five epochs of observation, an epoch representing at least four weeks. A plate of good definition was selected as standard, and the remaining plates were in turn superposed upon it so that the star images of the upper plate were brought into proximity to, but not exact coincidence with, the corresponding images of the standard plate. The resulting pairs of images were then examined for evidence of variation. When a star was suspected of variability, comparison stars were selected as close to it as possible, and when their magnitudes were established, the magnitude of the variable was determined from a comparison of the size and density of its image on each plate with those of the comparison stars on the same plate. A description is given of the method finally adopted for the determination of the magnitudes of the comparison stars, which proved very satisfactory.

RECENT ARCHÆOLOGICAL EXCAVATIONS IN EGYPT

THE Merimda Civilization. Results of importance for their bearing on stratigraphical relations and development in culture were obtained in the excavations of the Academy of Sciences on the prehistoric site of Merimda-Beni Salama, west of the Nile Delta, which lasted from January 25 until April 4, 1939. In this season—the seventh devoted to this site—it has been demonstrated that of the various levels each corresponds to a different stage of development, contrary to the earlier conclusion that the Merimda civilization was uniform throughout. Although, it is true, the population did not change, and the mode of life throughout was the same—the practice of agriculture, combined with stock-breeding and hunting—while their weapons and tools were similar, and their burial customs identical, yet it is now possible to trace development.

Three levels of occupation can be distinguished. The first is a wide stretch of sand, yellowish in colour, on which the inhabitants lived in lightly constructed huts, too widely spaced to prevent the invasion of the sand, in which the hearths are visible in black, while the interments are shown by greyish tints. The second level is of a light grey colour, showing a series of superimposed surfaces, hardened by occupation. The constructions were closer together, and of a more solid character. The third layer is of a deep blackish colour, consisting in the main of the debris of human habitation, in which the proportion of sand is very much less than in the earlier levels. The settlement evidently was a much closer agglomeration of structures, oval in shape and constructed of lumps of clay, which make their appearance for the first time together with large baskets for cereals. These baskets were buried in the earth, and are replaced later by large pottery jars. The evidence shows a development from a scattered occupation to a compact town, traversed by streets.

It has now been established that numerous types of pottery found in the primitive settlement are perpetuated throughout the whole duration of occupation, but that others disappear in the course of development. Such, for example, is the fate of fine basins of a hard clayey material, with a brilliant red polish on the exterior, except for an unpolished horizontal band engraved with a palm-leaf motif. This is found more rarely and of inferior quality in the second layer, and disappears, and with it the palm-leaf motif, in the third. Next season's work will be devoted to working out further evidence of development on these lines.

Saqqara. During the last two or three seasons, the excavations by the Antiquities Department of the Step Pyramid at Saqqara have been intermitted in the interests of clearance and preservation. In the past season, M. Lauer has been engaged in clearing the great court, measuring 180 m. by 100 m., at the south of the pyramid. The clearance resulted in the discovery of fasciculated column drums of the colonnade in process of being restored, portions of boundary stones inscribed with the names of Zoser and the princesses Hetep-her-nebti and Int-ka-s, and a small fragment of the statue of Zoser with the titles of Im-hotep belonging to the statue foun twelve years ago.

Among other finds were three little granit statuettes of the Fifth Dynasty, which had bee stolen by robbers but abandoned. Two of the represent the same person standing. They be traces of colour on the head, the eyebrows, the eye and the nails, the granite representing the skin. T clothing was also painted. The third statuette black granite also bears traces of colour, and inscribed with the name of Her-en-kaw, direct of the scribes of the textile fabrics. A hea of a woman in stuccoed and painted wood foun near by, which seems to date from the New Kin dom, shows a pair of earrings which are painted blac

Before the close of the season, the clearance w completed of the south side of the Pyramid of Un and of the contour of his funerary temple. Eviden was then brought to light that Unas, in order build his own pyramid, had completely destroyed t funerary monument of his predecessor Dadkar This action, taken in conjunction with the eviden of certain inscribed material, found in the course the work, raises the important historical point as the identity of the ruler responsible for the chan of dynasty usually attributed to Teti. To th question no answer can yet be given.

Tuna el Gebal (Hermopolis West). Excavations this site by the Fouad I University, which last seas had been occupied with material of the Ptolema period, were again pushed forward in Gallery *C*, a by the end of the season had reached the period Psammetichus and Amasis. On clearing the galler an interior room cut below it appeared. Here, in further chamber, a remarkable discovery was that a sarcophagus. Previous evidence suggested th these galleries had been reserved for the mummi of ibises and baboons; but the sarcophagus prov to be that of a prince and chief priest of Hermopol The chamber was filled with canopic jars of alabast covered with inscriptions, and placed in pairs either side of the sarcophagus. Their covers we carefully sculptured with the heads of the fo "Sons of Horus". At the right of the sarcophagus the foot were 400 blue faience statuettes (ushabt inscribed with the name of the high-priest Ankh-ho while on the east side were several blue faience vas containing unguents, fruits, and gilded leaves. T sarcophagus contained a mummiform coffin of woo The mummy wore a mask of silver and a band gilt leather on the chest. On both sides of the bo were two sheets of gilt bronze bearing in relief figu of the four "Sons of Horus". The mummy lay wi head to west.

Another corridor filled with jars which, apparentl had not been reached by robbers, yielded 1 statuettes of Osiris in bronze, statuettes of isis, a of the bull, while among the finest pieces was prince of Hermopolis standing between the goddes Isis and Nephthys with Horus in front of him on lotus column, flanked by the two uraei of Upper a Lower Egypt. This ensemble is before an Ibis seat on a stand, sculptured and set with stones of ma colours imitating lotus flowers.

EARTHQUAKE INSURANCE

By E. TILLOTSON

ENERALLY speaking, earthquake insurance is still only undertaken in very few cases and ually with reluctance by underwriters. This is derstandable in that exact statistical evidence only ists in the majority of cases over a period of ± 10 years, which is insufficient to make it possible judge when another shock is likely to take place any particular locality. Moreover, in the present ate of knowledge, earthquakes cannot be predicted actly by any other means. It is, however, possible indicate which areas are more likely to experience rthquake shocks than others, and it should there- re be possible to initiate some sort of insurance ainst these natural calamities.

Further difficulties are, first, to envisage how much mage is likely to be done by a shock, and secondly, build up sufficient reserves of capital to cover the sses. Given sufficient interest on the part of property wners in this type of insurance, mutual assistance companies and perhaps initially Government aid companies undertaking earthquake insurance, the estion of reserves of capital could be solved and e companies could then proceed to formulate emium rates. One may suppose that these will be verned in any particular case by several factors ch as expectancy of occurrence of shocks, type of ilding, amount of coverage, and an additional sum r expenses, profit and reserves.

The expectancy of occurrence of shocks varies, cording to the locality and can at best only be aluated roughly. As example, it appears that in pan there may be a severe shock every three or ur years, whilst in the United States it has been timated that there is a strong shock approximately ery twenty-five years with a tendency for it to cur in the west rather than in the east. In Great ritain, scarcely any damage is done by earthquakes all.

Buildings vary greatly from the steel-framed inforced concrete buildings of low altitude such as ose designed by Dr. Tachu Naito, of Tokyo, which ffer very little in any earthquake, to concrete block ildings and the native huts of tropical countries, hich are often completely razed. Between these tremes, buildings offer various degrees of resistance earthquake shocks, and it would not be difficult the light of knowledge gained in previous shocks classify buildings according to the extent to which ey would be likely to be damaged should an earth- ake of known intensity occur.

The type of ground on which a building rests also s an important effect on its resistance to earth- akes. Structures on unconsolidated sand or swamp ffer much more severely than those of similar sign built on solid ground or rock. Also buildings er old faults are particularly liable to damage, as e faults nearly always renew their movement during earthquake. For these reasons the advice of a ologist would be very valuable to any company dertaking earthquake insurance risks.

It is usual in all cases of insurance to calculate nual premiums from the formula

$$P = Cp,$$

where P is the annual premium, C the amount of covering and p the probability of occurrence of the disaster. It has been shown by Marchant that this formula may lead to

$$P = \int_A^U y\,x\,dx + U\int_U^V y\,dx,$$

where y is the probability factor that the sum of money involved in the accident be just x, V the total value of the goods and buildings involved in a possible accident, A the value of the goods not insured, and U the upper limit of payments guaranteed by the assurer. The difficulty in the case of insurance against earthquake hazards is to determine the form of y. Working purely on a statistical basis, he proceeds as follows: At any particular time in the given locality, let the total value of the insured goods be G, and during T years determine from statistics

n_1 years during which the earthquake damage was less than $G/10$;

n_2 years during which the earthquake damage was between $G/10$ and $2G/10$;

n_3 years during which the earthquake damage was between $2G/10$ and $3G/10$.

. . . .

n_{10} years during which the earthquake damage was between $9G/10$ and G.

The probabilities that the occurrences may fall into the above categories may be estimated as

$$p_1 = n_1/T = \int_0^{G/10} y\,dx\,; \quad p_2 = n_2/T = \int_{G/10}^{2G/10} y\,dx$$

$$p_3 = n_3/T = \int_{2G/10}^{3G/10} y\,dx$$

. . . .

$$p_{10} = n_{10}/T = \int_{9G/10}^{G} y\,dx\,;$$

from which we obtain by approximation,

for $x = G/20$ $\quad y = 10p_1/G$

for $x = 3G/20$ $\quad y = 10p_2/G$

for $x = 5G/20$ $\quad y = 10p_3/G$

. . . . . .

for $x = 19G/20$ $\quad y = 10p_{10}/G$

From these figures it is possible to construct a graph showing the form and variation of y with x. From the graph the premiums to be paid may be calculated after the values of A and U have been fixed by agreement. Thereafter adjustments would have to be made in the light of the considerations mentioned previously, it being assumed that the conditions will remain the same during the year.

In Switzerland, one of the foremost countries in dealing with insurance against all calamities caused by the forces of Nature, earthquake insurance is only undertaken by the Canton of Zurich, since the Swiss Re-insurance Union has advised against taking such risks on the grounds that it is impossible completely to predetermine the effects of an earthquake shock.

The "Fonds suisse" is, however, available in cases where insurance is impossible, and this now amounts approximately to two million francs. In New Zealand some earthquake insurance is undertaken by private companies, but the liability of these companies for payments under the Workers' Compensation for Accidents Act has been limited by the Government to £50,000 in a single earthquake or a series of earthquakes lasting seven days. In Great Britain certain companies undertake such insuran on request, but information is unavailable excep from the companies concerned, there being apparent no clearing house for such information. In tl United States, earthquake insurance is underwritt mostly by the mutual fire insurance compani which state that the premiums need not be high due attention is paid to earthquake-proof design in tl buildings concerned.

CRYSTALLO-CHEMICAL ANALYSIS

THE BARKER INDEX AT OXFORD

By Dr. M. W. Porter and R. C. Spiller, Department of Mineralogy, Oxford

EVERY chemist is familiar with the well-developed crystals bounded by plane faces which are formed by chemical substances. That the angles between these faces are characteristic of the substance and can be measured accurately by the reflecting goniometer is also common knowledge.

Clearly it would be of advantage to the chemist were he able to make practical use of these characteristic angles for purposes of identification, as an alternative to the ordinary method of analysis. Only a very small amount of material would be required, for a crystal of the size of one cubic millimetre, or even less, can be accurately measured. Moreover, when the measurement is completed, the crystal remains intact. If an index were made which included all measured substances, arranged in the numerical order of their measured angles, any substance could be identified by measuring a crystal of it and seeking in the index the angular values obtained.

Why has the chemist hitherto been unable to make use of this method of identification?

The difficulty arises from the multiplicity of angles which can be measured on any given crystal and from the lack of guidance in the choice of the angles which are to be used as the basis of the index. It is clear that what is wanted is a set of rules which will ensure that two independent workers who have measured crystals of the same substance will choose, as characteristic of that substance, the same set of angles, by which it can be classified.

The number of chemical substances that have been measured considerably exceeds eight thousand, and the measurements of some seven thousand of these have been collected in the five large volumes of Groth's "Chemische Krystallographie", where they are arranged according to *chemical composition*. During the past thirty years, crystallographers have attempted to put this valuable material into such a form that it might be rapidly and successfully used in the identification of chemical substances. First among those to make such an attempt was Fedorov, the great Russian crystallographer. He devised a method of classification based on his theory of crystal structure and, with the help of his pupils, he produced his great index, "Das Krystallreich", which was published in 1920. It contained a list of all the crystals then measured, and by means of this index any of the substances could be identified by the measurement of its angles. The method employed in this remarkable work was, however, complicated, and the calculations required were lengthy and laborious.

The late Dr. T. V. Barker, of Oxford, who w Fedorov's pupil and enthusiastic collaborator, h hoped to make this method of practical use, but l gradually came to the conclusion that it was ir possible to do so. After many years he devised simpler method based, not as Fedorov's was, up theories of crystal structure, but purely on ge metrical form. His book "Systematic Crystal graphy" (Thomas Murby, London, 1930) describes set of simple rules based on what he termed tl "principle of simplest indices" (*op. cit.*, p. 2), whi he proposed to make the foundation for a practic index of crystals. In this index, under each cryst system, a certain angle, chosen by these rules f each substance as the main classification angle, w to be incorporated in order of increasing magnitud The rules ensured that no ambiguity could ar in the choice of the classification angles. Owi to pressure of other work, Dr. Barker published tl short treatise "Systematic Crystallography" inste of a much larger and more ambitious work, tl uncompleted manuscript of which is in the Universi Museum at Oxford. He hoped to begin work on t index in May 1931, but in April of the same ye he was taken ill and died.

The possibility of compiling the Barker Ind after the untimely death of its originator, and witho his direction, was immediately discussed at Oxfo by a number of crystallographers who were intereste and they decided to try out the method independentl At the end of a year, they unanimously conclud that the method was simple and workable. It w decided to proceed with the preparation of the Ind and, with the kind permission of Prof. H. L. Bowma to make its headquarters in the Mineralogical Depa ment of the University Museum at Oxford.

In the initial stages of the work, certain unforese difficulties arose the solution of which involved tir and labour. The first of these was that, in order cover certain cases, it was found necessary to ma minor modifications and additions in the rules draft by Dr. Barker. The second difficulty was that co siderable delay has been, and will continue to l caused by the misprints and errors of computati found in the original descriptions. These have in cases to be cleared up before the classification ang can be found. In order to guard against simil errors in the Barker Index itself, every calculati is being made independently by two workers a checked by a third before the results are typed or card and filed in a card index.

When some years had been spent in the compila- n of the Index, it was felt that it was sufficiently r advanced to offer material for a searching test its usefulness in the actual identification of com- unds. Such tests had been carried out successfully Dr. Barker and were described in "Systematic ystallography" (pp. 24–27), but his great familiarity th the work and the fact that the material available that time was limited led us to believe that other trial of the method would be of practical lue.

It was decided to carry this out in two of the less nple crystal systems, the orthorhombic and mono- nic, and a list of some 1,230 substances which were ady for the Index was sent to Prof. G. M. Bennett, ofessor of chemistry, King's College, London, who d kindly offered to collaborate in such a test. From is list Prof. Bennett selected sixteen substances ich he sent, numbered, but unnamed, to us at ford. Fifteen of the sixteen were successfully entified. The measurement of the remaining one s not possible as the faces were not sufficiently od to give even fair reflections on the goniometer. e list of substances is given below, and it will be n that many of them have a complicated chemical mposition, and would be difficult to identify by her methods, especially if, as was the case, only e or two small crystals were available for exam- ation. The time taken to identify each compound ried from thirty minutes for the easier crystals to r hours for the most difficult.

T OF COMPOUNDS IDENTIFIED BY MEANS OF THE BARKER INDEX.

Ethyl-2 : 4-dinitrophenyl-aniline. (Groth, 5, 53.)
Methylanilide of benzene sulphonic acid. (Groth, 5, 78.)
Benzene-azo-β-naphthyl benzoate. (Groth, 5, 290.)
Tribenzylamine. (Groth, 5, 323.)
Phenyl benzoate. (Groth, 5, 134.)
1-Phenyl-3-methyl-4-benzylidene-pyrazolone. (Groth, 5, 587.)
Methylanilide of p. toluene sulphonic acid. (Groth, 5, 84.)
Sodium nitroprusside (dihydrate). (Groth, 1, 432.)
Potassium sulphate. (Groth, 2, 337.)
Sulphur. (Groth, 1, 26.)
. . . . . . (unmeasurable).
Ammonium sulphate. (Groth, 2, 344.)
Eugenol benzoate. (Groth, 5, 189.)
Potassium nitrate. (Groth, 2, 74.)
Potassium dihydrogen orthophosphate. (Groth, 2, 795.)
Topaz. (Groth, 2, 202.)

The procedure adopted in these identifications, ich can only be outlined here, was as follows: e crystal (or in some cases two or three crystals) s measured on a two-circle reflecting goniometer. gnomonic or stereographic projection was made m these measurements and the crystal system entified so far as possible from the projection and ecked (if necessary) by the optics. The selection the classification angles was made according to the rker rules. The Index was then consulted under appropriate crystal system for the main classifica- n angle. Generally, a number of angles within limits of the error of measurement offered them- ves. The remaining classification angles were then npared and, when a set which agreed as a whole th those measured was found, the identification s established. When the classification angles licated a member of an isomorphous group, a ther test of a simple nature had to be made. It s recommended by Dr. Barker that such a test uld be made in all cases as a check on the identifi- ion. The test may be a simple chemical one, the ermination of the density, the observation of the colour or cleavage, or the examination of some of the optical properties.

No doubt the question will be asked, what happens if the classification angles are not to be found in the Index? This may happen owing to the fact that the faces of a crystal may vary in different circumstances of crystallization. New faces may appear and old faces may be suppressed. Certain new combinations of faces may give rise to classification angles not to be found in the Index. Actual cases of this sort occurred among the compounds given above and were successfully dealt with as follows: By the graphical insertion into the projection of one or two faces not observed, or the suppression of one or two of the faces present, a new set of classification angles was obtained. These were measured graphically in order to save time and then searched for in the Index, with successful results. Although the difficulty arising from the variability of faces, or of combinations of faces, has been brought forward as a disadvantage of the Barker method (see A. K. Boldyrew und W. W. Doliwo-Dobrowolsky, "Ueber die Bestimmungs-tabellen für Kristalle", *Z. Kristall.*, (A) 93, 321–367; 1936) in actual practice it has not been found to be serious. Nor do the many hundreds of cases of different combinations of faces already recorded give rise to a great number of additional entries in the Index. In working through some 1,800 monoclinic and orthorhombic substances, we have found that about 2,300 entries are required. Donnay and Mélon (see Tables for Tetragonal Substances, Johns Hopkins University, Studies in Geology, No. 11, p. 328; Oct. 1934) in their tables for the tetragonal system found that 456 substances require 582 entries.

A further example of the value of the Barker method may be mentioned. With the help of it, F. A. Bannister and M. H. Hey were able to identify some crystals found in oceanic bottom samples from the Weddell Sea and brought back by the Scotia Expedition (Discovery Reports, 13, 60–69, Cambridge, 1936). The crystals varied in size from 0·2 mm. × 0·1 mm. to 0·3 mm. × 0·15 mm., and several of these were successfully measured and the Barker classification angle determined. The tetragonal symmetry of the crystals was confirmed by their optics and by a Laue photograph. The authors identified the salt as hydrated calcium oxalate from a table of tetragonal substances compiled (independently of the tables by Donnay and Mélon) by Dr. Hey on Dr. Barker's method. Identification in the ordinary way, by means of chemical analysis, was in this case out of the question.

The above identifications give practical evidence of the usefulness of the Barker method, and encourage the belief that when once the Index is complete it will be of great service to chemist and crystallographer alike. Its compilation has now made considerable progress, but new collaborators would be welcomed as the work is necessarily slow. Practical help in the compilation of the Index has been given by Mrs. Barker, P. Terpstra, J. H. Haan, P. Stienstra, J. Mélon, J. D. H. Donnay, M. H. Hey, C. Judson and T. W. J. Taylor.

In conclusion, it may be pointed out that, in the descriptions of new substances to be made in the future, a minimum of calculation will be required if the Barker rules are applied, and the lengthy tables of angles frequently met with in crystallographic descriptions will be unnecessary.

CONTROL OF HEALTH SERVICES

A BROADSHEET, "The Control of Health Services" issued by P E P (Political and Economic Planning) emphasizes the need for an administrative reorganization of the local public health services, and outlines various proposals which have been made with this object. From an administrative standpoint, public health services are divided into those directly administered by the central government departments, those controlled by local authorities under such supervision and the National Health Insurance Scheme. The central department primarily responsible for the public health services in England is the Ministry of Health, but the supervision of the school medical service is delegated to the Board of Education. The Board of Control, which is the supervising body of the services for mental patients and mental defectives, is responsible to Parliament through the Minister of Health, as is the General Register Office dealing with population statistics. Most of the Minister's powers over public health services in Wales are exercised through the Welsh Board of Health, while in Scotland the Department of Health for Scotland performs much the same functions as the Ministry of Health but controls the medical inspection of school children. The Medical Research Council is under a Committee of the Privy Council, while the Factory Act, including its medical provisions, is administered by the Home Office. The National Health Insurance Joint Committee co-ordinates the work of the Ministry of Health, the Department of Health for Scotland, the Welsh Board of Health and the Ministry of Labour for Northern Ireland in connexion with National Health Insurance.

Eighty-three county boroughs in England and Wales exercise all statutory health functions allocated to local government, but outside their territory these are distributed between 62 county councils, including the London County Council, 306 municipal boroughs, 575 urban districts, 476 rural districts, 28 metropolitan boroughs and the Corporation of the City of London. The 24 large Scottish burghs are virtually independent health authorities but except in Aberdeen, Dundee, Edinburgh and Glasgow are not concerned with the school medical services, wh the 171 small burghs have fewer public Heal functions in their own right than the English distr councils.

Administrative boundaries are already hinderi developments which are possible through mode transport in centralization of equipment, and aer defence is making regional planning of health servi more urgent. The criticism in the report on t Anti-Tuberculosis Service in Wales and Monmout shire could probably be applied to many areas England. Financial stringency is not the only ca of failure to deal with overcrowding; failure of t counties to put pressure on inefficient district counc and to carry through a review of their areas, nepotis prejudice, individualism and a refusal to spe money on communal services are contributory caus The Committee on the Scottish Health Services 1936 advocated that the Department of Heal should be empowered to call on local authorities submit schemes for the provision and maintenan of certain services for the areas of two or mo authorities and similar proposals were made in t minority report of the Royal Commission on Lo Government in the Tyneside Area in 1937 as alternative to an even more radical proposal of t majority report for administration of specif health services by a regional authority.

Practically all these schemes, like that of t British Medical Association, "A General Medi Service for the Nation", propose an administrati division between the environmental and the perso health services, the former being administered local units and the latter by regional authorities o a wide area. The British Medical Association sche proposed that councils with a population of less th 75,000 in rural and 100,000 in urban areas shou leave all their public health functions to a system complete and comprehensive local public heal administration units. The plans of the Ministry Health to meet an emergency as revealed in t House of Commons may ultimately lead to radi changes in the organization of the health services.

MACROMOLECULES

IN a lecture to the Freiburger wissenschaftliche Gesellschaft (published by Hans Speyer Verlag Hans Ferdinand Schulz, Freiburg im Breisgau), Prof. H. Staudinger reviews the nature and importance of macromolecules, which play such an important part in the chemistry of living tissues. These compounds possess many unexpected properties which cannot be foreseen from a study of simpler substances.

A macromolecule is defined as one built up of not less than a thousand atoms bound together by primary valencies. At present no upper limit is known to the size of the molecule, but it is possible to group them into threads, plates and spheres. The simplest are high polymers derived from simple unsaturated compounds, for example, vinyl chloride polymerizes to a product in which three thousand simple molecules are combined by co-valencies a which is used for synthetic leather, tubing, etc. this case the product is a complex mixture which c be partly resolved by fractionation into what called *polymerhomologues*. Svedberg has shown th the molecules of many proteins are uniform b native cellulose can be partly depolymerized in lower products with varying degrees of polymeri tion. Thus a polymerhomologous series of cellulo exists and the same holds also for starch, glycog caoutchouc and balata.

A method has been found of studying changes physical properties of the products and of th solutions with change in degree of polymerizati Both homopolar and heteropolar combinations known. Hydrocarbons like polystyrols may form s with organic solvents but not with water, while the introduction of hydroxyl groups may reverse this effect. Again, the introduction of polar groups may result in hydrosol formation. By the polymerization of acrylic acid, it is possible to build up a complete polymerhomologous series with degrees of polymerization ranging from 10 to 2,000. These acids and their salts give osmotic pressures which are about one fifth of the theoretical values, and polyvalent anions may exert a similar buffering effect on the osmotic pressures of cations. The behaviour of albumens is particularly complicated, since both acid and basic radicals are present. The polyacrylic acids have served as a model in unravelling these complexities. The physical properties of linear or thread molecules depend on molecular length. It is convenient to group them into hemicolloids with length from 50 A. to 250 A., mesocolloids (250–2,500 A.) and eucolloids (above 2,500 A.) of which only the last-named group possesses typical macromolecular properties such as toughness, fibrous structure and the power of swelling. The viscosities of heteropolar thread molecules are complicated by swarming of the fibre-ions, which is affected by the presence of salts and acids.

Since macromolecules have the dimensions of colloid particles, any solutions that are formed are colloidal and may be termed macrocolloidal to distinguish them from the molecular colloids or micelles of soaps and dyes, which are very much less stable, since they do not involve principal valencies. In some cases macromolecules are formed by true condensation, for example, through loss of water. It is necessary to be able to distinguish between macromolecules and micelles. Particle size in homopolar compounds can be determined from osmotic pressure and with the help of the ultracentrifuge. The study of acetylated products is of great importance, for if the degree of polymerization is unaltered by acetylation the original compound must have been macromolecular since micelles could not withstand such drastic treatment. Unfortunately, this very simple principle is difficult in application since by-reactions may have a far-reaching effect.

Chemical investigation is rendered difficult by the fact that the greater the size of the macromolecule the smaller is the proportion of active reagent (water, oxygen, etc.) needed to bring about chemical change. Native caoutchouc contains thread molecules with a degree of polymerization of two to three thousand and swells greatly in water. On exposure to air the threads become linked at few points only by oxygen bridges so that an insoluble product results with limited swelling power, but the amount of oxygen absorbed is too small to determine. Nitrogen has no such action. Again, synthetic polystyrol threads can be linked at long intervals by using a minute amount of divinylbenzene so that a network is obtained which can be solvated but not dissolved. In some similar fashion, albumens can pass from a soluble form with unlimited swelling power to an insoluble form with limited swelling. Again, minute chemical changes such as methylation of terminal groups alone of a very long chain may influence chemical character; thus the dimethylether of polyoxymethylene is stable to sodium hydroxide. These facts are of great importance in the study of hormones and vitamins, which may be regarded not as mere catalysts but as reagents capable of reacting in minute quantities on macromolecules to produce far reaching effects.

SCIENCE NEWS A CENTURY AGO

The August Meteors seen at Breslau

ON August 14, 1839, the German astronomer Boguslawski wrote an account of his observations at Breslau of the August meteors, popularly known as "the tears of St. Lawrence"; the account being published in the Prussian State Gazette. "The sky," he said, "has been again particularly propitious for observing another fall of stars. On many days and nights preceding the 10th the heavens have been so covered that we could not observe when the uncommonly frequent fall of stars commenced. On Aug. 10, however, our hopes of seeing the phenomena increased owing to the clearness of the weather. . . . It was not, however, sufficient to count the numbers that fell; it was desirable also to measure the time of their appearance, and of the continuance of their fall, according to Franzmann's instrument, which beats thirds of seconds, and moreover to ascertain their relative height and apparent course in the heavens and all these observations could commence only at 26 minutes past 9 when all the observers, 15 in number, were assembled, occupying six windows of the observatory. Four gentlemen took care to observe and register the times of each appearance, according to two clocks. Till 14 minutes past 3, when dawn put a stop to the observations, they noticed 1008 falling stars, not including numbers which must have been overlooked because the numbers of observers was insufficient". Other meteors were seen on August 11 and 12 and "therefore," wrote Boguslawski, "the annual periodical return of an uncommon fall of stars towards the 10th of August is once more confirmed".

Steam Applied to Land Drainage

ON August 17, 1839, the *Mechanic and Chemist* said: "This drainage of land by steam power has been extensively adopted in the fens of Lincolnshire, Cambridgeshire, and Bedfordshire and with immense advantage. An engine of forty horse power, and scoop wheel for draining, and requisite buildings, costs about £4,000, and is capable of draining about 4,000 acres of land. In many places in the fens, land has been purchased at from £10 to £12 per acre, which has been so improved by drainage as to be worth £60 or £70 per acre". One of the largest districts drained was Deeping Fen near Spalding containing 25,000 acres, where there were pumping engines of 80 horse-power and 60 horse-power. Littleport Fen, near Ely of about 28,000 was drained by two engines whereas formerly there were 75 wind-driven pumps. Soham Mere, near Cambridge, forming a lake of 1,600 acres was drained by a 40 horse-power engine.

UNIVERSITY EVENTS

CAMBRIDGE.—J. C. Colbeck has been elected John Lucas Walker student.

A. F. Huxley, of Trinity College, has been elected to the Michael Foster studentship in physiology.

Dr. K. C. Dixon, of King's College, has been awarded the E. G. Fearnsides scholarship.

OXFORD.—Dr. L. A. Woodward, Lincoln College, has been appointed fellow and tutor of Jesus College in chemistry in succession to the late H. J. George.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

HEAD OF THE CHEMISTRY DEPARTMENT and a LECTURER IN ELECTRICAL ENGINEERING at the Burnley Municipal College—The Director of Education, Education Offices, Burnley (August 15).

GRADUATE LECTURER IN MECHANICAL ENGINEERING at the Coventry Technical College—The Director of Education, Council House, Coventry (August 16).

LABORATORY ASSISTANT (Male)—The Commandant, Experimental Station, Porton, near Salisbury (August 18).

HEAD OF THE DEPARTMENT OF ELECTRICAL ENGINEERING at the Liverpool Technical College—The Director of Education, 14 Sir Thomas Street, Liverpool 1 (August 23).

PROFESSOR OF VETERINARY SURGERY, OBSTETRICS AND ANIMAL HUSBANDRY at the Veterinary College, Ballsbridge, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (August 23)

PART-TIME DEMONSTRATOR IN BOTANY—The Secretary, Kings College, Strand, W.C.2 (August 26).

LECTURER IN CIVIL ENGINEERING at the Brighton Technical College—The Education Officer, 54 Old Steine, Brighton (August 26).

UNIVERSITY LECTURER IN PHYSICS—The Secretary of the Appointments Committee of the Faculty of Physics and Chemistry, Cavendish Laboratory, Cambridge (August 31).

RESEARCH ASSISTANT in the Department of Coal Gas and Fuel Industries with Metallurgy—The Registrar, University, Leeds 2 (September 1).

INSTRUCTRESS IN RURAL DOMESTIC SCIENCE at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the County Council, County Hall, Chelmsford (September 1).

RESEARCH OFFICER in the Pathological Division of the Tea Research Institute of Ceylon—The Secretary, Ceylon Association in London, 11 Idol Lane, E.C.3 (September 9)

PROFESSOR OF ELECTRICAL ENGINEERING in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (September 15).

LECTURER in the Physiological Department—The Secretary, University, Birmingham 3 (September 16).

BACTERIOLOGIST—The Secretary, Royal College of Physicians, Edinburgh 2 (September 20).

TEMPORARY LECTURER IN EXPERIMENTAL ZOOLOGY—The Registrar, University, Liverpool (September 20).

PROFESSOR OF CHEMISTRY—The Registrar, Dacca University, P.O. Ramna, Dacca, Bengal, India (September 30).

OFFICIAL GUIDE-LECTURER—The Director, British Museum, W.C.1 (September 30).

UNIVERSITY ASSISTANT IN PHYSIOLOGY—The Secretary, University, Aberdeen (October 1).

ASSISTANT CIVIL ENGINEERS (temporary)—The Civil Engineer-in-Chief, Admiralty, Whitehall, S.W.1 (marked 'A. C. E. August').

TEACHER OF ELECTRICAL ENGINEERING—The Principal, Technical College, Wolverton, Bucks.

DIRECTOR OF RESEARCH—The Secretary, Gas Research Board, Gas Industry House, 1 Grosvenor Place, S.W.1.

RESEARCH SCHOLARSHIPS tenable in the Department of Coal Tar Colour Chemistry—The Principal, Technical College, Huddersfield.

ASSISTANT ENGINEER for the Sudan Government Railways—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (marked 'Engineer').

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

City of Leicester Municipal Libraries. Sixtieth Report to the City Council, 1st April 1938 to 31st March 1939. Pp. 20. (Leicester: Municipal Library.) [277

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1938. Pp. 28. (London: H.M. Stationery Office.) 9d. net. [277

A.R.P. in Industry: a revised and amplified Description of the Civil Defence Act, as it affects Owners and Occupiers of Industrial and Commercial Establishments. (Issued from the Lord Privy Seal's Office.) Pp. 16. (London: A.R.P. Department.) Free. [287

Forestry Commission. Nineteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1938. Pp. 61. (London: H.M. Stationery Office.) 1s. net. [287

City of Leicester Museum and Art Gallery. Thirty-fifth Report to the City Council, 1st April 1938 to 31st March 1939. Pp. 36. (Leicester: Museum and Art Gallery.) [287

Combustion Appliance Makers' Association (Solid Fuel). Proceedings of the Third Annual Conference, 1939, 29th and 30th March. (Document No. 3176.) Pp. x+402. (London: Combustion Appliance Makers' Association.) [317

Tuberculosis and Social Conditions in England: with Special Reference to Young Adults (a Statistical Study). By Dr. P. D'Arcy Hart and Dr. G. Payling Wright. Pp. vii+165. [London: National Association for the Prevention of Tuberculosis.) 3s. [317

Agricultural Research Council. A.R.C. Report Series, No. 5: Fodder Conservation, with Special Reference to Grass Drying. A Report prepared for the Committee on the Preservation of Grass and other Fodder Crops. By E. J. Roberts. Pp. v+137. (London: H.M. Stationery Office.) 2s. net. [317

Amgueddfa Genedlaethol Cymru. National Museum of Wales. Two Bronze Age Cairns in South Wales: Simondston and Pond Cairns, Coity Higher Parish, Bridgend. By Sir Cyril Fox, with Appendices by L. F. Cowley, H. A. Hyde, Prof. John Percival and Dr. F. J. North. Pp. 125–180+plates 39–66. (Cardiff: National Museum of Wales.) 2s. 6d. [28

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd. Twenty-fourth Annual Report, 1938. Pp. 108. (Cheshunt: Nursery and Market Garden Industries' Development Society, Ltd.) [38

East African Agricultural Research Station, Amani. Annual Report, 1938. (Colonial No. 167.) Pp. 56. (London: H.M. Stationery Office.) 1s. net. [38

Other Countries

Meddelanden från Statens Skogsförsoksanstalt. Häfte 31, 1938–39. Pp. iv+401. (Experimentalfältet: Statens Skogsförsoksanstalt.) [287

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 21, No. 9 (Mathematics No. 37): Beiträge zur Geometrie der Kreise und Kugeln (30). Von Sôzi Matumura. Pp. 319–334. Vol. 26, No. 1 (Mathematics No. 38): Beiträge zur Geometrie der Kreise und Kugeln (31). Von Sôzi Matumura. Pp. 58. Vol. 26, No. 2 (Mathematics No. 39): Über Flächen und Kurven (I). Von Sôzi Matumura. Pp. 59–88. (Taihoku: Taihoku Imperial University.) [317

Transactions of the National Institute of Sciences of India. Vol. 2, No. 1: Amplification of the Theory of Multi-Phased Gastrulation among Insects, and its Applicability to some other Arthropods. By Dr. Mithan Lal Roonwal. Pp. 37. (Calcutta: National Institute of Sciences.) 4 rupees. [317

Report of the Kodaikanal Observatory for the Year 1938. Pp. 4. (Delhi: Manager of Publications.) 2 annas; 3d. [317

Cornell University: Agricultural Experiment Station. Bulletin 715: Economic Studies of Vegetable Farming in New York. 6: Production and Marketing of Celery, 1936. By J. N. Efferson. Pp. 62. Memoir 220. Joint Correlation applied to the Quality and Price of McIntosh Apples. By John R. Raeburn. Pp. 44. Memoir 221. Leguminous Plants and their Associated Organisms. By J. K. Wilson. Pp. 48+10 plates. Memoir 222: The Effect of Sulfur Fungicides on the Photosynthesis and Respiration of Apple Leaves. By R. A. Hyre. Pp. 40. Memoir 223: The Effect of Temperature and Relative Humidity on the Powdery Mildew of Roses. By Karla Longrée. Pp. 43. Memoir 224: Studies on Narcissus Mosaic. By Frank A. Haasis. Pp. 22+2 plates. (Ithaca, N.Y.: Cornell University Agricultural Experiment Station.) [317

Hand-Book of Common Water and Marsh Plants of India and Burma, 1936. By K. Biswas and C. C. Calder. (Health Bulletin No. 24. Malaria Bureau No. 11.) Pp. xiii+140+38 plates. (Delhi: Manager of Publications.) 2.12 rupees, 5s. [18

Publications of the Observatory of the University of Michigan. Vol. 7, No. 8: Spectrographic Observations of Phi Persei. By Oscar Lee Dustheimer. Pp. 171–190. Vol. 7, No. 9: A Review of Lake Angelus Prominence Observations. By Robert R. McMath and Harold E. Sawyer. Pp. 191–208+5 plates. (Ann Arbor, Mich.: University of Michigan.) [18

Institut International d'Agriculture. Bibliothèques agricoles dans le monde et Bibliothèques spécialisées dans les sujets se rapportant à l'agriculture. Pp. xxiv+311. (Roma: Institut International d'Agriculture.) 25 lire. [18

U.S. Department of Agriculture. Leaflet No. 183: Cankerworms. By T. H. Jones. Pp. 8. (Washington, D.C.: Government Printing Office. 5 cents. [28

National Geographic Society. Contributed Technical Papers, Solar Eclipse Series, No. 1: National Geographic Society—U.S. Navy Solar Eclipse Expedition of 1937 to Canton Island. Pp. 394. (Washington, D.C.: National Geographic Society.) [28

U.S. Department of the Interior: Geological Survey. Bulletin 897-D: Nickel Content of an Alaskan Basic Rock. By John C. Reed. (Mineral Resources of Alaska, 1936.) Pp. ii+263–268. 5 cents. Bulletin 909-C; Geophysical Abstracts 94, July–September 1938. Compiled by W. Ayvazoglou. Pp. ii+105–150. 10 cents. Professional Paper 191: A Monograph of the Foraminiferal Family Nonionidae. By Joseph A. Cushman. Pp. ii+100+20 plates. 30 cents. Professional Paper 193-B: Notes on Fossils from the Eocene of the Gulf Province. By Julia Gardner. (Shorter Contributions to General Geology, 1938–39.) Pp. ii+17–44+plates 6–8. 10 cents. Professional Paper 193-C: Some Linguloid Shells from the Late Devonian and Early Carboniferous Rocks of Pennsylvania and Ohio. By George H. Girty. (Shorter Contributions to General Geology, 1938–39.) Pp. ii+47–67+plate 9. 10 cents. (Washington, D.C.: Government Printing Office.) [48

Catalogues, etc.

Natural History. New Acquisitions, List No. 3. Pp. 8. (Den Haag: Antiquariaat Junk.)

Catalogue of New Books on Chemistry, Pure and Applied. Pp. 50. (London: H. K. Lewis and Co., Ltd.)

Philips Technical Review. Vol. 4, No. 6, June. Pp. 153–180. (London and Eindhoven: Philips Lamps, Ltd.)

Die Askania-Warte. Nr. 18, Juli-August. Pp. 73–100. (Berlin-Friedenau: Askania-Werke A.G.)

The Clinical Application of Oestroform and Progestin B.D.H. in conditions associated with Menstruation and Pregnancy. Vol. 1, No. 4. Pp. 12. Thyrogan. Pp. 2. (London: British Drug Houses, Ltd.)

Dunns Seed Wheats, 1939. Pp. 32. (Salisbury: Dunns Farm Seeds, Ltd.)

Editorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 144 SATURDAY, AUGUST 19, 1939 No. 3642

SCIENCE AND MORAL REARMAMENT

SINCE the international crisis of last September public attention has been directed time and ain in letters to the Press and in other ways to e need for rearmament in the moral sphere. The ovement and the interest in it have undoubtedly rung from a feeling that a critical point has been ached in the history of our civilization, and that ere is danger of disaster unless certain changes the psychology of nations can be brought about.

The movement was by no means confined to reat Britain. Early in June this year a National eeting for Moral Rearmament was held in ashington to which addresses were sent, not only prominent American citizens, but also by memrs of the House of Lords and of the House of ommons, by British Labour leaders, from orthern Ireland, from Scotland, and from a umber of European countries including Switzernd, Holland, Norway, as well as from a number political and cultural leaders in the Balkans. n this occasion the message from ex-President oover was particularly urgent. "The world has me out of confusion before," he wrote, "because me men and women stood solid. . . . They ood firm because they individually held to rtain principles of life, of morals, and spiritual lues. These are the simple concepts of uth, justice, tolerance, mercy, and respect for e dignity of the common man." The message om Mr. Cordell Hull, the Secretary of State, ruck the same note of urgency: "Here in the st-war period there has been a general lowering standards of conduct—moral, political, social, d economic. International morality has seldom en at a lower ebb. The time is ripe and the need urgent for a renewal and restoration of the rmer high standard of conduct of both individuals and governments."

A month later, a World Assembly for Moral Rearmament in the Hollywood Bowl, California, was attended by 30,000 people, and it is estimated that 10,000 were turned away. Twenty-five nations sent representatives, and there was a joint meeting for Chinese and Japanese. Once more a remarkable series of addresses was sent. A manifesto signed by 60,000 British citizens, and messages from artists, labour leaders, educationists, and men of science were among those received. A message signed by seventeen distinguished British men of science runs as follows:

"All who are engaged in the increase of Natural Science are necessarily interested in Moral Rearmament. The effect of the new knowledge which is gained by the study of Nature depends upon the spirit in which it is received and used. Men of good will can make a glorious blessing of it, if they act with wisdom and skill; but ill will and folly can draw from it a curse. Most earnestly, therefore, do we pray as scientists for the success of your coming conference."

This manifesto is to be warmly welcomed as evidence that men of science are alive to the supreme importance of moral issues. We have in these columns frequently directed attention to the lag which exists between the progress of scientific investigation and the ethical advance of mankind. Scientific advance has been more rapid than ethical; indeed there is, as Mr. Cordell Hull said, evidence of actual ethical decline. It is on this account encouraging to note that men of science are not disposed to ignore ethical problems on the specious ground that these lie outside their province. The ethical advance of mankind badly needs speeding up, and men of science are evidently prepared to take their part in applying the necessary stimulus.

We hear much of the increasing specialism of modern scientific study; yet men of science are citizens and human beings as well as specialists, and as such it is incumbent upon them to seek to put an end to the present confusion. Their duty in this respect is all the clearer on account of the general respect in which their pronouncements are held. No other class of intellectual guide enjoys the same public confidence; neither journalists, bishops, literary men, educationists, nor professional philosophers have the ear of the people to the same extent. Furthermore, men of science are only too well aware that the future development of science is inextricably bound up with the survival of certain moral standards and values, such as disinterested love of truth, toleration for new opinions, and so on. If scientific researches are ever subordinated to utilitarian or propagandist ends, the fate of science will be sealed, for in the cultural sphere segregation is impossible.

It may be that the public is entitled to look to the men of science for something even more fundamental than ethical guidance. Mr. Hoover's message spoke of salvation coming from those who "individually hold to certain principles of life, of morals, and spiritual values". Likewise a message from British educationists to the World Assembly stressed the need to equip people with "simple and absolute moral standards". But principles and standards logically rest upon convictions; they fit into a framework of ideas which form an organic whole. But the trouble now is that this framework has been loosened and some parts of it are missing. Is it possible for men of science to tighten up and repair this framework, or if that is no longer possible, to provide us with a new one? Men of science were in no small degree responsible for weakening the traditional framework; can they not now turn from a destructive to a creative role? It would be a thousand pities if their ever-increasing specialism caused men of science to eschew fundamental problems altogether, and to become mere "intelligences within high walls".

Lately, we have received from Prof. T. D. A. Cockerell, of the University of Colorado, a communication which shows that the mind of at least one man of science is trying to think out some of the implications of new knowledge. "It comes to this," he writes, "mankind has evolved, with all his wonderful powers, and with his emerging sense of right and wrong, and of the value of personality. Especially does it seem incredible to us that the attributes of the human mind should be uniquely the property of a little organic slime on a infinitesimally small fragment of the matter i the universe. Hence we postulate a greater min and wonder about it, as a couple of cells in th body might (were they suitably endowed) wonde whether they were part of something greate without being able to reach a decision that wa capable of demonstration. I cannot bring myse to believe that the human mind is a purel ephemeral and essentially quite unimporta phenomenon in a vast inanimate universe.

Thoughts such as these must have occurre to many scientific workers in their speculativ moments, and it would be a pity if all such ide were dismissed as idle and irrelevant to the wor in hand. There is no good reason why men science should place themselves under a sel denying ordinance whereby all philosophical spec lation is taboo. Now that academic metaphysi has become as technical a subject as the high mathematics, the public have need of a philosoph which conveys some meaning to their mind There is no call for men of science to dogmati in the philosophic sphere; which they are n likely to do, being chary of dogmatism in the own. All that the public requires of them is som measure of guidance as to the nature of the univer of which we form a part.

In one respect, as Prof. Levy has pointed ou the man of science has the advantage of th philosopher. Whereas the latter only profess to tell us what the world means, the former te us what can be done with it. His outlook is ther fore practical; and on this account it ma actually prove that his philosophical speculation however unacademic, are nearer the mark tha those of his metaphysical colleague. There is mu to be said for the view that the human intellect is tool devised for dealing with our material enviro ment, and is most reliable when it is thus engage Divorced from action on the environment, t human intellect turns in on itself and functio as uselessly as a squirrel in a cage, or as the engi of a car before the clutch has been let in.

At the present time there is too much defeatis about with regard to science. Its potentiali have become so great that people are afraid of Such defeatism would have small chance of sprea ing if men of science would take the public in their confidence, and tell them what science c do for men of good will. Those who understa science best know that what we are suffering fr is not too much of it but too little.

THE STUDY OF BRITISH VEGETATION

The British Islands and their Vegetation
By A. G. Tansley. Pp. xxxviii + 930 + 162 plates. Cambridge: At the University Press, 1939.) 45*s.* net.

THE subject of plant ecology, like the science of which it forms a part, began as a purely escriptive study concerned with the natural or emi-natural aggregates of diverse species that onstitute plant communities, instead of with the onceptual aggregates of similar individuals that re the concern of the taxonomist. Moreover, in ts inception the study of plant communities was ainly floristic. The pioneers in Great Britain ere the brothers Robert and W. G. Smith and t was at the latter's house in 1904 that the Central ommittee for the Survey and Study of British egetation had its inception. This gave place to he British Vegetation Committee and this in urn, nine years later, was replaced by the British cological Society with the *Journal of Ecology* as s official publication.

No one has done more to promote the study of hytogeography in Great Britain than the author f the work under review. As editor of the *Journal f Ecology* for more than two decades, Prof. Tansley id more than any other single person to organize nd stimulate interest in descriptive ecology, and he bulky volume before us is a fitting culmination o the author's work in this field.

The British Vegetation Committee consisted of small group of enthusiasts which, besides W. G. mith, included C. E. Moss, F. W. Oliver, A. G. ansley and T. W. Woodhead. In 1911 Tansley rganized an excursion in Great Britain for the enefit of foreign men of science, and with the elp of other members of the Committee prepared he handbook entitled "Types of British Vegetaion". The book was definitely static in its method f presentation, although F. W. Oliver's investiations on maritime habitats had already given n impetus to the dynamic approach to the study f vegetation.

"Types of British Vegetation", which Tansley dited, at once achieved popularity. It was the nly publication then available on the subject, it as well illustrated, handy in size and very low n price. Unfortunately the edition was quite mall and the book soon became a second-hand arity. Now, after the lapse of more than a quarter f a century, Prof. Tansley has provided us with nother work, also essentially descriptive in haracter, but the scope of which has been greatly xtended beyond that of the volume it replaces. The floristic aspect is still prominent, and extensive lists of species are furnished; but the structure of the communities and their successional relations receive much fuller treatment. It is perhaps inevitable that the present work is neither small nor inexpensive.

As the author himself emphasizes, the work is largely a compilation of abstracts from the published literature and as a consequence there are certain gaps which one would like to have seen filled. The interesting vegetation of the limestone pavements, for example, has similar meagre treatment as twenty-eight years ago. We regret, too, the omission of the vegetation of arable land and disturbed soil, especially as there is available a not inconsiderable, though admittedly rather scattered, literature on the topic. For, despite their semi-artificial character, such have an important bearing on the early stages of succession.

The first section of the book treats of the environmental complex, the physical features, geology, climate, soil and biotic conditions. The chapter on soil is somewhat academic and might with advantage have been more directly related to the structure of soils as they occur in Great Britain. The attempt to place British soils into systems of classification devised for regions of more differentiated climates is not without its dangers for, as has been emphasized by Glinka, the soils of Britain can be regarded as aclimatic and, as Sir John Russell has pointed out, cannot read ly be fitted into existing schemes of classification. The section on prehistory is a useful summary of the data furnished mainly by the study of sub-fossil remains, especially of pollen distribution.

Part 3 treats of the nature and classification of vegetation types, whilst Parts 4–9, representing nearly three-quarters of the entire work, are devoted to the detailed description of the various categories of plant community. The method adopted is an approach to the type system, summaries being furnished of the published accounts of particular examples. Partly owing to the nature of the areas which have been investigated, the picture presented is sometimes a rather partial one. This is very noticeable in the account of the vegetation of ponds and is sufficiently emphasized by the entire absence, from among the species cited in this connexion, of such characteristic plants as *Alopecurus geniculatus* and *Bidens cernua*, or of any mention of the Juncetum dominated by *Juncus inflexus*, so characteristic of the margins of ponds in the stiffer and more basic soils.

The work as a whole, which is profusely illustrated with half-tone reproductions, many of which are of great merit and technical excellence, is not merely a valuable survey and a monument of what has been accomplished during the past thirty years, much of it under the stimulus of Tansley's initiative, but also an indication of the gaps that still require to be filled. Whilst there still remains much work that can be carried out in descriptive plant ecology in Great Britain, it is probably true to say that such studies, though they may reveal new manifestations, are unlikely to yield new principles, and in this sense the work before us may be said to mark the closing of the purely descriptive phase of the study of Britis vegetation. Future progress lies rather in th direction of causal ecology, of the study of th biological relations of species, and in the applicatio of the principles of physiology and the factors c competition to the elucidation of the problems o plant and animal life under natural and semi-natural conditions. But, with the advent of such knowledge, many segregations and doubtless new syntheses of communities will become necessar before we can attain to a classification of vegetatio types that will adumbrate both the great diversit of organization and the similitude of environmenta factors.

E. J. SALISBURY.

KEPLER'S APPROACH TO OPTICS

Johannes Kepler Gesammelte Werke
Herausgegeben im Auftrag der Deutschen Forschungsgemeinschaft und der Bayerischen Akademie der Wissenschaften. Unter der Leitung von Walther von Dyck und Max Caspar. Band 2: Astronomiæ Pars Optica. Herausgegeben von Franz Hammer. Pp. 466. (München: C. H. Beck, 1939.) 9 gold marks.

WITH the appearance of the second volume of the new edition of Kepler's works the first three volumes are now available, the third containing the "Astronomia Nova" having been issued first in order of date. It is curious that the three already exhibit the complex personality of Kepler in a violently contrasted way. In the first, the mystic element is predominant, and that is hard to reconcile with a truly scientific spirit. The second reveals the impatience of a sanguine temperament, which is not easily compatible with a philosophic outlook. The third, equally the product of those active years which followed the death of Tycho Brahe, reflects an assured serenity, when insight and resource never fail and every difficulty is met and overcome with untiring industry. No voluminous writer can be expected to produce a succession of masterpieces of the highest order, but in the inequality of his work it would be hard to find a parallel to Kepler.

The first words of the lengthy title are "Ad Vitellionem Paralipomena", and they cover the contents of the first part of the book now reprinted. The sources of Kepler's knowledge of optics may be briefly indicated. The most important contributions to the subject by the ancient world were contained in works attributed to Euclid and Ptolemy. These, sharing the common fate of such books, were lost to Europe in the following age, but were preserved in an Arabic form. The study was thus kept alive until th Arabian astronomer known as Alhazen (d. 1038 wrote a text-book on it. It was not until th thirteenth century that interest in optics reappeared in Europe. A text-book, "Perspective" based very closely on the work of Alhazen, wa then written by a Pole (or Thuringian), Witelo (the Vitellio of Kepler). A slighter but simila work, a "Perspectiva", was also written in the same century by John Peckham, who became Archbishop of Canterbury (referred to by Keple under the name Pisanus). It was these books which were printed in the sixteenth century, and that of Witelo was the main source of Kepler's knowledge of the subject. He refers also to the work of della Porta, but the earlier and more important work of Maurolycus in Italy was not accessible to him.

The present editor is very careful to insist on these limitations to the knowledge inherited by Kepler from his predecessors. They may be accepted. But it does not follow that the knowledge of optics, practically that of the year 1000 was equally circumscribed in the world at large Apart from the Italian school, the craftsmanship of the Dutch lensmakers may be recalled for two reasons. By universal tradition it was from Holland that Galileo derived the suggestion for his telescope. It is also scarcely necessary to look further for the inspiration which in turn guided Snell, Descartes and Huygens in optical research

But in England also, the study of optics had not been altogether neglected. Already in the thirteenth century Roger Bacon had done work o a very different order from the compilations made by his contemporaries. That work was transmitted in manuscript form to Leonard and Thomas Digges and John Dee in the sixteenth century hese men formed a group working independently f any Continental tradition, and yet not isolated, nce they were known to Tycho Brahe, as Harriot few years later was known to Kepler. Thus search in optics had been kept alive to such an xtent that Harriot was able to supply himself nd his friends with telescopes; but it remains true hat the progress made had taken a practical shape nd the results had not been published in the rinted form. In consequence, some things which epler claimed as new were not so original as he pposed.

The book follows a most comprehensive plan. t includes geometrical optics, physiological optics, nd in the second section deals with a variety of stronomical matters such as eclipses and problems f parallax which would now be considered alien o the main subject. In the circumstances of the ime, there was plainly an opening for a new work n geometrical optics, and the needs of astronomy rompted a careful consideration of the subject, nore particularly for the investigation of astronomical refraction. With these motives and with a ertain amount of material in hand, Kepler tarted on his task early in 1603. He seems to ave worked to a self-imposed time-table. The ork was to be finished by the end of the year nd to be published in the following spring. It id appear in the following autumn, and in view f modern conditions, there seems little reason for omplaint on the score of delay in the production f a large volume.

The project may have been justifiably optimistic r foolishly arrogant, according to the point of iew. In any event, the difficulties of the task ecame more and more apparent, and as they rew Kepler became more impatient. This is hown in his correspondence and it is abundantly lear from internal evidence. Ideas are started nd carried to no logical conclusion. Passages hich should have been re-written were merely mended in a hasty way. But Kepler persisted nd the book was finished within the year. He new the eager and uncritical public for whom he atered. But his own interest in the subject was robably waning.

For this, two reasons may be readily conjectured. he first one and the more important excuse for is impatience was the urgent call of that other ork which was the true mission of his life. Hence he adherence to a time limit. But he must also ave become aware that the conditions were npropitious for the production of a "Markstein weiter [or any other] Ordnung". What the science f optics at that time plainly needed was a foundaion in accurate experiment. This was entirely acking. Now Kepler was himself no experimental hysicist, and he had no source from which he could draw what was necessary. The experimental data at his command were incredibly slight, and he must have become conscious of the fact.

This applies in particular to the capital problem of the time, the determination of the law of refraction. Kepler's formula is

$$\alpha - \beta = k \alpha \sec \beta,$$

where α is the angle of incidence, β the angle of refraction. With $(1 - k)^{-1} = n$, this gives results similar to the law

$$\sin \alpha = n \sin \beta$$

for the smaller refractions. The constant k for air-water is based on the assumed values $\alpha = 80°$, $\beta = 50°$ (more than 2° in error). As the formula is really empirical, being founded on the flimsiest physical argument, it seems strange that a form so inconvenient for the derivation of β from α should have been adopted. The relation also seems inconsistent with the most obvious principle of optics, the reversibility of the ray.

Passing on to the problem of astronomical refraction, Kepler was in a position of complete ignorance as to the nature of the atmosphere. He assumed that it was homogeneous and ultimately fixed its height at about 4 km. Tycho Brahe had left three separate tables of refraction for the sun, moon and stars, and Kepler found it impossible to represent the solar table in spite of repeated trials. He therefore resorted to the original observations of Tycho and found material which removed the difficulty. Thus he succeeded in constructing a table of refractions which has been found superior to those of Tycho. But the advance must be regarded as belonging to astronomy rather than to optics.

The present editor's analysis and notes are of great value. If a rather lower estimate has been placed here on the intrinsic importance of Kepler's book, it is in the belief that the time was not ripe for the production of a major work. It was the threshold of a period of great advances in optics, but for the moment the knowledge which could only come from experiment was lacking. When Harriot supplied a list of angles of refraction with angle of incidence 30° for no less than fourteen media, with the corresponding specific gravities, and pointed out that there was no direct relation between refractivities and densities, quite characteristically Kepler argued against the evidence. He might have learnt more about optics from Harriot, as he might have learnt something about the sidereal universe from Digges, and Wallis was not far wrong in his general thesis that early English science had not met with due recognition on the Continent.

H. C. PLUMMER.

HISTORY OF MEDICINE

(1) Early Medieval Medicine

With Special Reference to France and Chartres. By Prof. Loren C. MacKinney. (Publications of the Institute of the History of Medicine, the Johns Hopkins University. Third Series: The Hideyo Noguchi Lectures, Vol. 3.) Pp. iii+247 (9 plates). (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1937.) 12*s*. 6*d*. net.

(2) Medicina aborigen americana

Por el Dr. Ramon Pardal. (Humanior, Biblioteca del Americanista Moderno, Sección C: Patrimonio cultural indiano, Tomo 3.) Pp. 377+6 plates. (Buenos Aires: Jose Anesi, n.d.) n.p.

(3) A Brief Rule to Guide the Common-People of New-England how to Order Themselves and theirs in the Small Pocks, or Measels

By Thomas Thacher. Facsimile Reproductions of the three known editions, with an Introductory Note by Dr. Henry R. Viets. (Publications of the Institute of the History of Medicine, the Johns Hopkins University. Fourth Series: Bibliotheca Medica Americana, Vol. 1.) Pp. liv+16. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1937.) 7*s*. net.

(4) A Discourse upon the Institution of Medical Schools in America

By John Morgan. Reprinted from the first edition, Philadelphia, 1765. With an Introduction by Abraham Flexner. (Publications of the Institute of the History of Medicine, the Johns Hopkins University. Fourth Series: Bibliotheca Medica Americana, Vol. 2.) Pp. vi+vii+xxviii+63. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1937.) 9*s*. net.

(5) Adaptation in Pathological Processes

By Dr. William H. Welch. Reprinted from Transactions of the Congress of American Physicians and Surgeons, 1897, Vol. 4, pp. 284–310. With an Introduction by Dr. Simon Flexner. (Publications of the Institute of the History of Medicine, the Johns Hopkins University. Fourth Series: Bibliotheca Medica Americana, Vol. 3.) Pp. xi+58. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1937.) 7*s*. net.

(1) IN his work on early medieval medicine Prof. C. MacKinney, who occupies the chair of medieval medicine in the University of North Carolina, gives a richly documented account o medicine in that portion of the Middle Ages extending from the sixth to the eleventh century. Durin that period two distinct types of medicine wer prevalent, namely, the supernatural, which included reliance on Christian saints and their relic Christian-Pagan charms and magical incantation and human medicine, which consisted chiefly o empirical methods of healing mainly by drug surgery and diet. Of the three lectures containe in the book the first deals with the changin modern conceptions of the Middle Ages formerl regarded as stagnant and unproductive but no looked upon as an era of vigorous activity.

In the second lecture, in which Prof. MacKinne discusses medicine in Merovingian and Carolingia France, it is shown that in the Merovingian ag comprising the three centuries before Charlemagn there was a steady advance in France in medica practice which was accelerated during the tent and eleventh centuries. Although the outstandin methods of medical practice at that time were a before blood-letting, diet and herbal potions, th clergy became more interested in medical condition and took a much more active part in carin for the sick.

In the third chapter, which is devoted to medica progress at Chartres in the tenth and eleventh centuries, extracts from the works of Gerber Richer and Fulbert illustrate the separation o medical practice from mere book knowledge. Sixt pages of notes and photographs of medical manuscripts are appended to the text.

(2) Dr. Ramon Pardal's work which forms par of the series edited by Dr. Imbelloni, who contributes the preface, is divided into four part devoted respectively to medical ethnology, medicine in ancient Peru and Mexico, stimulating narcotic and hallucinating drugs, of which the chie are coca, maté and peyotl, and American drug in modern medicine. In the first part the autho shows that the medicine of the American India was of a primitive character, based on magi therapeutical empiricism and the surgery c emergencies. The practitioner in those times wa esteemed rather for his magical power than fo medical knowledge. It was only among the people possessing a relatively superior feudal organizatio such as the Incas and Aztecs, that the elemen of a higher order appeared and the functions c priest and doctors were separated. The secon part deals with the practice of medicine in ol Peru, with special reference to the operation c

phining and the representations of diseases, ecially syphilis, on pottery. The drugs used modern medicine for which we are indebted to natives of South America include the balsams Tolu and Peru, guiacum (once regarded as a cific for syphilis and now only employed in ut and chronic rheumatism), sarsaparilla (also ed in former times as an anti-syphilitic drug, but w almost confined to quacks who sell it as a ood-purifier'), cinchona, copaiba, pilocarpine and mopodium.

The work will appeal to the anthropologist and ethnologist, as well as to medical practitioners d pharmacologists interested in the history of healing art.

(3) Dr. Thomas Thacher's "Brief Rule", of ich the three editions are published in this little lume, represents the earliest medical document be printed in America north of Mexico. It nsists of a single printed sheet which first ap-ared in 1677–78 and was reprinted in 1702 and 21–22. The author was born in Somersetshire, t migrated with his parents to New England in 35 at the age of fifteen years in accordance with practice of many dissenting ministers and their milies in the early part of the seventeenth ntury. Thacher was brought up to be a clergy-an like his father, but like many of his con-nporaries was something of a physician as well a minister, and enjoyed a considerable practice Boston. A severe epidemic of smallpox which oke out in that city in 1677 causing 700 deaths mulated Thacher to publish his broadside, ich is taken almost word for word from the cond chapter of Sydenham's "Medical Observa-ns". Subsequent outbreaks of smallpox in ston in 1702 and 1721 were the occasion of the rinting of the work.

(4) In the address which is here printed in simile, and was delivered in 1765 in the College Philadelphia, where he occupied the chair of theory and practice of medicine, being indeed e first professor of medicine in the United States, . John Morgan, who had received his medical ucation not only in Philadelphia but also in ndon, Edinburgh, Paris and Leyden, gives a neral survey of the different departments of dicine and describes the existing conditions in nerica, the difficulties accompanying the study medicine and the impracticability of making y great progress until it had been put on a better oting. The preliminary sciences of anatomy, teria medica, botany and chemistry are reviewed d their contribution to the cure of diseases nsidered. The necessity of a knowledge of Latin d Greek for the physician is then emphasized well as familiarity with the French language, ile acquaintance with mathematics and natural philosophy is regarded as indispensable. As regards the contemporary state of medicine in America in 1765, Dr. Morgan deplores the lack of professional teachers to give complete and regular courses of lectures in the different branches of medicine, in striking contrast with the medical schools in Europe which he had visited. He suggests, therefore, that a course of clinical practice and clinical lectures by physicians of knowledge and experience should be established to remedy this deficiency, and recommends the foundation of a medical library. He himself proposes to give a course of lectures on materia medica followed by one on the institutes and theory of medicine. Next he urges that the activities of physician, surgeon and apothecary should not be combined in one man, but asserts that "practitioners would enjoy much more satisfaction in practice if physic, surgery and pharmacy were in different hands". Finally, he dwells on the advantages which American students have over those in Europe in possessing an ample field for the study of natural history.

(5) Dr. William Welch's address, which represents the presidential oration delivered before the Congress of American Physicians and Surgeons in 1897, is, as Dr. Simon Flexner remarks in the introduction, as applicable to the subject to-day as it was forty years ago. Dr. Welch maintains that pathological adaptations have their foundation in physiological processes or mechanisms. Pathological adjustments, however, lack the co-ordinated fitness characteristic of physiological adaptation, as he illustrates by the case of a heart hypertrophied in consequence of a vascular lesion which does not completely restore the normal condition of the circulation. Similarly, a kidney hypertrophied in consequence of deficiency in the other kidney is more susceptible to disease than the normal organ. While adaptation is usually to some extent advantageous to the individual, it is not necessarily so, as is shown by a scar in the brain causing epilepsy. Throughout his address Dr. Welch emphasizes the importance of taking into consideration not only the facts of human and allied physiology but also those accumulating in the domain of experimental embryology and morphology, especially as regards the influence of various changes of environment, particularly of definite chemical, thermic or mechanical changes upon the movement or growth of cells.

In conclusion, Dr. Welch points out that systems of treatment based exclusively on the theory of the *vis medicatrix naturae* often rest on an insecure foundation, inasmuch as the agencies employed by Nature may be either inadequate or entirely helpless.

J. D. ROLLESTON.

A STUDY OF HUMAN RELATIONS

Man the Slave and Master

By Mark Graubard. Pp. x+366. (London: J. M. Dent and Sons, Ltd., 1939.) 10*s*. 6*d*. net.

TO-DAY, as never before, the man of science is faced with the problem of the relation of science and society. Science is a powerful weapon for evil as well as good, and it is the business of the man of science to ensure so far as he can that his work is not misused. One of the great difficulties of such a task is that few modern men of science are well informed outside their own fields of work. Still more is the layman ignorant of science, especially in that he is seldom acquainted with that manner of approach which is often termed the 'scientific method'.

Dr. Graubard has set himself the task of helping to remove this difficulty by presenting, in simple terms, an analysis of human behaviour and the composition of society based on biological knowledge. He discusses conditioning, heredity and evolution, both biological and social, and he does it in a way that should commend the book to men of science and laymen alike. He then turns to the application of his knowledge to the scientific control of human affairs, and though at this stage it is inevitable that some disagreement must ar his analysis and proposals can be read with pr even by those whose views diverge most.

It is a pity that the book is marred in places occasional inaccurate and loose statement. In account of Mendel's work with peas, the round wrinkled characters of the seed are described determined by the mother plant's constituti whereas they are, in fact, dependent on the ge type of the zygote itself. His implications th Mendelian inheritance in animals was first served in rabbits and that departure from Mend second law, of independent assortment, was f found in Drosophila, show a lack of appreciat of Bateson's work with poultry and sweet pe On p. 190, the author says "Hence they [that all the races of man] form a species" and on p. "the Negro, who of all the species of man has least hair". Other similar examples could quoted.

These are, however, minor blemishes and sho not be allowed to obscure the fact that Dr. Gr bard has written a valuable book, at once criti and informatory. It should be read by all who interested in the study of human relations.

K. MATHER

CONSERVATION OF NATURAL RESOURCES

Conservation in the United States

By Prof. A. F. Gustafson, Prof. H. Ries, Prof. C. H. Guise and Prof. W. J. Hamilton, Jr. Pp. xi+445. (Ithaca, N.Y.: Comstock Publishing Company, Inc., 1939.) 3 dollars.

THE conservation and the restoration of its natural resources are perhaps the most important questions that the United States has to face. These are here divided into sections dealing with the soil, forests, wild life and minerals, especially coal and oil. Each is written by an expert who has researched with the view of ameliorating the present difficulties. Perhaps their most interesting feature is the close connexion, never stressed but everywhere made plain, between purely scientific investigation and the practical problems. This is as it should be, as the work is intended to be a text-book to stimulate students who have already had a broad scientific training. It everywhere sets out the historical facts, present position and the possible and desira remedies so far as the necessities induced increase of population allow.

While mineral resources may be regarded waning assets merely to be treated with the great economy, the soil and water are as necessary man's existence to-day as in all ages. Passing o a section dealing with the topography of the coun and the consequent production of soil regi of varied productivity, these always associa with water, there arise questions of soil deplet by the loss of plant nutrients and of erosion los due to wind and rain. The white man found eastern part of the country unbroken forest wh had to be cleared for crops. Organic mat disappeared from the soil so that its surface carried away by the rainfall, already half the soil being lost by this means over an area estima at 855 million acres. Another 322 million acres eriously depleted by wind erosion, so that nearly wo-thirds of the country is affected. Remedies uggested are in the due employment of green manures, crops to be ploughed in to hold the water in the soil, and schemes of planting that will tilize the rainfall rather than encourage the ormation of gullies, methods excellently shown n a series of photographs. These must be associated with considerations of the conservation nd reafforestation of the woodlands, a problem f great complication since a large country is ivided into many vegetative regions dependent on temperature, wind, rainfall and subsoil, each rea with its own trees and undergrowth. Forest fires must be controlled, while waste in the lumber ndustry has to be avoided. Fortunately the questions here have become national, though the ndividual States and even counties are helping, appreciating the local effects on rainfall and the value of such wooded parks to the psychology of heir own people. The national forests now aggregate 170 million acres, and the aim appears o be to double this amount by the planting of he high lands but mainly of the abandoned arming areas, and in this way reclaiming immense wastes.

The section dealing with the animal resources, fish, birds and game, is excellent. The decline of the supply of certain fish was inevitable in an absence of knowledge of their biology, but the Fish Commission has the matter well in hand and has already had striking success in matters of regulation, avoidance of pollution and hatcheries. The buffalo herds have gone for ever, but Pennsylvania has done fine work in the encouragement of deer, while the beavers, reintroduced from Canada less than twenty years ago, have now to be trapped—a new industry.

While in this study of the United States much is local, the analogy with Africa is striking, the terrain very similar. European countries start there with the experience of America through three centuries. This suggests the necessity for paternal governments to control unthinking settlers so that the land may not be impoverished. It may not ever require to be developed as that of the United States, but it will undoubtedly have to provide food for a teeming population. So far the agriculture of native areas is small, but the cow as the unit of wealth is disappearing and a certain change of habits in the native population must occur. The thoughts which are induced by this study of America should excite the imagination of all who have to rule in Africa, where clearly it is already time for regularized conservation.

J. Stanley Gardiner.

FOUR-TERMINAL NETWORKS

Einführung in die Vierpoltheorie der elektrischen Nachrichtentechnik

Von Prof. Dr. R. Feldtkeller. (Physik und Technik der Gegenwart, Abteilung Fernmeldtechnik, herausgegeben von Prof. Dr. Heinrich Fassbender, Band 2.) Pp. ix+142. (Leipzig: S. Hirzel, 1937.) 3.80 gold marks.

THIS is an excellent introduction to the comparatively young theory of four-terminal networks, that is, of alternating-current transfer systems of which only the input and output pairs of terminals are accessible for measurements. After a brief outline of network analysis, the author passes in Chapter ii to a thorough theoretical investigation of linear symmetrical four-terminal networks, of which the behaviour for different terminal impedances is examined by means of circle diagrams based on the network parameters. The application in Chapter iii of this theory to the particular case of loss-free systems illuminates the theory through the relative simplicity of the circle diagrams required, while Chapter iv deals with asymmetric linear systems.

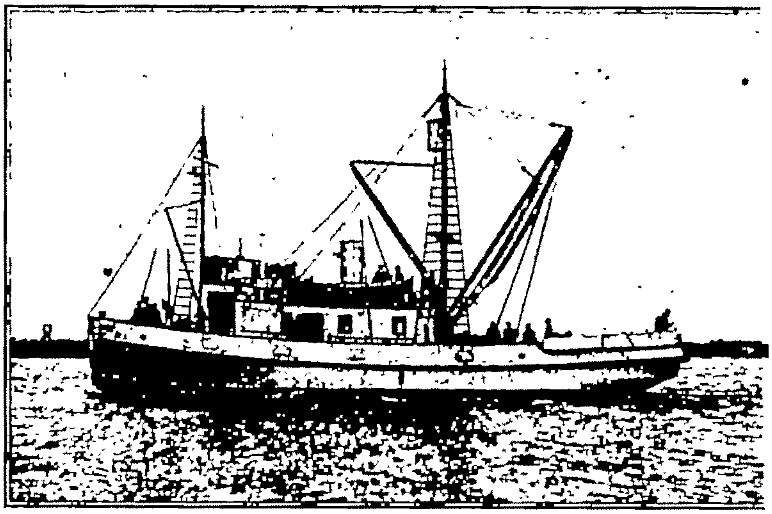
Chapter v treats the general theory of linear four-terminal networks by the use of matrix algebra, a field of electrotechnical advance in which the author was a pioneer. With this treatment, as the author remarks, the book passes from text-book to hand-book, and the two final chapters provide at once the tabular material for, and a demonstration of, the labour-saving use of four-terminal theory in matrix form. Matrices are derived for the fundamental interconnexions of the four-terminal networks, and the theory of propagation networks in cascade is touched on. In the sixth and last chapter are collected the matrices of simple four-terminal structures, including transformers and (linear) amplifying valves, while a final section shows the derivation of equivalent *T*- and π-networks for systems obeying the Kirchoff reciprocal principle, and for systems not so restricted.

The book is clear, neat and detailed; the few errors that have escaped the proof-reader are mainly of interest as evidence of revision by the author in the interests of clarity.

FISHERIES RESEARCH IN AUSTRALIA

BY SIR DAVID RIVETT, K.C.M.G.

SINCE the ill-fated trawler *Endeavour*, under Dr. Dannevig, was lost at sea in 1914, fisheries exploration has rather languished in Australia. This is scarcely pardonable in a country with 12,000 miles of coastline, a relatively poor fish supply, especially in the inland areas, and a definite need for quantities of fish meal on its stock farms. During the past two years, a vigorous effort has been made to improve matters under the Council for Scientific and Industrial Research working in co-operation with universities (particularly that of Sydney) and State Departments.



M.S. *Warreen*.

Dr. H. Thompson, formerly of the Newfoundland Fisheries Services, has been appointed officer-in-charge of investigations, and under his guidance the Station illustrated in the accompanying photograph is nearing completion. The site, made available by the New South Wales Government, is that of Dannevig's hatchery at Cronulla, the southernmost Sydney watering-place, on the Port Hacking estuarial group of salt-water inlets. It is admittedly a very beautiful spot for a marine biological station, with deep and shallow water frontages of rocky and sandy foreshores. Museum and library facilities are easily accessible in Sydney; and the fish market there will be useful in the collection of biological material and statistics from the trawling and seine-netting fleet.

MARINE BIOLOGICAL RESEARCH STATION, CRONULLA.

The aquarium and offices are in the left foreground and the main laboratory building in the right Behind are the concrete tanks. On the shores are the pond and boat sheds.

The pre-existing hatchery appointments have been converted for experimental work. Salt water is pumped to a 25,000 gallon concrete tank and fed by gravity to an aquarium where the temperature is under control. A large tidal concrete pond (100 ft. × 42 ft.) has been reconditioned for the retention of fish for observation or experiment. New additions include a workshop, net- and fish-cleaning shed, and a main building containing offices, stores, biological, chemical and bacteriological laboratories, dark-room, charting and drawing room, and a large library. Refrigerating cabinets and a small canning plant are provided.

A 16-ft. motor skiff has been built for local sampling work and a 2-ton truck has been equipped as a mobile laboratory.

For exploratory work, mainly on pelagic, or urface-swimming, fish, M.S. *Warreen* (a native ame for the sea) was built in Melbourne and has een in commission for about fifteen months. She 82 ft. long, of 108 tons displacement, and is ted with a 215 h.p. main engine of Atlas Polar iesel construction, with Ruston auxiliaries. She rries radio equipment for transmitting and ceiving, and an echometer for automatic record- g of depth. A small laboratory permits limited ork at sea. A large purse-seine net is carried on turn-table in the stern.

Over so great an extent of sea, one small vessel capable of a speed of only 9 knots can do but little: hence very full use is being made of reconnaissance from the air. Aircraft and personnel are made available to the Council by the Royal Australian Air Force; and particularly in the 'spotting' of shoals of tuna and so-called salmon (*Arripis trutta*), air observation has been conspicuously successful. Already possibilities have been demonstrated which are attracting the attention of commercial men; but a great amount of scientific investigation will be necessary before a sound basis for fisheries development is secured.

STRUCTURE OF THE RAYON FIBRE

By Prof. H. Mark

REFERENCE has frequently been made in these columns[1] to the progress of our knowdge concerning the structure of natural and rtificial fibres during the last few years. The ccompanying illustration (p. 314) gives a résumé f the present state of knowledge as represented y the cellulose fibre, which is very well known nd at the same time of great economic imporance.

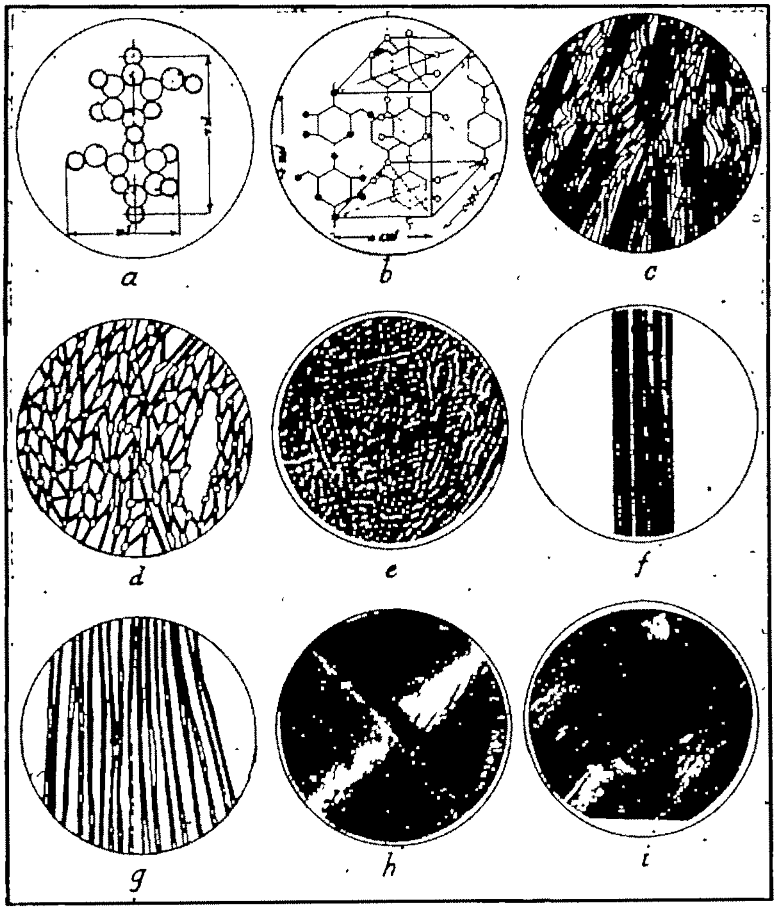
The illustration was made up under the assumpion that we have at our disposal a microscope llowing us magnifications of unlimited amounts n such a way that we can always increase its esolving power by the factor of 10 by switching in nother imaginary objective. Looking at a rayon hread through such a microscope, we should btain such a series of pictures, and it seems esirable to discuss them one after the other and o point out what kind of information they give nd to what extent the particular qualities of the bre are shown by them.

(*a*) We start with the highest magnification, bout 1 to 50,000,000, and observe the ***fundamental hemical unit*** of cellulose, namely, the ***glucose residue*** omposed of 6 carbon atoms, 10 hydrogen atoms nd 5 oxygen atoms[2]. These glucose units have a ing structure and are linked together by main alence bonds. They stand for the chemical beaviour of the material, for example, for the fact hat cellulose is easily wetted and swells in water, ut does not take up organic substances such as etrol, benzene or oil. They are also responsible r the fact that one can produce certain derivaives of cellulose, namely, cellulose nitrate (celluid), cellulose acetate (cellon), etc. Finally heir presence is responsible for the fact that by hydrolysis cellulose can be converted into a sugar.

(*b*) We pass now to the next magnification, 1 to 5,000,000, and get an insight into the ***crystallographic unit*** of the fibre. What we see is the ***elementary cell*** of the cellulose lattice revealed by X-ray investigations[3]. We see that the different glucose residues are united to long chains lying parallel to each other and running through the fibre along its axis. The presence of these long and highly orientated chains explains the double refraction of the material, its high mechanical tenacity, the anisotropy in swelling and the behaviour towards substantive dye-stuffs.

(*c*) When we switch in a magnification of 1 to 500,000 we get the next picture. Here each single chain of diagram *b* is represented by a thin line. We learn that these chains are partly bundled together with a considerable degree of order forming a ***micellar structure***, and partly they represent a complicated framework of entangled fringes[4]. We get the impression that the whole fibre consists of parts with comparatively high crystallographic orientation and of other parts which can be called amorphous. This peculiar structure accounts for the fact that rayon fibres at the same time show a considerable strength and a high elasticity. It is responsible for the amount of swelling, the dyeability, and the resistance to creasing. Every process that aims at producing rayon has to take account of this fact.

(*d*) The next step, leading to a magnification of 1 to 50,000, gives a more general view of this ***fringe and net structure*** of cellulose. In *d* the parallel strokes represent the crystallized areas while the small irregular circles are the amorphous regions. We see that the fibre may be regarded as an irregular flexible net built up of these two units and exhibiting at certain places larger holes which, of course, are in some way due to the origin of the material[5]. This structure is in general connected with the mechanical properties of the thread with its elasticity, plasticity, tenacity and its chemical reactiveness. The spaces and crevices between the crystallized areas absorb dye-stuffs, wetting agents and other reacting substances. They are of great importance to the behaviour of the fibre as a textile.



(*e*) We have reached a magnification of 1 to 5,000 and are now at the utmost limit of normal microscopic resolving power. The differentiation of picture *d* has disappeared and we observe a *fibrillar structure* in which the morphological units of the fibre are visible. They may be not so pronounced in artificial filaments and hence the above picture shows the fibrillar structure of a cotton fibre. The length, width and orientation of the fibrillæ are of great importance for all the finer textile properties such as elasticity, softness, lustre, creasability, etc.

(*f*) Switching in the next magnification, 1 to 500, we have finally reached the range of microscopical observation with normal light[6]. The picture shows a *viscose rayon thread* exhibiting system of stripes parallel to its fibre axis. The are responsible for the soft lustre of the yarn, i pleasant appearance, and its easy dyeabilit Pictures such as this are of great importance technical routine tests carried out in rayon factorie The present one, for example, shows little speck indicating that some contamination of the materi has taken place.

(*g*) This picture, with a mag nification of 1 to 50, shows bundle of a normal *viscose rayc thread*. Pictures of such kin are of importance to control th levelness of the yarn, its homo geneity in diameter, colour, dye ability and lustre.

(*h*) and (*i*) The last two pic tures finally give us the wel known aspect of an artificia *silk yarn* with a magnificatio of 1 to 5 and without magnifica tion at all. They need n explanation, being familiar t everyone.

The set of the above nin pictures may offer a certain in sight into the structure of very important substance start ing from the trade product namely, *rayon yarn*, and endin with the last detectable chemica unit, namely, the *glucose residu* The location and understandin of every single structural prin ciple is of importance, for eac influences all the different tech nical qualities of the final pro duct; the better and mor accurate these nine pictures ca be made, the higher will b the probability to make a rayon yarn of bes quality.

---

[1] See, Astbury, W. T., NATURE, 141, 968 (1938). Clark, L. H NATURE, 142, 899 (1938). Bragg, W. H., NATURE, 142, 910 (1938

[2] Compare, Haworth, W. N., "The Constitution of Sugar (London, 1929). In (*a*) the positions of the hydrogen atoms a omitted because they could not be located experimentally shaded circles represent C-atoms, the open ones O-atoms. Dimen sions of residue, 10·3 A. and 7·5 A.

[3] See, Polanyi, M., *Naturwiss.*, 15, 288 (1921). Sponsler, L. O and Dore, H. W., *Coll. Symp. Mon.*, 174 (1926). Meyer, K. H, and Mark, H., *Ber.*, 61, 593 (1928). Astbury, W. T., "Fundamenta of Fibre Structure" (Oxford, 1933), p. 77 *ff.* Gross, S. T., an Clark, G. L., *Krist.*, A, 99, 357 (1938). Meyer, K. H., Misch, L and Badenhuizen, N. P., *Helv. Chim. Acta*, 22, 59 (1939). Crystallo graphic dimensions, *a* = 8·35 A.; *b* = 10·3 A., *c* = 7·9 A.

[4] Astbury, W. T., *Trans. Farad. Soc.*, 29, 193 (1933). Mark, H., *Rayo Record*, 493 (1932); *Trans. Farad. Soc.*, 29, 6 (1933). Houwink, R. *Trans. Farad. Soc.*, 31, 10, 28 (1935). Frey-Wyssling, A., *Prot.*, 262 (1936).

[5] Gerngross, O., Herrmann, K., and Abitz, W., *Biochem. J.*, 228, 40 (1930). Hermans, P. H., *Koll. J.*, 81, 143, 300 (1937); 82, 58 83, 71 (1938); 86, 107 (1939). Kratky, O., *Koll. J.*, 80, 139 (1937) 84, 268 (1938). Kratky, O., and Mark, H., *J. Phys. Chem.*, 36, 129 (1937).

[6] Farr, W. K., Eckerson, I., and Sisson, W. A., *Contrib. Boyce Thompson Inst.*, 6, 189, 309, 315 (1934). Bailey, A. J., *Ind. Eng. Chem.*, 40 (1938).

POLYPLOIDY INDUCED BY COLCHICINE AND ITS ECONOMIC POSSIBILITIES

BY DR. G. H. BATES,
THE FARM INSTITUTE, PENKRIDGE, STAFFORD

THE technique employed by plant breeders has undergone revolutionary changes since the st workers began the production of new and proved varieties. The methods of the selection-ts, such as Luther Burbank, were certainly ectacular, but they were laborious, expensive d haphazard. Mendelism marked a great step rward, in that it was possible to work along pre-nceived lines in an orderly and economical anner with a fair idea of what was likely to aterialize. There is no doubt, however, that endelian methods have taken us as far as they an, at least in respect of our commonest crop lants. We have exhausted all possible combina-ons of known characters and have reached a oint where, as Salaman has declared, we are mply 'ringing the changes' on existing material. point has been reached where the hybridizer an only wait for some new mutation to turn up.

Attempts have already been made to produce hese mutations by the artificial production of olyploidy. Such practices as thermal treatment, entrifuging and decapitation of the apical shoots the seedling have proved successful in a very nall number of cases. They are, however, far o laborious to be considered worth while.

In view of the above facts, it is small wonder that the discovery by Blakeslee and Avery of the alue of colchicine as an agent for the production f polyploidy has received a great welcome. The eed for such a stimulus has probably accounted or the wave of optimism which seems to have wept through the ranks of plant breeders through-ut the world. Results up to the moment, however, carcely seem to justify the description of the new echnique as being more than promising.

The drug colchicine, prepared from parts of *olchicum autumnale*, has been known to physicians or many years, mainly as a specific for gout. Hope as expressed that it might also prove to have an nhibiting action on carcinomatous cells. It is nly recently that its influence on mitosis has been discovered and put to practical application.

There have been several theories as to the exact manner by which it brings about somatic doubling. t has been suggested that nuclear division takes lace at a greater rate than cell division, under the nfluence of colchicine, thus resulting in bi-nucleate ells with subsequent fusion of the pairs of nuclei. The investigations of Levan, supported to a certain extent by others, have practically established the fact that another mechanism is responsible. It appears that inactivation of the nuclear spindle prevents anaphase reduction, thus leading to a doubling of the chromosome number. Experiment has shown that meiosis is also affected, but this has no economic application as has the influence on mitosis.

The exact action of colchicine and the mechanism by which changes are effected has great interest for the cytologist. However real may be the achievement in this direction, the practical plant breeder is more concerned with the accomplished fact and its possibilities.

Literature on the subject has already assumed large dimensions and results pour in from all parts of the globe. The number of workers is now so great as to make a detailed account of their different activities impossible in a small space. A review of available publications leaves one with the impression that, in the main, reports are fragmentary and often unconvincing.

Easy and rapid methods for identifying the polyploid condition are certainly desirable; but it is doubtful whether they are, as yet, sufficiently trustworthy to be used in proof of claims made for the results of a new and revolutionary technique. One could wish that statements were supported by something more concrete than such criteria as pollen grain size, dimensions of the stoma guard cells and *gigas* characters. On the other hand, claims for the production of tetraploid plants of several species are made which are supported by chromosome counts. It must be conceded that the work is as yet in its infancy, and technique is by no means perfected.

The practical application of the treatment has taken different lines and there are several methods for the administration of the alkaloid. The soaking of the seed in dilute solutions varying in concentration from 0·05 to 1·0 per cent is the commonest practice. The influence upon the seedling depends upon such factors as the concentration of the solution, period of soaking, nature of the testa and the rapidity with which the seed germinates. In some cases it is suggested that the testa should be removed or that the seedling itself should be treated.

A large amount of routine work is necessary to determine the optimum concentrations for the seeds of different species. I have found that a 0·05 per cent solution has a profound influence on the seedlings of mustard after soaking the seed for four days. In the case of several gramineous species the seed of which had been treated in like manner, only a very small proportion of individuals was visibly affected. In the case of sweat peas, the seeds either failed to germinate or the distorted seedlings perished.

The main objection to seed treatment is that germination is either partially or completely checked, root development is restricted or absent for some considerable time and a great waste of material occurs. There is a characteristic swelling of the hypocotyl, more notable in some species than in others. Many odd distortions occur, each characteristic of a particular species

The treatment of apical and axillary buds has produced tetraploid shoots. This is affected by painting on the solution, in combination with a wetting agent, by spraying or by immersion. A 0·4 per cent solution is recommended by American workers for the direct application method.

Spraying of the parts is the least desirable of methods from the operator's point of view. It is important to stress the fact that colchicine is a dangerous drug and that in the hands of irresponsible persons disastrous results may occur. The human mucous membranes are particularly sensitive and one reads of serious eye injuries.

I have employed the 'injection' method as elaborated, for other purposes, by the East Malling workers. A 0·05 per cent solution has been used, a vertical slit in the stem of the plant or a severed petiole being placed in a tube of the solution. Profound morphological changes take place, and, as the influence is localized, its intensity varies throughout the affected part of the plant. In tl case of *Vicia Faba*, the flowers were swollen the base and were all abortive except two. The gave rise to pods showing *gigas* characters with a erect habit of growth. In *Fragaria* species, distorte fruits have been produced. A large amount material has been treated by this method, but is as yet too early to determine whether polyploid has resulted.

Colchicine is an expensive commodity and i vestigations are proceeding to explore the poss bilities of acenaphthene as a cheaper substitut Kostoff has shown that the disintegrating fra ments of the corm of Colchicum can produc polyploidy in germinating seedlings in clo proximity.

Reviewing the whole of the work on induce polyploidy in a dispassionate manner, one mus admit the remarkable nature of the achievement from the cytological point of view. Whether ther will be much material gain accruing to the pla breeder remains to be seen.

In the case of garden plants there are distinc possibilities. Abnormal or distorted varieties wit unusually large flowers have an economic valu with a public displaying an insatiable appetite fo novelty. Food plants are in a different categor Tetraploids are of frequent occurrence, but are no always of special merit ; in fact, the reverse quit often obtains. Increased size is not always o importance, for with most of our arable crops ther are varieties capable of producing plants just a large as the soil will grow them.

We do not, of course, know how the new tetraploid types will react to disease infection, how thei cooking qualities may be affected for better o worse, or how altered morphological character may be of benefit to the cultivator. For th present the chief possibility appears to be th production of fresh material upon which to build

OBITUARIES

Dr. A. Harker, F.R.S.

THE death of Dr. Alfred Harker, emeritus reader of petrology in the University of Cambridge, on July 28 at the age of eighty years has removed from our midst an outstanding figure in British geology—one whose brilliant contributions in his own field over half a century placed him in the forefront of living petrologists.

Born in Hull on February 19, 1859, Harker entered St. John's College, Cambridge, in 1878 and graduated eighth wrangler in the Mathematical Tripos of 1882. He was placed in the first class of both parts of the Natural Sciences Tripos with physics as his chie subject, and was elected to a fellowship in his colleg in 1885. Though not of the 'Bonney School', so muc were his early geological interests strengthened a St. John's that he was eventually attracted to demonstratorship under McKenny Hughes. H became University lecturer in 1904 and on the deat of Hughes in 1917 was elected to a special readershi in petrology.

Harker's earliest papers dealt with the cleavag structure of slates, an investigation for which hi mathematical training peculiarly fitted him. These studies were based in part on his observations on the dates of North Wales, where soon he became absorbed n a new interest—"the petrology of the igneous ocks associated with the Cambrian (*Sedgwick*) ystem of Carnarvonshire"—and endeavoured to race the relationship of the igneous phenomena of he district and concurrently operating crustal tresses, a theme which he was greatly to amplify in is later writings. The results of this work were ncorporated in the Sedgwick Prize Essay for 1888. During 1889–93 he was engaged in the Lake District where, in collaboration with J. E. Marr, he traced a aried group of lavas, ashes and sediments into the ureole of the Shap Fell granite. These papers form pioneer contributions on the nature and origin of metamorphic rocks and rank with Rosenbusch's lassical studies on the *Steigerschiefer* of the Vosges.

With a reputation now thoroughly established, Harker, at the instance of Sir Archibald Geikie, was seconded in 1895 to the Geological Survey of Scotland for summer field work in Skye. The mapping of the mountainous groups of the Cuillins and the Red Hills of central Skye which followed, was completed in 901, and will ever remain as a monument to his skill and ardour as a field geologist, and disposed finally of the embittered controversies of Judd and Geikie on the igneous succession of that island.

The outcome of his researches in Skye, and later n Rum, appeared in two Survey memoirs—"The Tertiary Igneous Rocks of Skye" (1904) and "The Geology of the Small Isles of Inverness-shire" (1908)—and at once attracted wide attention. Considering he time of their execution, and as the work of one ndividual, these researches will always rank as one f the greatest achievements in igneous geology.

The way was now prepared for Harker to present to a wider audience his long-considered views on the broad aspects of magmatic descent and the controlling influence of tectonic environment. These problems, among others, he unfolded in his "Natural History of Igneous Rocks" (1909). Written in an xtremely lucid style and with a rare power of hilosophical generalization, this volume has come o exert a deep influence on petrologic thought. If ome of his conclusions have needed amendment, in s broad lines, his achievement has been none the ess fundamental.

The same philosophic outlook characterized Harker's presidential addresses to the Geological Society. In the last of these he returned once more to the subject f metamorphism, a field which became his dominant nterest in later years. His final work appeared in 932 under the title "Metamorphism", a treatise hich has been appraised in the words of an acknowledged authority as filling "an important place in he literature of petrology, and in lucidity, balance and breadth of view can serve as a model to all future riters on the anatomy and history of rocks".

Harker was elected a fellow of the Royal Society n 1902 and awarded a Royal Medal in 1935. From he Geological Society of London he received in succession the Murchison and Wollaston Medals. Honorary doctorates were conferred upon him by the niversity of Edinburgh and McGill University, hile he was honorary or corresponding member of many scientific societies, British and foreign. These honours he accepted with such extraordinary modesty that many of them remained hidden and unsuspected by even those most intimate with him.

Harker's elementary lectures made little appeal to the average Tripos man, but he excelled in contact with senior students, and his advanced courses became the source of inspiration to many generations of students.

After his retirement in 1931, and to within a few weeks of his death, he continued to devote much time to the care of the petrological collections of the University. In the Harker Collection of rock slices numbering now some 40,000 slides neatly labelled in his own handwriting and representative of research material drawn from all quarters of the globe, he has endowed his department with a unique monument.

At St. John's College, where he had been for some years the senior fellow in residence, he was rather a lone figure, though on his retirement he seemed to cast off some of his natural reserve. By his old pupils he was held in affectionate regard, and the expression of this esteem was signally evoked at the dinner held in his honour at Cambridge on the occasion of his eightieth birthday. Those who were privileged to have his confidence and companionship will retain a lasting memory of the generosity and humility of a truly great man.

C. E. T.

Mr. W. Scoresby Routledge

We regret to record the death of Mr. W. Scoresby Routledge, traveller and anthropologist, which took place suddenly at Paddington on July 31 in his eightieth year.

William Scoresby Routledge was born at Melbourne in 1859 and was educated privately and at Christ Church, Oxford, graduating in 1882. He then entered University College Hospital, London, where he was Erichsen prizeman in operative surgery. He was, however, at heart an explorer, and for many years lived among primitive peoples. With the Micmacs of central Newfoundland, primitive tribes at that time still living mainly by hunting and fishing, he became proficient in woodcraft and learned to endure conditions which to the ordinary civilized individual would appear to border on privation. This early training served him to good purpose in his later travels, more especially during his stay among the Akikuyu of East Africa Colony, now Kenya, with whom he lived at a time when there was little exaggeration in terming them a 'prehistoric' people—the title he gave them in the valuable study of their manners and customs in "With a Prehistoric People" (1910), of which he was the joint author with his wife, Katherine, the daughter of the late Gurney Pease of Darlington, whom he married in 1906.

Mrs. Routledge, who had read history at Oxford, guided by the influence of Dr. R. R. Marett, was no less a keen anthropologist than her husband, and even while their joint book on the Kikuyu was in the making they were already planning their next and most important expedition. This was a journey to Easter Island to investigate and explore systematically the antiquities of that island, and more especially the origin and meaning of the sculptured statues and the script for which the island is famous, and of which the meaning had long been sought by travellers and anthropologists. The expedition, which sailed in a small schooner-rigged yacht with auxiliary power, named the *Mana*, which Routledge had built for the purpose, was in Easter Island when the War broke out in 1914. It returned to England in 1916, after visiting a number of islands in the Pacific, including Pitcairn, from which they brought back two descendants of Young, the mutineer officer of the Bounty, whom they presented to His Majesty King George V in an interview in July 1916. Further research on the history of Easter Island was carried out in 1920 and 1922, when the Routledges visited and surveyed the Austral and Gambier groups and collected much valuable anthropological material bearing on distribution. The results of the earlier expedition were published in a volume "The Mystery of Easter Island" which appeared in 1919.

WE regret to announce the following deaths:

Sir Edward Brown, former secretary of t National Poultry Council and first president of t World's Poultry Science Association, on August aged eighty-seven years.

Miss A. R. Clark, librarian at the Laboratory the Marine Biological Association of the Unit Kingdom at Plymouth.

Dr. Edmund Heller, director of the Fleishhack Zoological Park, formerly director of the Milwauk Zoological Gardens, on July 18, aged sixty-fo years.

Prof. L. Lévy-Bruhl, professor of philosophy the Sorbonne during 1899–1927, president of t Institut française d'Anthropologie during 1927–3 aged eighty-two years.

Dr. Heinrich Poll, formerly director of t Anatomical Institute, Hamburg, on June 12.

Prof. W. A. Tarr, professor of mineralogy a geology in the University of Missouri, on July 2 aged fifty-eight years.

NEWS AND VIEWS

Memorial to Sir William Perkin

IT was a pleasing thought of the people of Sudbury, now part of the new borough of Wembley, and of the friends of the late Sir William H. Perkin, to commemorate his long residence there by the erection of a memorial in the form of a tiny garden of rest and a large oval oak seat. The memorial was unveiled by the eldest Miss Perkin on August 12 in the presence of the civic authorities, the church, some friends and a large number of the public. An appropriate oration on Perkin's life and work was given by Dr. C. E. Goddard. The growth of London has swept away the peaceful home and garden and fields where Perkin retired to in 1874 to devote his life to research; he became also a good citizen and much beloved in the village. The memorial stands on a corner of his land, the noisy traffic thunders past it on two sides and there is a round-about in front. But this tiny spot is a haven of refuge and peace, and those who use it for a few moments in years to come can read the tablet and muse perhaps on what kind of a man was this Perkin, founder of the dye industry. 'Scientist and citizen' might appropriately have been added, for it was as the latter, a man conspicuous for his probity and good works, that Sudbury knew him.

Ship-Burial and Treasure Trove in Suffolk

THE verdict of the jury at the coroner's inquest, which took place on Aug. 14, on the Anglo-Saxon ship-burial, or rather on the grave furniture in precious metals found therein, at Sutton Hoo in Suffolk (see NATURE of August 5, p. 239), was such as, perhaps, might well have been expected. It would be more than difficult to argue convincing that a royal burial, in the circumstances indicat here by the character of the relics, could have tak place, with that secrecy and intention to resum possession, which have been laid down from time time in legal pronouncement as the essential princip of 'treasure trove'. Unless the matter is carri further in the High Court, as Mr. L. H. Vulliam, the coroner, indicated as a possibility, the Sutt Hoo treasure now becomes legally the property Mrs. E. M. Pretty, the owner of the land upon whi the burial was found by Mr. Guy Maynard of t Ipswich Museum. It may be hoped, however, th arrangements will be made in due course to ensu its display to the public and availability for stud as its historic interest demands. It would now appea since there has been an opportunity for the articl to be examined and cleaned in the British Museu that the find is far more valuable than was at fir reported. This is shown in the evidence of Mr. C. W Phillips of Selwyn College, Cambridge, who had bee in charge of the opening of the tumulus since Jul and also in a supplementary note contributed b *The Times* museum correspondent in the issue August 15 which mentions more especially the silve The objects in this metal include six shapely shallo bowls in almost perfect preservation, about 8 or inches across, and all provincial Byzantine or la Roman. They are decorated with a broad cros usually of a quatrefoil pattern. A silver dish decorat with a classical woman's head is provincial Byzanti work of the sixth century. A large platter, 28 inch across, was made at Constantinople, and bears mar of the reign of Anastasius I. The gold work, howeve a Saxon, and is said to be extremely massive. In association were forty Merovingian coins. It is thought that this may be the burial place of Redwald, the first of the East Anglian royal family to become High King of England.

The British Speleological Association

DR. R. R. MARETT's presidential address to the fourth annual Conference of the British Speleological Association, which met at Swansea on August 5–8, tendered in humorous vein an anthropologist's explanation of the attraction of the modern study of caves in 'speleolatry'—primeval man's worship of the cave, which in the racial consciousness of a late-born generation had assumed the guise of a devotion to science. He was, however, able to support his contention that speleolatry stood for something real in the history of religion by reference to the evident mystic intention, at least in part, of the palæolithic cave art of France and Spain and the therapeutic cult of the cave of later times. No doubt Dr. Marett had in mind the symbolism of a mystic ritual of approach, when at the opening of the Conference he presented Sir Cyril Fox, director of the National Museum of Wales, with a silver key. Members of the Association were given ample opportunity to experience the inward thrill of which their president had spoken, in the visits which were paid to the numerous caves on shore and inland in the neighbourhood of Swansea, in which the Paviland cave in the Gower Peninsula, famous in the annals of palæontology for its association with the name of Dean Buckland, received its due meed of attention; while in the exhibition arranged by Mrs. A. Williams at the Royal Institution of South Wales, they found illustration of the cave sites and their structure, as well as of the evidence of their occupation by men and animals, ranging from Mousterian to medieval times. Among those who addressed the Conference were Prof. T. Neville George, who discussed the geological aspect of the caves of South Wales, and Prof. Bosch-Gimpera, formerly rector of the University of Barcelona, who dealt with the cultures of the Spanish caves. Dr. Marett was re-elected president of the Association, with Prof. L. S. Palmer as chairman.

Totemic Ceremonial in Arnhem Land, Australia

DR. DONALD F. THOMSON, who was specially commissioned by the Government of the Commonwealth of Australia to investigate conditions among the aborigines of the Northern Territory during 1936–7, has collected much information relating to the customs and beliefs of the tribes of Arnhem Land, shown in numerous papers published in scientific periodicals and elsewhere since his return to England. He has obtained evidence, for example, running counter to the opinion, long generally accepted, that the indigenous peoples of Australia had been virtually free from external influence after their settlement there. It is now accepted, however, that influence from the north entered the continent at York Peninsula by way of Torres Strait; and Dr. Thomson finds in the use of wool or fabric to represent the hair of a dog in totemic ceremonial evidence of intercourse with early Malayan or Macassar voyagers, by whom this greatly valued material was brought to the area. Although the dog, which forms the central figure in a remarkable totemic ceremonial witnessed by Dr. Thomson and described by him (*Illustrated London News*, August 12), has been assimilated by the natives to the Australian dingo, it bears unmistakable evidence of an external origin, while the rites differ in many ways from the typical Australian totemic ceremonies. The ritual performance re-enacts in pantomime the myth of the original pair of 'dog' ancestors, who sank in the mud and were overwhelmed by the sea in trying to reach a stranded whale. Finally, they were turned into a great rock, whence now come the baby spirits of members of the clan who enter the mother at pregnancy. In the totemic ceremony, the figure of a dog, which has been constructed by the old men in secret, after giving birth to puppies—an event symbolized by cutting off the hindquarters—is carried along a road while members of the tribe imitate both the gait of puppies and the struggles of the original pair when caught in the mud. One of the tribal totems is a representation of a 'square-face' gin bottle carved in wood.

International Congress of Americanists in Mexico City

THE twenty-seventh International Congress of Americanists was held in Mexico City during August 5–15. General Cardenas was honorary president of the Congress, the acting president being Dr. Alfonso Caso, director of the National Institute of Archæology and History, whose excavations on Monte Alban have so greatly enriched the national collections of pre-Hispanic antiquities. Mr. T. A. Joyce, formerly of the Ethnographic Department of the British Museum, and Dr. Paul Rivet, of the Musée de l'Homme, Paris, and the foremost authority in France on the ancient indigenous peoples of America, were among those elected as vice-presidents for the meeting. According to a dispatch from the correspondent of *The Times* in the issue of August 8, 120 European and 180 Mexican and other American archæologists, anthropologists, and historians attended at the Congress. Communications were submitted in nine sections, which included anthropogeography, physical anthropology, American prehistory and archæology, as well as a section devoted specially to the prehistory and archæology of Mexico, linguistics, social anthropology and a section dealing with the practical problems which affect the indigenous and negro population of the continent. Excursions were made to archæological sites at Acolman, Teotihucan, Tenayuca, Tepotztlan, and the now famous Monte Alban.

Joint Industrial Councils

A BROADSHEET issued by Political and Economic Planning (P E P) reviews the present position of the joint industrial councils and their development from the Whitley Committee in 1916. During 1918–21, National Whitley Councils were established in 80 industries but afterwards a number of joint industrial councils collapsed or became moribund. By 1924 there were more than 30 trade boards and more than 50 Whitley Councils in existence but only three new national councils were set up between 1921 and 1930. Although the General Strike of 1926 emphasized the need for a more constructive relation between management and labour, and the Mond-Turner conferences assisted to break down old suspicions and frictions, the position between 1928 and 1934 was stationary. In the last few years, the basic ideas of industrial democracy, industrial organization and standing committees have gained support, and machinery for their implementation has been consolidated. Since 1933, new trade boards have been established in four industries, as well as a form of district organization, with statutory application of agreements, in road transport, while negotiations are proceeding for the improvement of conditions in retail trades by co-operative methods.

THE broadsheet describes in some detail the establishment, achievements and limitations of the two new Whitley Councils, the National Joint Industrial Council for the Clay Industries and the corresponding Council for the Cast Stone and Cast Concrete Products Industry. In addition the tendency in the older industries for standing committees representing employers and operatives and others, such as the Joint Committee of Cotton Trade Organisations, to be set up for many purposes is increasing. The building trades have set up the Civil Defence Constructional Industries Committee for the organization of demolition and rescue squads (both light and heavy) in the localities. A Joint Consultative Committee, representing the building employers, operatives and defence departments has also been set up to discuss defence problems affecting the industry. In flour milling there has been a joint deputation to the Government with proposals for maintaining supplies in war-time, while in the docks the employers and operatives are working out a scheme for the transfer of labour from port to port under emergency conditions in war-time. The driving force for co-operative effort no longer comes from a minority of enlightened employers and trade union leaders: on the workers' side particularly the impetus comes from the rank and file as well as from headquarters. Persistence of this attitude should lead to a new period of expansion in the organization of co-operation in British industry.

The Rockefeller Foundation

FIFTEEN million dollars were disbursed in 1938 by the Rockefeller Foundation for the advancement of "the well-being of mankind throughout the world". Being more than twice the year's income, this huge expenditure involved recourse to the principal fund as well as reducing accumulated balances. In addition to its complete annual report, the Foundation has published for wider circulation in pamphlet form an extraordinarily interesting review by its president, Raymond B. Fosdick. In the field of public health, in which alone the Foundation itself undertakes the conduct of operations, the fight against yellow feve progressed satisfactorily and more than a million vaccinations were performed with its new virus (17*D*). But a more formidable task is resistance to the invasion of South America by *Anopheles gambiae*, the most deadly of Africa's malaria carriers, introduce apparently by air traffic into Natal in Brazil nine years ago and steadily spreading westward. The Foundation is now co-operating with the Governmen of Brazil in organizing an anti-gambiae service. In all, 2½ million dollars were given to public health work. The account of contributions to work in the medical sciences is prefaced by a note on the comparative volumes, trends and merits of private and public support of medical-research in America and Europe and on the particular fields in which further research is likely to be most productive. One of the least developed is that of mental hygiene: "In no other field is the need more desperate or the potentialities for useful advances more promising. . . Cases of mental and nervous diseases occupy more hospital beds in this country than all other diseases combined."

WHILE medical sciences absorbed a quarter of the Foundation's 1938 appropriations (not counting 1,580,000 dollars given to the China Medical Board under an earlier authorization), an equal amount was spent in support of the social sciences, chiefly by financing a five-year programme of research and training in public administration in non-academic institutions. Believing that an understanding of the social forces moulding the future can only be arrived at through the dispassionate scientific approach which gave us command over our physical environment, the Foundation continued its support of various organizations working along such lines, notably the Institute of Pacific Relations and the Geneva Graduate Institute of International Studies. Of the 3 million dollars given to the natural sciences, more than half went to the University of Chicago for the endowment of biological research and more than a million in grants to other institutions for work in experimental biology. For projects of rural reconstruction in China 300,000 dollars were given, and despite Japanese depredations all these projects are still functioning. A sketch map shows the enforced transference towards the south-west of the scene of their operations.

Conditions and Aspects of the Scientific Profession

THE summer number of the *Scientific Worker* includes an account of an investigation of the profession of science which the Association of Scientific Workers is undertaking. The inquiry covers the methods of entry into the scientific profession and the actual conditions and economic aspects of the profession. The plan of research is designed to include a study of undergraduates in science departments and a study of practising qualified scientific workers. The former will endeavour to discover the factors which determine the decision to take a university course, the choice of university and course of studies and the extent to which vocational wishes influence these problems. The second will cover three groups of men of science—chemists, physicists and biologists—and will be directed to discover the objective conditions of scientific employment and the attitude of men of science to scientific training and employment. These studies will cover the training for and obtaining of scientific posts, the conditions of scientific employment as well as the tenure of posts and incidence of unemployment. The studies on attitude will embrace attitude to university, to employment and to the main types of professional associations. It is hoped that the results obtained will provide data upon which policy for the regulation of the scientific profession can be based and also indicate how the practice of science in industrial firms affects the development of industry as well as possibilities in the application of science to industry.

Education in Germany

THE main features of education in Germany as remoulded under the Nazi regime are presented in a bulletin ("Education in Germany". Washington, D.C.: Government Printing Office, 1939) prepared for the United States Office of Education by Dr. Alina Lindegren, specialist in west European education, who visited Germany in 1935 and 1936 and completed her investigation of the subject a year ago. Among the most pregnant changes have been those in the education of teachers. Long before the Nazi party came into power its leaders resolved on a rapid unification of the teaching staffs and on eliminating teachers antagonistic to its views. The resultant limitation and precise definition of objectives must have been important factors in the production of a vigorous and efficient system. For teaching in elementary schools, candidates must enter two-year training colleges in which the curriculum includes three main fields: political world-view (*weltanschauliche*) education, scientific study and practical work. Entrance conditions include ability to sing and to play the violin, piano or organ and to instruct in gymnastics and sports. Women must in addition qualify in needlework and home economics. Aspirants to secondary school teaching posts must spend a year in one of these training colleges so as to mix with candidates for elementary school-teaching and so help to unify the profession. The declared purpose of the secondary school is to give preliminary training to especially gifted young people fit to qualify themselves eventually for authoritative positions in the political, cultural and economic life of the nation, and "the constant basis of selection shall be physical fitness, fitness as to character, mental fitness or ability, and national fitness". Conditions of study in the universities, which are subject to close control by the Reich Government, are elucidated by a comparison with the corresponding conditions in the United States.

Educational Finance in the U.S.A.

IT has long been recognized in the United States that there are glaring inequalities between the educational opportunities available in different parts of the country and that the systems of financing the public schools do not take sufficient account of the distribution of financial resources. The resources of many States being insufficient for remedying these inequalities, Federal aid has been invoked again and again in the past five-and-twenty years to correct defects in particular fields—first vocational education and later rural education, teacher training, health work in schools, nursery schools and adult education—but hitherto there has been no comprehensive measure for making good the radical defects in the systems of financing the public schools. The President's Advisory Committee on Education, constituted in 1936, with special reference in the first instance to vocational education, has lately taken this matter in hand, and a pamphlet on "Principles and Methods of Distributing Federal Aid for Education" has been prepared by its research staff (Supt. of Documents, Washington, D.C. 20 cents). It starts with the assumption, based on a study of present costs, that 48 dollars per pupil per annum is not more than enough to pay for elementary and secondary education of tolerable quality in a community enjoying optimum conditions of cost and is insufficient where sparsity of the population or high cost of living enhance the expensiveness of education. It proceeds to elaborate ingenious plans for distributing Federal aid, amounting to upwards of 600 million dollars a year, designed to approximate to the ideal—to each community according to its educational needs, from each according to its means.

Association for the Study of Systematics

THE Association for the Study of Systematics in Relation to General Biology was formed in 1937 (see NATURE, 141, 163; 1937: 142, 1069; 1938). Up to the present, the organization of the Association has been deliberately kept as loose as possible, and there has been no subscription. In a leaflet recently issued it is announced that the annual subscription is now five shillings. Further, a fund has been started to provide for expenditure on special purposes. Donors of £5 or more to this fund during the next three years will be designated founder members, and will enjoy for life the privileges of ordinary members. The leaflet also outlines the work so far carried out by the Association. It is hoped that all present members will continue on the new terms and that other biologists will find themselves in sympathy with the aims of the Association. Copies of the leaflet, with forms of application for membership, can be obtained from Mr. H. W. Parker, British Museum (Natural History), Cromwell Road, or from Mr. J. S. L. Gilmour, Royal Botanic Gardens, Kew, Surrey.

Blood Group Tables

THE rapid increase in the literature on blood groups makes it desirable to have a reference work on the subject. Dr. William C. Boyd has supplied this need (*Tabulæ Biologicæ*, 17, 113–240) by presenting the basic facts in tabular form with a minimal amount of text. All the essential facts regarding blood groups are given, together with nearly 500 references to the literature. Part 1 is general, its nine sections including tabular treatment of the chemical and serological nature of the agglutinogens *A*, *B*, *M* and *N*; relations to other species; subgroups; heredity of the types; medico-legal applications; relation to disease; and blood groups in animals. Part 2 is anthropological, giving maps of the world distribution of the *A* and *B* and complete tables of the frequency of *A* and *B* as well as *M* and *N* in the various ethnic stocks tested in all parts of the world up to the time of publication. By the use of two kinds of type an attempt is made to distinguish between the more reliable results and those which, because of small numbers (less than 200) or for other reasons, are regarded as less reliable. This compilation of the serological and anthropological facts regarding the blood groups will be of much service to all workers who are interested in this subject.

Position of the Illegitimate Child

THE League of Nations has just published a "Study on the Legal Position of the Illegitimate Child" (London: George Allen and Unwin, Ltd., 1939. 4*s*.). The study opens with a short historical survey of the social aspects of the legislation on the subject in various countries, followed by an analysis of the various legislative provisions respecting civil status, name, nationality and legal domicile, and inheritance rights. The fate of the illegitimate child being closely bound up with that of its mother, a chapter on the unmarried mother's rights is included. The last part of the volume deals with social insurance laws, and welfare measures, including public assistance and preventive health measures.

Television Broadcasting

SIR NOËL ASHBRIDGE gives a review of the progress being made in broadcasting and television in the *Proceedings* of the Wireless Section of the Institution of Electrical Engineers of June. The period under review extends from the end of 1934 until the end of 1938. During this period the number of licence-holders in European countries has increased by more than 60 per cent. The details of the Royal tour in America in increasing the popularity of sound broadcasting have not yet been published, but it is known that the excellent broadcasts of sound and television have greatly increased the popularity of the British Broadcasting Company. The second part of Sir Noel's report deals exclusively with television broadcasting. The great improvements made in the quality of the pictures shown, the great trouble taken by the Government Post Office to locate the position and find out the cause of the interference, when complaints are made, and the remedies they suggest, in many cases completely eliminating the trouble, have satisfied the users in nearly every district. The nominal hours of transmission are now from 3 to 4 p.m.; and from 9 to 10 p.m. The vision transmitter and the studio and control room equipment at the Alexandra Palace Station have been considerably improved; in particular, an improved type of 'Emitron' tube, known as the long-gun type is now in use for studio work. It is now possible to obtain very satisfactory results with telephoto lenses Satisfactory reception is possible up to a radius o about thirty miles from the Palace. In exceptiona cases reception has been reported up to 200 miles It is hoped that in the future international standardization with regard to definition and picture frequency may become available, as the absence of a commo standard would be a most serious drawback.

A Factory without Windows

A DESCRIPTION is given in the *Electrical Review* o August 4 of a factory without any windows whic is being constructed for the Simonds Saw and Stee Co. at Fitchburg, Mass., U.S.A. It is completely air-conditioned and artificially illuminated throughout. It concentrates productive machinery now covering 17½ acres in several plants, into 5½ acre of production space, from which daylight is completely excluded. Lighting fixtures are being installed in 1,440 positions. Each consists of a 100-watt lamp and a simple curved porcelain reflector. These produce an illumination of not less than 20 ft. candles throughout each room on the working plane The Company plans to operate the new plant intensively on a three-shift basis, so that the work goes on continuously day and night. Service main for water, gas, steam, power, light, air and oil are laid between the floors through ducts direct to more than 1,000 machines and furnace positions. The plant has a connected power load of 6,000 horsepower and a total of 4,200 electric outlets giving current for light, machine power, transformers, motor-generators and other units. Dust and exhaust gases are removed through underground ducts, served by thirty dust-removal units. The entire building is air-conditioned by Carrier units and the humidity and temperature controlled through hydrostats and thermostats at four special positions. 'Man-cooler' systems have been provided for the comfort of men working at the furnaces. Air will be circulated through the building at the rate of about 400,000 cub. ft. per minute. It enters the structure through louvres on the end walls of four lean-to buildings which adjoin the main building. Water is obtained from four artesian wells by electric pumping. Air is blown through water-sprays in each of these structures before being distributed.

The All-Welded Hull of H.M.S. *Seagull*

H.M.S. *Seagull* is one of the two minesweepers ordered to be built at Devonport Dockyard as part of the 1936 Naval programme. It was decided that *Seagull* should be built all-welded, whilst the sister ship *Leda* should be constructed in accordance with the normal practice, that is, mainly riveted. The occasion was to be utilized by obtaining a trustworthy comparison between the two methods of construction. So far as was practicable, the thicknesses of plating were left unaltered. The *Seagull* was launched on October 28, 1937, the launching weight as 313 tons, and the weight of the *Leda* was 338 ons. The welded vessel was commissioned and ompleted in 1938. Both ships underwent rough- eather trials in Faroe–Icelandic waters for about fortnight in September 1938.

A PAPER read by A. Nicholls on the *Seagull* to he Institution of Naval Architects on March 31, 939, and abstracted in *Electric Welding* of June, ives the conclusions to be deduced from the relative osts of building the two ships and their behaviour hen on active service. In the discussion on the paper, he Captain of the *Seagull*, who was present, said hat he had found the vessel perfectly satisfactory in ll respects, although he admitted that he had his oubts when he heard that he had been drafted to n all-welded ship. He had taken her to the region f Iceland for her trials in order to give the vessel a evere test in rough weather, and he testified to the lmost complete absence of creaks and groans. He had ound that at the same revolutions per min. his vessel as faster than any other in the flotilla, due, he hought, to the saving in weight, and he found that er fuel consumption was considerably less than the *eda* and the other vessels of the flotilla. On the *eagull*, which was a minesweeper, there was very ttle vibration from the winch aft, when drawing n the cables. The author concluded that there are o insuperable difficulties in the way of fabricating ship's structure entirely by welding and that the edistribution of labour entailed by the new technique oes not involve additional expense nor increase the ime of building.

ew York and London Roads

IT is stated in *Roads and Road Construction* of uly that municipal engineers were greatly impressed y the highways followed during the Royal tour in he environments of New York. In particular the est Side Express Highway, the Triborough Bridge, he Henry Hudson Parkway and the Great Central arkway can be described as magnificent highways. hey form part of the system which has been built p during the past ten years near New York. Some f the engineers have returned with plans for bringing ertain old-fashioned highways of Great Britain up o date. In New York City and Long Island alone here are more than a hundred miles of parkway and early two hundred fly-over crossings. Traffic using hese routes is able to reach the heart of Manhattan ithout a single hold up such as those which delay otorists many times on most routes into big cities f Great Britain. The question is discussed why ew York and in a lesser degree Paris, Rome and erlin have been able to achieve what London has nly been able to do in a very minor degree. It is uggested that there are two factors, the first connected with organization and the second with a appy choice of opportunities and times for road uilding. The development of parkways in the icinity of New York was conceived and promoted y an independent organization known as the Long land State Park Commission. This Commission as pursued a continuous policy, and has overcome difficulties in a way impossible to a well-meaning local authority. The opportunity presented by the economic crisis of 1929 and the vast sums afterwards distributed by the Federal Government for the relief of distress and unemployment was taken full advantage of with very happy results. The result has been that New York has now an unrivalled arterial road system. It is hoped that a similar coincidence, namely a strong independent planning authority aided by the central government could, and perhaps one day will, do the same for London.

A 'Hot' Lightning Flash

A RECENT report issued by Science Service, of Washington, D.C., states that the Westinghouse Company has perfected a method, first discovered by P. L. Bellaschi, for producing an artificial electric discharge which imitates natural lightning in its ability to set fire to materials in its path. This form of discharge, which is called 'hot' lightning, is used for the routine testing of all high-tension power transformers sent out by the Company. The volt-amperes required for the test are 1½ million volts, 80,000 amperes. In the previous method used of creating discharge flashes, the heat developed was intense and they had enormously destructive explosive effects on whatever they hit unless it was adequately protected, but they did not last long enough to set fire to combustible targets, only leaving a scorched hole. In the 'hot' lightning stroke, there is a low-amperage, long-duration stroke following the main and 'leader' lightning discharged, similar to natural lightning. The after-stroke of 'hot' lightning generates temperatures only half as high as the main stroke, but it lasts between 100 and 1,000 times as long. The long-duration charge is produced by means of additional condensers or by a transformer from which the charge is 'soaked' through a series of resistance inductance coils in oil and permitted to follow the initial high-current discharge relatively slowly. Demonstrations are shown by the Company of 'hot' lightning, fusing sand in a fibre tube, setting fire to cotton cloth and burning holes through copper sheets varying from one thirty-second to one-sixteenth of an inch in thickness.

Earthquakes during May 1939

ACCORDING to the Bureau central séismologique de Strasbourg, 120 earthquakes were felt by people or recorded by instruments during May 1939. Eight were registered on each of the first and last days, seven were registered on each of the sixth and fourteenth, and only one was registered on each of the seventh, fifteenth, eighteenth and twenty-ninth. The most severe shocks appear to have been those in the region of Akita, Japan, on the first, in California near 29·5° N., 113·8° W. on the second, in the Azores (scale 5 on the island of Santa Maria) on the eighth, in the monts d'Aubrac, France (scale 5) on the sixteenth, in the Adriatic on the twentieth, and at Kalacryta (Greece) where houses were cracked and the intensity reached 8 on the Rossi-Forel scale on the thirty-first, six in all. The last of these appears to have been the most intense. It was accompanied by a great noise and was followed by twenty-seven aftershocks, seven of which were strong. Next in order of intensity were those of the sixth, felt scale 4 at Calapan in the Philippines, the seventeenth with epicentre in the Pacific south of the Bonin Islands, the eighteenth felt scale 4 at Brig in the Jura bernoise, Switzerland, and the twenty-seventh at Birmanie near 25° N., 95° E. The moderately strong seismic activity in Italy appears to have been continued, shocks having been experienced during May near Romagna, Bologna, Pouilles and Isernia.

International Conference on Flames and Furnaces

An International Conference on Flames and Furnaces will be held during September 17–20, 1940, at the Royal Institution in London on the initiative of the Institute of Fuel and the British Coal Utilisation Research Association. One purpose of the Conference is to bring the new developments of chemical kinetics and spectroscopy to the notice of engineers and industrialists with the view of accelerating their practical application. The technical programme of the International Conference in 1940 has been prepared by a Committee of thirty engineers and scientific workers. Flames in the internal combustion engine and explosive flames generally are excluded from the scope of the Conference, which will be concerned with the free combustion of gases, liquids and solids in air. The Editorial Committee proposes to invite the authors of papers to collaborate in covering the whole ground of flame and furnace research with the minimum of overlap. Selected authors throughout the world will be asked to contribute papers on specified problems, and early in 1940 the Editorial Committee will co-ordinate the various papers with the help of selected experts in each field acting as chairmen and reporters of the various technical sessions. It is hoped to secure a large attendance of foreign engineers and scientific workers for a conference which should have great practical industrial significance.

International Genetical Congress

The programme of the seventh International Genetical Congress to be held in Edinburgh during August 22–30 has now been published. Pre-Congress activities include an International Conference on Nomenclature and Terminology of Cytology and Genetics, organized by the International Union of Biological Sciences and the Institut International de Co-operation Intellectuelle, to be held in London during August 14–17. A tour has also been arranged to cover London, Cambridge, Chester and Windermere. During this tour, various institutes at Cambridge will be visited on August 18 and 19, and the Fresh Water Biological Station at Wray Castle, Windermere, will be visited on August 22. Full details of the Genetical Congress to follow at Edinburgh are given in the programme, a copy of which can be obtained from Prof. F. A. E. Crew, Institute of Animal Genetics, King's Buildings, West Mains Road, Edinburgh.

Announcements

The Clement Cleveland Medal has recently bee awarded to Mlle. Eve Curie by the New York Cance Committee in recognition of her biography of he mother. This is the first time that this distinctio has been conferred upon a foreigner.

Dr. Eugen Fischer, professor of anthropology i the University of Berlin, has been awarded th Goethe prize for art and science by the Germa Chancellor.

The following appointments and promotions in th Colonial Service have recently been made: S. Barnett, veterinary officer, Kenya; W. J. Gra veterinary officer, Tanganyika Territory; F. Waddington, veterinary officer, Tanganyika Terr tory; H. T. Dale, meteorological assistant, Nigeria W. H. C. Belgrave, chief research officer, director agriculture, Straits Settlements, and adviser agriculture, Malay States; A. C. Shill, adviser agricultural marketing and controller of agriculture exports, Malta, chief horticultural officer, Palestine T. A. Strong, conservator, Malayan Forest Servic conservator of forests, Ceylon.

The thirty-first annual Autumn Meeting of th Institute of Metals will be held in Glasgow durin September 5–8. Further information can be obtaine from the Secretary, Iron and Steel Institute, Grosvenor Gardens, London, S.W.1.

The Association of Special Libraries and Information Bureau (ASLIB) will hold its sixteenth annua Conference at University College, Nottingham, durin September 15–18, under the presidency of Sir Harr Lindsay. Further information can be obtained fro the General Secretary, Association of Speci Libraries and Information Bureaux, 31 Museu Street, London, W.C.1.

The Swiss Society of Naturalists will hold its on hundred and twentieth meeting at Locarno durin September 23–25 in conjunction with the Swis Medico-Biological Society. The subject for discussio will be the pathology and clinical aspects of hereditar diseases and their diffusion. Further information ca be obtained from the secretary, Prof. E. Ludwig Pestalozzistrasse 20, Basel.

The eighth Congress of the Institut Internation d'Anthropologie will meet at Istanbul during September 18–25 under the presidency of Prof. E Pittard of Geneva, president of the Institute. Th meeting will be held in five sections, coverin palæontology and archæology, physical anthropolog heredity and blood groups, social anthropology linguistics and the history of religions.

The Rockefeller Foundation has established training fellowship in psychosomatic research tenabl at the Tavistock Clinic, of the annual value of £45 available for three years from September 1, 193 Further information may be obtained from D A. T. M. Wilson, Tavistock Clinic, Malet Place, W.C.

LETTERS TO THE EDITORS

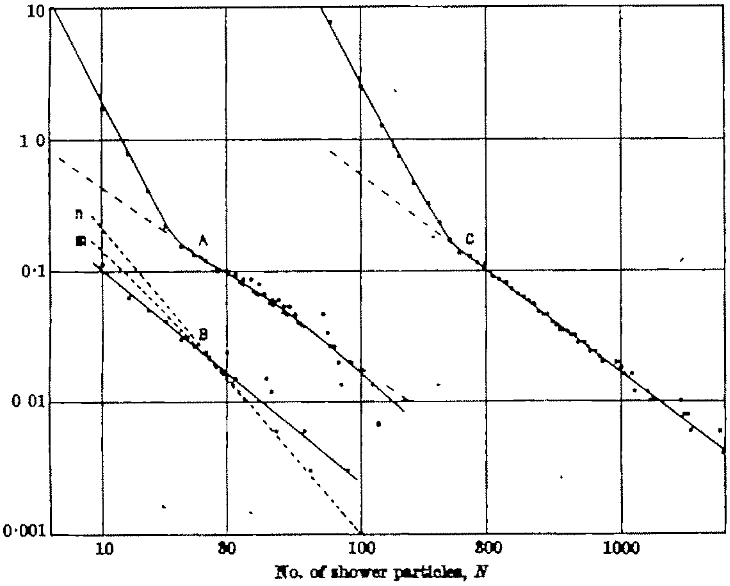
The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 334.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Cosmic Ray Ionization Bursts

COSMIC ray ionization bursts produced by showers f ten or more particles in a small ionization chamber volume 1 litre) have been recorded at sea-level in ambridge and, thanks to the hospitality of Prof. . M. S. Blackett and Dr. H. J. J. Braddick, under 0 m. of clay in London. The data discussed here, urves *A* (150 hours) and *B* (350 hours), are from ms with no lead or other dense shower-producing aterial above the chamber (the wall of the chamber as of duralumin, 1·2 cm. thick, so as to avoid much as possible showers produced by cascade ultiplication in the chamber itself). Curve *C* 00 hours) is the result of similar observations sea-level with a large ionization chamber (volume 5 litres, wall-thickness 0·3 cm. of steel), most of hich were published by one of us[1] in 1936, when e method of recording was also described. The urves show the number of showers per hour in hich *N* or more particles intersected the ionization amber; the number of shower particles *N* was timated on the basis of a specific ionization in rmal argon of 90 ion-pairs per cm.



The ionization bursts obtained at sea-level with the g ionization chamber (curve *C*) involve much larger mbers of shower particles than those obtained with e small chamber (curve *A*), and also each curve s a remarkable change of slope at a rate of currence about 0·16 per hour. The curves, hower, can be superposed fairly closely if the size of e showers in the small chamber is multiplied by . We deduce from this approximate proportionality the *size* of these showers (as distinct from their te of occurrence) to the areas of the thin-walled chambers used to observe them that they are mostly *extensive showers*, originating in the atmosphere, of the same type as those found by Auger and his co-workers[2] with counters. We should not expect to find exactly the ratio of the areas (approximately 1 : 30) because narrow showers or condensations of rays of cross-section smaller than the area of the large chamber tend to increase disproportionately the bursts in the small chamber.

The bursts which are found underground (curve *B*) must be produced by the penetrating component of the cosmic rays. We have calculated the distribution curve to be expected in the tube station for cascade showers produced by electrons 'knocked on' by mesons using the data given in the paper by Bhabha[4] in which, however, the meson was assumed to have spin ½. We adopted, following Euler and Heisenberg[5], an exponent 1·87 for the integral energy distribution of the mesons originating in the atmosphere. The calculation shows (curve *m*) that the showers resulting from this process alone are nearly sufficient to account for the bursts recorded underground, if we assume that the cross-sectional area of the showers underground is not much greater than the area of the chamber (actually more of the larger bursts are found than are given by this calculation, but the theoretical implications of this discrepancy will be discussed later).

At sea-level a similar calculation (curve *n*) gives much fewer bursts than are observed even if we suppose that the showers are so narrow that all the shower particles in any one burst can intersect the small chamber: but we already know that most of the showers observed at sea-level are at least wider than the large chamber. We therefore conclude that a negligible number of the extensive showers observed at sea-level is produced by electrons knocked-on by mesons. It would seem also that an insufficient number of such showers can be produced by the spontaneous decay of the meson, a process which might be invoked to explain the steeper parts of the sea-level curves.

We think, therefore, that nearly all the showers which produce bursts at sea-level in our thin-walled ionization chambers originate very high in the atmosphere, and that the dual nature of the distribution curve at sea-level (as indicated by the change of slope) is due, not to the existence of showers of two kinds, but to the fact (already noted by Auger[2]) that each extensive shower has a core of closely spaced particles surrounded by a relatively wide fringe of much more thinly spaced particles able to produce bursts of small size.

HUGH CARMICHAEL.

St. John's College,
Cambridge.

CHANG-NING CHOU.

Cavendish Laboratory,
Cambridge.

---

[1] Carmichael, *Proc. Roy. Soc.*, A, 154, 223 (1936).

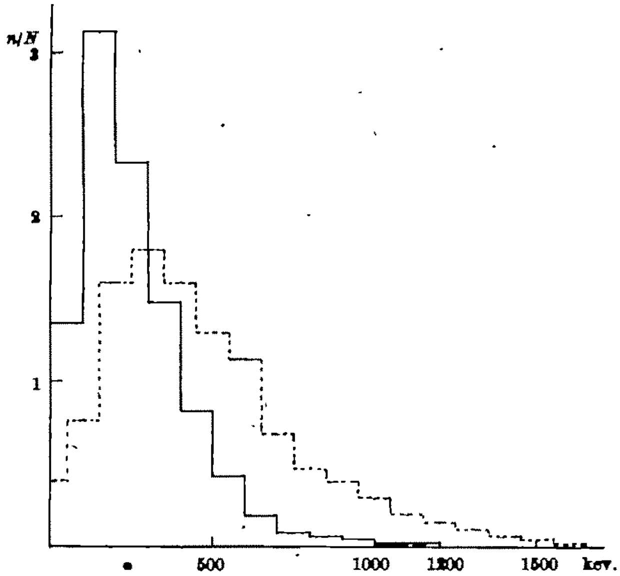
[2] Auger, Maze, Ehrenfest and Freon, *J. Phys. et Rad.*, 10, 39 (1939).

[3] Euler and Heisenberg, *Er. exak. Naturwiss.*, 17, 1 (1938).

[4] Bhabha, *Proc. Roy. Soc.*, A, 164, 257 (1938).

β Spectrum of Actinium K

THE radio-element actinium K recently discovered[1] derives from actinium ($Z = 89$) by emission of an α-particle and is placed in the position 87 of the Mendeléeff table. This element behaves chemically like an alkaline metal, and its period is 21 minutes.



β-Continuous spectrum of actinium K (full line) and of actinium C″ (dotted line).

Actinium K has been prepared from an aqueous suspension of lanthanum fluoride containing actinium. The different radio-elements normally deriving from actinium were eliminated by eight successive precipitations of carbonates (lead, barium, lanthanum) with ammonium carbonate. The residual solution was evaporated and calcined. The decay curve of the product obtained by this way shows that the actinium K is radioactively pure.

A fraction of the product was placed on a sheet of mica 20 μ thick or on a sheet of aluminium 5 μ thick and introduced into a Wilson cloud chamber. The method of introduction of the sources and the method of measurement of the β-ray tracks have already been described[2]. 1,600 β-rays have been measured in this way, and the continuous spectrum obtained is represented in the accompanying graph. For comparison the continuous spectrum of actinium C″ has been indicated in the same figure.

The principal characteristics of the spectrum are brought together in the following table, in which are also shown the characteristics of the continuo spectra of actinium B and actinium C″.

	E_p (kev.)	E_m (kev.)	E_M (kev.)
Actinium K	150	265	1·200
Actinium C″	300	470	1·600
Actinium B	400	360	1·000

E_p = energy corresponding to the maximum probability emission.
E_m = average energy.
E_M = maxima energy.

There have been observed on the photograph plates tracks of a certain number of positons th energies of which vary from 400 to 2,000 kev. Th frequency of these positons is ten times higher wh the mica sheets are used instead of the aluminiu It is thus possible that the actinium K emits an inten γ-radiation of more than 3,000 kev.; the posito observed would result from the materialization these γ-rays in the support.

If we admit that the upper limit of energy actinium K spectrum is 1,200 kev. this point is fou on the upper branch of the Sargent curve, correspon ing to permitted transitions.

M. PEREY.
M. LECOIN.

Laboratoire Curie,
Institut du Radium,
Université, Paris.

---

[1] Perey, M., *C.R.*, 208, 97 (1939).

[2] Lecoin, M., *J. Phys et le Radium*, 9, 81 (1938).

Phase Transitions of Nuclear Matter

THE distribution of capture cross-sections of slo neutrons reveals a surprising concentration strongly absorbing elements in the region of t rare earths[1]. As has been pointed out[2], this fa may be explained in the simplest way by the su position that the mean spacings between th resonance capture levels of slow neutrons have minimum in this region of the periodic system. more detailed study of the connexion between th distribution of the capture cross-sections and th variation of resonance level density carried out me seems to prove definitely the non-monoton shift of the resonance level spacings with a minimu in the region of the rare earths (mean atomic weig 160).

This fundamental fact permits us to draw so conclusions on the properties of excited nucle matter. The general conception of nuclear excitati due to Bohr[3] enables us to treat excited nuclei thermodynamical systems. Between the mean lev spacing D and the thermodynamical quantities the nucleus, we have the relation[4]

$$D \sim e^{-S(E,A)}, \qquad (1)$$

where S is the entropy of the nucleus as a functi of the excitation energy E and the atomic weight From (1) it follows that a minimum of D implies maximum of S if all thermodynamical quantities a assumed to be continuous. Consequently the nucle entropy at excitations equal to the dissociati energy of a neutron Q varies non-monotonicly wi A. As is well known, Q is fairly constant for lig elements but decreases slowly towards the end the periodic system because of the coulomb repulsio If all the nuclei at excitations equal to Q were in t same thermodynamical state, then the excitati nergy should be given as a function of the nuclear emperature Θ by a common expression of the form

$$E = \alpha \cdot \Theta^n. \qquad (2)$$

According to Landau and Weisskopf, $\alpha \cong \alpha_0 \cdot A$ and $n = 2$, while according to Bethe $\alpha = \beta \cdot A^{2/3}$ and $n = {}^7/_3$. It may be shown quite generally that here does not exist any power dependance of E upon Θ which agrees with the non-monotonic variation of D exhibiting a sharp minimum at $A = 160$, at any rate if we assume $\alpha \sim A$ or $\alpha \sim A^{2/3}$. Thus the shift of D shows, either (I) that not all nuclei are in the same thermodynamical state at excitations equal to Q, which excitations for the heavier nuclei correspond to lower temperatures, or (II) that the coefficient α in equation (2) is a complicated and possibly non-monotonic function of A, due perhaps to the variation with A of the relative effects of the electrical and short-range nuclear forces.

The first possibility, which seems to us to be the more likely one, means that the properties of excited nuclear matter change at a certain temperature. So we arrive at the *hypothesis of phase transitions of nuclear matter*. This hypothesis is especially attractive since it makes nuclear matter analogous to two other quantum 'liquids', namely liquid helium and the conductivity electrons which also undergo phase transitions at low temperatures. Perhaps phase transitions are a common property of any liquid exhibiting sharply expressed quantum properties, but only the further experimental study of the structure of the nuclear energy spectrum can ascertain whether nuclear matter really exists in two different phase modifications.

The same hypothesis of phase transitions has also been suggested simultaneously by Dr. I. Pomeranchuk. A more detailed discussion of the problem will be published in a paper to appear in the *Physical Review*.

I. GUREVICH.

Radium Institute,
Academy of Science of the U.S.S.R.,
Leningrad.
July 2.

Dunning, J. R., and others, *Phys. Rev.*, 48, 265 (1935).

Hevesy, G., and Levi, H., *Kgl. Danske Vid. Selskab. Math. Phys. Medd.*, 14, No. 5 (1936).

Bohr, N., NATURE, 137, 344, 351 (1936); *Science*, 86, 161 (1937); Bohr, N., and Kalckar, F., *Kgl. Danske Vid. Selskab. Math. Phys. Medd.*, 14, No. 10 (1937).

Landau, L., *Sow. Phys.*, 11, 556 (1937); Weisskopf, V., *Phys. Rev.*, 52, 295 (1937); Bethe, H., *Rev. Mod. Phys.*, 9 (1937).

Effect of Tube-Length on the Visibility of Dust Particles with an Oil-immersion Objective

WHEN a well-corrected oil-immersion objective is used to examine dust particles mounted in a medium such as Canada balsam, of similar refractive index to the oil, the finer particles will give a very similar image on either side of the correct focus, provided the objective is used at the tube-length for which it is designed. We have found, however, that if the dust deposit is mounted dry on the underside of the microscope cover-glass, the image on either side of the correct focus is not the same at the specified tube-length, and in order to obtain the best images, the tube-length must be reduced.

The dust deposits which are collected on a cover-glass by the thermal precipitator are mounted dry in the above way, and examined with a 2-mm. apochromatic oil-immersion objective, *N.A.* 1·30. In these circumstances a considerable fraction of the finest particles are not visible unless the tube-length is reduced until the images on either side of the focus are similar. The necessary reduction in tube-length is of the order of 2 or 3 cm., an amount which is often beyond the tube-length adjustment of an ordinary microscope. An equally satisfactory correction can, however, be obtained by using the adjustable tube-length corrector designed by the British Scientific Instrument Research Association, at the tube-length specified for the objective.

The details of this investigation and of certain other factors which affect the counting of dust particles will be published elsewhere.

We wish to thank the Gold Producers Committee for permission to publish this communication.

D. G. BEADLE.
H. S. PATTERSON.

Physico-chemical Investigation Department,
Transvaal Chamber of Mines,
Johannesburg.
June 29.

Electronic Conduction of Magnetite (Fe_3O_4) and its Transition Point at Low Temperatures

WE have measured the electronic conductivity, down to liquid nitrogen temperature, of a number of iron oxides of the homogeneous 'Fe_3O_4' phase, especially as a function of the exact stoichiometric composition of the material. This seemed of theoretical interest for several reasons:

(*a*) Fe_3O_4 is an abnormally good conductor among the semi-conductors with partially filled lattice bands[1].

(*b*) Fe_3O_4 has a very remarkable crystal structure involving a probably statistical distribution of both Fe^{2+} and Fe^{3+} ions at equivalent lattice points[1].

(*c*) There are indications that Fe_3O_4 shows a transition point in the neighbourhood of 120° K. Anomalies in the magnetic behaviour[2] at 120° K., in the specific heat[3] and in the lattice constant[4] at 114° K., have been found. The magnetic anomaly, however, depends on the mode of preparation[5].

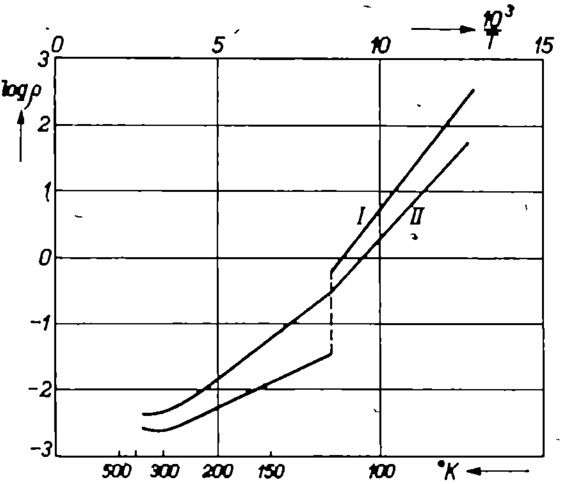
We thought it possible that the statistical distribution of Fe^{2+} and Fe^{3+}, which is a statistical distribution of electrons about the double number of lattice points containing Fe^{3+}, and which accounts for the rather high electronic conductivity of magnetite, would lead to some type of order at lower temperatures. A transition of this kind would probably offer an explanation of the anomalies at 120° K. One would expect such a transition to be very sensitive to the ratio Fe : O in the crystal, since an excess of oxygen (solid solutions of Fe_3O_4 and γ-Fe_2O_3) would imply: (*a*) vacant lattice points in the 16-fold position[6] containing, in stoichiometrically pure Fe_3O_4, 8 Fe^{++} + 8 Fe^{+++}, and (*b*) an increase of the ratio $Fe^{3+} : Fe^{2+}$ at this lattice position; both factors would be unfavourable with respect to order. For the irregularities found by Hilpert and Forrer this would supply an explanation more satisfactory than that put forward by these authors.

Furthermore, one would expect that such a transition, involving the conducting electrons, would be accompanied by very pronounced effects in the specific resistance at the transition temperature.

Actually we have found a strong discontinuity in the resistivity curves of some Fe_3O_4 samples, and a considerable influence of the ratio Fe : O.

The main difficulty consists in the preparation of homogeneous crystalline samples of varying composition but all belonging to the Fe_3O_4 or magnetite (spinel) phase[7]. Details of our present technique will be given elsewhere; we used pure oxide pressed into bars and sintered at about 1,300°.

We have found for magnetite with a composition in the neighbourhood of Fe_3O_4 a gradual increase of the resistance (for example, by a factor 10) as one goes from 300° K. to 120° K., a sudden increase of the resistance at approximately 117° K. by a factor of the order 100, and towards still lower temperatures again a continuous increase. Samples containing an excess of Fe_2O_3 in solid solution, however, show a stronger gradual increase of the resistance with decreasing temperature, but a much smaller jump in the curve at about 120° K. or even merely a change in the temperature coefficient of the resistance in that temperature region.



The accompanying graph shows log ρ against $1/T$ for two bars: I with $FeO : Fe_3O_4 = 1 : 1{\cdot}025$, and II with $FeO : Fe_3O_4 = 1 : 1{\cdot}08$. All details of the curves are in full accordance with the picture proposed above for the nature of the transition and our concept of the cation arrangement in the Fe_3O_4 (and the γ-Fe_2O_3) lattice. In further support of our views, we found that sample I shows a distinct drop in the susceptibility for weak magnetic fields at about 117° K., whereas with sample II the corresponding effect is much weaker.

A more complete account of this work, and details about certain hysteresis phenomena accompanying the transition, will be given elsewhere. Measurements at liquid hydrogen and liquid helium temperatures are in preparation.

E. J. W. VERWEY.

Natuurkundig Laboratorium,
N. V. Philips' Gloeilampenfabrieken,
Eindhoven.
June 22.

New Iodine and Fluorine Derivatives of Monosilan

WE have recently investigated the reaction betwee monosilane, SiH_4, and hydrogen iodide at 80° i the presence of aluminium iodide, and have isolate from the products two stable iodides of the formul SiH_2I_2 and SiH_3I, which are formed together wit silico-iodoform and silicon tetraiodide. The forme is a heavy colourless liquid of low volatility (vapou pressure 2–3 mm. at 0°), while the monoiodid is a liquid of boiling point 45·8° and meltin point −56·5°, which resembles methyl iodide i appearance.

Both these compounds attack mercury, and, in th case of silyl iodide, the products have been shown t consist of monosilane, disilane, hydrogen and me curous iodide. It is possible that mercury sil iodide, $HgSiH_3I$, might be formed under certai conditions, but this compound is certainly less stabl than mercury methyl iodide. Silyl iodide in the vapou phase absorbs light of wave-length less than abou 2800 A. and is rapidly decomposed by light in presenc of oxygen, with liberation of free iodine. Both iodide burn readily in air, with liberation of free iodine an formation of silica.

Silyl iodide reacts with magnesium in the presenc of anhydrous ether. Some magnesium is dissolve and the residue is blackened. At the same time white, ether-soluble compound separates in smal amounts and hydrogen and monosilane are evolved Addition of water results in the evolution of furthe quantities of hydrogen and monosilane. It is though that this reaction is due to the formation of a Grignar compound by the silyl iodide. Its stability is evidentl lower than that of the corresponding compound pre pared from methyl iodide. The numerous syntheti reactions which a compound of the above typ would be expected to undergo are being furthe investigated.

The reaction between dichlorosilane and antimon trifluoride at room temperature, in presence of anti mony pentachloride as catalyst, has yielded a ne fluorinated silane of the formula SiH_2F_2 (boilin point, − 77·5°; melting point, − 119·1°). Thi substance is separated with difficulty from silico tetrafluoride, which is also formed in the reactio by a process of fractional condensation at low tem peratures. The fluoride is an inflammable gas whic is without action on mercury or glass. Silyl chlorid SiH_3Cl, undergoes a similar reaction with antimon trifluoride, but the products have not yet been com pletely separated.

A. G. MADDOCK.
C. REID.
H. J. EMELÉUS.

Imperial College of Science and Technology,
London, S.W.7.
July 24.

Anomalous Thermal Expansion of Carbon Disulphide at Low Temperatures

APPLYING the method of Kamerlingh Onnes an I. A. D. Boks[1] and using special quartz apparatu I have determined the value of the ratio v_t/v_0 fo carbon disulphide in the domain of temperature from + 20° to − 112° C., giving particular attentio to the vicinity of − 80°, because at temperature lower than that the carbon disulphide become nuddy, small quantities of sulphur floating in the iquid.

---

[1] Verwey, E. J. W., and de Boer, J. H., *Rec. Trav. chim.*, **55**, 531 (1936); de Boer, J. H., and Verwey, E. J. W., *Proc. Phys. Soc.*, **49**, extra part, 57 (1937); Schottky, W., *Z. tech. Phys.*, 19, 611 (1938).

[2] Weiss, P., and Forrer, R., *Ann. Phys.*, (10), **12**, 330 (1929).

[3] Parks, G. S., and Kelley, K. K., *J. Phys. Chem.*, 30, 47 (1926); Millar, R. W., *J. Amer. Chem. Soc.*, **51**, 215 (1929).

[4] Ellefson, B. S., and Taylor, N. W., *J. Chem. Phys.*, **2**, 58 (1934).

[5] Forrer, R., *C.R. Acad. Sci.*, **207**, 281 (1938); Hilpert, R. S., Maier K. H., and Hoffmann, A., *Ber.*, 71, 2676 (1938).

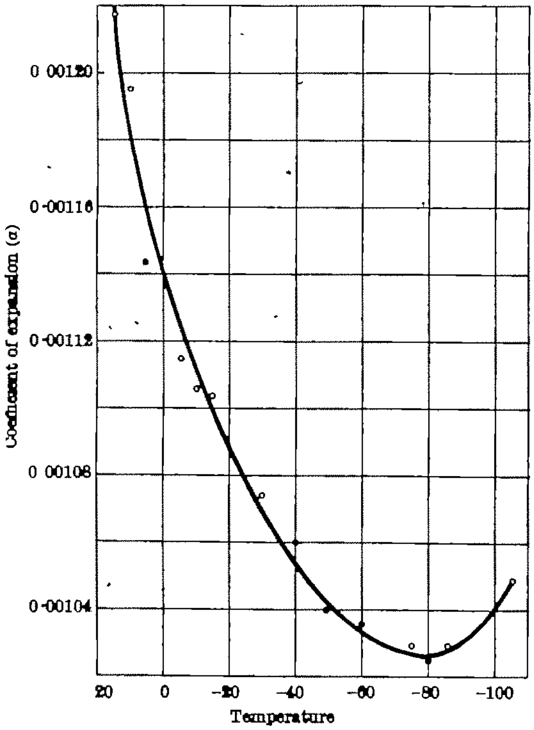
[6] Verwey, E. J. W., *Z. Krist.*, **91**, 65 (1935); cf. also Hägg, G., and Söderholm, G., *Z. phys. Chem.*, (B), **29**, 95 (1935).

[7] van Arkel, A. E., Verwey, E. J. W., and van Bruggen, M. G., *Rec. Trav. chim.*, **55**, 337 (1936).

On the basis of these experimental results, I have alculated the coefficient of expansion

$$\alpha = \frac{1}{v}\frac{dv}{dt},$$

and also the variation of this coefficient with temerature, namely, $\frac{1}{\alpha}\frac{d\alpha}{dt}$ for the whole domain investigated. It appears that the coefficient of thermal xpansion of carbon disulphide decreases rapidly with temperature, reaches a minimum at − 80° and hen increases; the variation of the coefficient of xpansion, that is $\frac{1}{\alpha}\frac{d\alpha}{dt}$, diminishes when the temerature decreases and changes sign at − 80° from ositive to negative.



The accompanying diagram shows the course of he coefficient of expansion of carbon disulphide, he phenomenon proves certainly the existence of n anomaly in the change of density of the carbon isulphide with temperature. However, neither this henomenon nor an evident anomaly in the course f the dielectric constant of carbon disulphide[2] ecessitates the existence of two liquid phases of this ubstance, as my investigations on the specific heat ave proved that a transformation point does not xist in carbon disulphide.

J. MAZUR.

Physical Laboratory,
Polytechnic Institute,
Warsaw.
June 30.

---

[1] Onnes, Kamerlingh, and Boks, I. A. D., Comm. Leiden 170

nardi, H., *Z. Phys.*, 9, 153 (1922).

Physical Characterization of Calf Thymus Nucleohistone

We have characterized calf thymus nucleohistone, prepared by modified Huiscamp[1] methods, by observation of its sedimentation velocity, sedimentation equilibrium, diffusion, viscosity and electrophoresis. Between pH 5·2 and pH 9·0 in buffers containing 5 per cent sodium chloride it is monodisperse, and close to pH 10·4 is irreversibly transformed into a homogeneous material having a smaller sedimentation constant than the original nucleohistone. In these buffers, the reciprocals of the sedimentation constants of the nucleohistone and its transformation product are linear functions of the protein concentration, and the limiting values of the sedimentation constants for zero protein concentration have been found.

Using the limiting value of the sedimentation constant, and the diffusion constant for dilute protein solutions containing 5 per cent sodium chloride, the molecular weight of the nucleohistone is found to be 2,200,000 in good agreement with the value 2,100,000 determined by sedimentation equilibrium. The sedimentation data indicate that the molecule is highly elongated.

In buffers of ionic strength 0·02–0·04 the molecule is less stable. This is true of solutions in neutral 2 per cent calcium chloride, in which the sedimentation constant is independent of protein concentration, and equal to the limiting value for 5 per cent sodium chloride – buffer solutions. Near pH 12 in 5 per cent sodium chloride – buffer solutions a precipitate is formed exhibiting the typical behaviour of a histone.

The electrophoretic behaviour was investigated in buffers of ionic strength varying from 0·02 to 0·08, using both types of Tiselius apparatus. The protein is insoluble in such buffers below pH 5, the insoluble region including the isoelectric point, which is estimated to be close to pH 4. From pH 5 to pH 9 the material is negatively charged and homogeneous electrophoretically. Dialysis against tenth normal sodium hydroxide followed by return to lower pH shows that the major part of the material is unaltered.

The effective charge of the protein molecule as calculated from titration data is not in agreement with the charge calculated from mobility data alone. This difference is attributed principally to the linear nature of the molecule, a length to width ratio of 50 being indicated.

The marked variation, with the ionic strength of buffer, found for the mobility is of the type required by the Debye-Hückel theory. Theoretical difficulties at present prevent the correlation of the absolute theoretical values with those found experimentally.

The rates of electrophoretic migration varied in the two sides of the U-tube, depending chiefly upon whether the initial migration had been from protein to buffer or vice-versa. It also varied with protein concentration. These variations appear to depend on several factors, including differences in conductivity and ionic strength, pH and viscosity on the two sides of the migrating boundary. Corrections determined for conductivity and ionic strength have been found to reduce the magnitude of the variations to about one half.

The molecular kinetic and electrophoretic behaviour of the protein appear to be independent of the method of preparation.

R. Owen Carter.
James L. Hall.
Laboratory of Physical Chemistry,
University of Wisconsin,
Madison, Wisconsin, U.S.A.
July 11.

[1] Huiscamp, W., *Z. physiol. Chem.*, **32**, 145–196 (1901).

Oxidation of Succinate by Heart Muscle

It is widely held that the oxidation of succinate in animal tissues proceeds in the following manner:

Oxygen ⟷ Cytochrome Oxidase ⟷ Cytochromes ⟷
(*a*,*b*,*c*)
[Succinate ⇄ Fumarate
Succinic dehydrogenase].

It is assumed that no co-enzyme or intermediary hydrogen carrier is required to link succinic dehydrogenase to the cytochrome-cytochrome oxidase system[1]. This question has acquired special significance in view of the essential role of the succinic-fumaric acid system in cellular respiration which has been postulated by Szent-Györgyi[2].

Oxidase preparations obtained by the method of Keilin and Hartree[3] from beef heart muscle extracts by isoelectric precipitation catalyse the reduction of methylene blue by succinate under anaerobic conditions as well as the oxidation of succinate by molecular oxygen. Upon repeated isoelectric precipitation, the aerobic activity towards succinate is greatly impaired, whereas that towards hydroquinone is unaltered; in both cases an excess of cytochrome *c* was added.

When phosphate extracts from ground and washed heart muscle are spun in an ultracentrifuge at 384 r.p.s. for 30 minutes, a sediment is obtained which does not catalyse the aerobic oxidation of succinate in spite of the fact that such preparations, even after twice repeated sedimentation, contain cytochrome oxidase, cytochrome *a*, *b* and *c*, and succinic dehydrogenase[4]. The ability to oxidize succinate aerobically is restored by the addition of small amounts of the clear, supernatant fluid obtained by the ultracentrifugation of crude heart muscle extracts. It exerts its activating power also towards oxidase preparations which have been partially inactivated by repeated isoelectric precipitation. The supernatant fluid alone is inactive towards succinate even in the presence of an excess of cytochrome *c*.

The activating principle present in the supernatant fluid is not dialysable, but it is inactivated upon dialysis against large volumes of phosphate buffer, *p*H 7·4. It is partly destroyed when the crude extract is kept at 100° for 10 minutes, and it is precipitated by trichloroacetic acid. The rate at which the principle sediments in the quantity ultracentrifuge at 512 r.p.s. (field at the bottom of the tubes, 69,000 *g*) suggests a molecular weight of the order of 140,000.

The activating principle is not identical with catalase[5] or with aluminium[6]. It may represent the factor the removal of which in the experiments by Stotz and Hastings[7] and in those of Hopkins, Lutwak-Mann and Morgan[8] led to partial or complete inactivation of their oxidase preparations towards succinate. On the other hand, spectroscopic observations show that succinate when added to ultracentrifugally purified oxidase preparations causes the reduction of the cytochromes *a*, *b* and *c* present in such preparations as well as that of added cytochrome *c*. The concept that *the activating principle provides a coupling link between succinic dehydrogenase and the cytochrome-cytochrome oxidase system* would be valid only if it can be shown that the rate of reduction of cytochrome by the incomplete enzyme system is insufficient to bring about a measurable oxygen uptake under the conditions of the manometric experiments. This question, as well as the possible relationship of the activating principle to a flavoprotein[9], is under investigation.

The results of typical experiments will be found in the accompanying table:

Preparation	Time for reduction of methylene blue at *p*H 7·4 and 37°		Oxygen uptake (µl. in 60 min.) in presence of 5 mgm. dry weight of enzyme preparation at *p*H 7·4 and 37°; 0·033 mM. hydroquinone and succinate respectively			
	Succinate	Control	Hydroquinone	Hydroquinone + Cytochrome	Succinate + Cytochrome	Succinate + Cytochrome + Activator
1 × ultracentrifuged	—	—	—	—	0	392
3 × ultracentrifuged	3 min.	>60 min.	60	700	18	960
1 × isoelect. precipitated .. .	4 min.	>60 min.	—	720	545	—
3 × isoelect. precipitated .. .	7 min.	>60 min.	—	760	120	—
3 × isoelect. precipitated, after 48 hr. ..	—	—	—	—	0	176

This investigation was aided by a grant from th Jane Coffin Childs Memorial Fund for Medica Research.

Kurt G. Stern.
Joseph L. Melnick.
Laboratory of Physiological Chemistry,
Yale University School of Medicine,
New Haven, Connecticut.

[1] Szent-Györgyi, A., Harvey Lectures, **34**, 265 (1939).

[2] Szent-Györgyi, A., "Studies on Biological Oxidation and Some (its Catalysis" (Budapest-Leipzig, 1937).

[3] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **125**, 171 (1938

[4] Stern, K. G., Horwitt, M. K., Melnick, J. L., and Scheff, G., unpublished expts.

[5] cf. Lehmann, J., and Mårtensson, *Skand. Arch. Physiol.*, **75**, ((1936).

[6] cf. Horecker, B. L., Stotz, E., and Hogness, T. R., *J. Biol. Chem* **128**, 251 (1939).

[7] Stotz, E., and Hastings, A. B., *J. Biol. Chem.*, **118**, 479 (1937).

[8] Hopkins, F. G., Lutwak-Mann, C., and Morgan, E. J., NATUR **143**, 556 (1939).

[9] Straub, F., NATURE, **143**, 76 (1939); *Biochem. J.*, **33**, 787 (1939).

Poly-condensation of α-Amino Acid Esters

Under different experimental conditions, ther can be obtained from glycine ethyl ester, among oth known products, polypeptide esters of various cha lengths.

(1) Solutions of glycine ethyl ester in vario solvents, kept either at room temperature or boilir point, deposit precipitates on long standing fro which a number of fractions were isolated. Th

analytical data of some representative fractions correspond to the following new compounds: dodeka-glycine ethyl ester (solvent: xylene at room temperature); trideka-glycine ethyl ester (solvent: xylene at boiling temperature); heptadeka-glycine ethyl ester (solvent: benzene at boiling temperature).

(2) On passing oxygen or hydrogen through free glycine ethyl ester, the liquid gradually solidifies. After standing several weeks, there were isolated hexadeka-glycine ethyl ester from the oxygen-treated ester and eikosi-glycine ethyl ester from the hydrogen-treated ester.

It appears that, under suitable conditions, glycine ethyl ester can be condensed into linear chains of considerable length. The products are hornlike and practically insoluble even in hot water.

As in the case of other high-condensation products, it should be borne in mind that, although the analytical data and the chemical properties found are in agreement with the formulæ given, they might correspond also to mixtures of hitherto unknown peptide ester homologues of high chain length.

(3) The ability to form linear chains is not confined to glycine ethyl ester; thus alanine ethyl ester of which the only direct condensation product hitherto known was alanine anhydride) yields under suitable conditions, *inter alia*, condensation products which give a strong biuret reaction and seem to be alanine polypeptide esters.

Systematic experiments on the behaviour of various esters of the different representative amino-acids and their peptides are in progress.

MAX FRANKEL.
EPHRAIM KATCHALSKI.

Hebrew University,
Jerusalem.
July 6.

A Chromatographic Study of Lignite

WE find that the Tswett technique is appropriate for the accumulation and isolation of some interesting compounds occurring in lignites. Thus, light petroleum was allowed to percolate through 00 kgm. of lignite (coming from Várpalota, Hungary); the petroleum was sucked through a calcium hydroxide column. In this way the solvent is eliminated and the adsorbent shows different layers, especially under a quartz lamp.

After having eluted the upper half of the column by using alcohol – light petroleum mixtures, we kept the liquid at 0° and observed the formation of water-soluble needles or prisms (15 mgm.). This sample, a potassium salt, is a powerful reducing agent which apparently belongs to the ascorbic – reducing acid – reductone group. Dichlorphenol-indophenol, silver nitrate and selenic acid are instantly reduced at room temperature, but Fehling's solution is reduced only when heated. Iodine is decolourized rapidly in the cold. Ferric chloride produces a dark violet tint on the surface of the crystals.

If the filtrate of the salt mentioned above is washed free of alcohol and repeatedly chromatographed, a second, well crystallized but water-insoluble compound appears (150–300 mgm.) which seems to belong to the triterpene class. It gives the usual sterol reactions but is not precipitated by digitonine. Colourless prisms (from acetone), m.p. 244–247° (decomp., uncorr.); lævorotatory; molecular weight in camphor, close to 400.

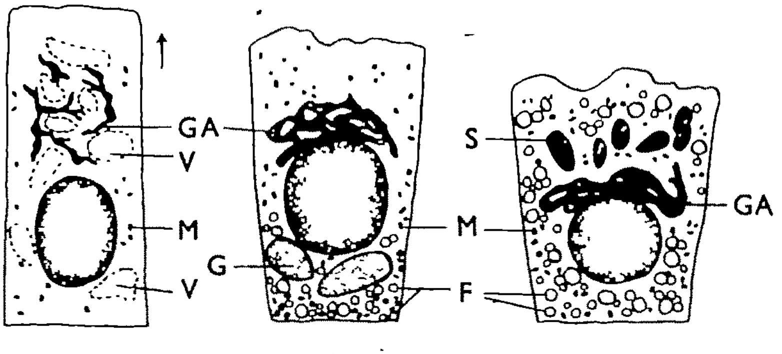
The chromatographic investigation of raw extracts of lignite was facilitated by a broad pink zone in the column, which deepens and becomes dark wine red, by elutriation with alcohol. Furthermore, it slowly becomes light yellow when kept in an open flask; this change is rapid, however, if carbon dioxide is introduced. So far we have not succeeded in crystallizing the compound responsible for these phenomena, possibly because it is accompanied by abundant quantities of resin.

L. ZECHMEISTER.
O. FREHDEN.

University,
Pécs, Hungary.
July 5.

Cytology of the Human Uterine Gland Cell

ONLY one type of cell is to be found in the uterine glands. Some of these cells may be ciliated, but are otherwise like the non-ciliated cells. In the proliferative and premenstrual phases (*b*), the normal constituents of these cells are mitochondria (*M*), Golgi apparatus (*GA*), fat (*F*) and glycogen (*G*). No formed secretions otherwise are found. Throughout the entire intermenstrual period, the Golgi apparatus remains juxta-nuclear and confined, but at menstruation (*a*), in the deeper parts of the glands, which are not broken down, a diffuse apparently secretory phase begins (*V*), closely resembling the secretion phases of such glands as those of the epididymis or pancreas islet cells. The surviving postmenstrual uterine gland cells have a clear cytoplasm and small juxta-nuclear Golgi apparatus. Thus, except just at menstruation, no satisfactory evidence for secretion by uterine glands during the normal intermenstrual phases could be found. There is, as has been mentioned, extensive storage of fat (premenstrual) and glycogen, and the lumen of the gland often shows a material which stains well in muchæmatein and mucicarmine, whatever value can be attached to these methods.



a MENSTRUAL *b* PREMENSTRUAL *c* PREGNANCY

But it is at pregnancy (*c*) that a true secretion (*S*) appears in the outer parts of the cells, in front of each Golgi apparatus. This is found in considerable quantities, and is in the form of droplets stainable in iron alum hæmatoxylin, and faintly in osmium tetroxide solution.

Thus we have concluded that two possible phases of secretion may occur in the human uterine gland cells—one just before or during menstruation—as might be concluded by the loosening out and breaking up of the Golgi apparatus, the other quite certainly a 'solid', probably protein secretion, which only appears at pregnancy.

This work was made possible by the Irish Medical Research Council. A fuller account will be published later.

J. Brontë Gatenby.
Olive E. Aykroyd.

Zoology Department,
Trinity College,
Dublin.
June 16.

Spontaneous Yellow Fever in Rhesus Monkeys in the Absence of Mosquitoes

Before a satisfactory method of prophylactic immunization had been devised, yellow fever was by no means uncommon among laboratory workers, some 37 cases having been reported. In every instance, those who contracted the disease had been in close contact with material containing either the virulent pantropic or the neurotropic strains of yellow fever virus, and the portal of entry was the skin, conjunctiva or nasopharyngeal mucosa.

During the past winter, two rhesus monkeys, *Macaca mulatta*, kept under laboratory conditions, at an interval of 71 days, have developed and died from spontaneous yellow fever. The monkeys were in two separate animal houses. In the case of the first animal, no other monkey infected with yellow fever had been in the same room for just over three months, while the second animal was in a room where no other infected monkeys had been for nearly six months. No virulent pantropic virus was in use in the laboratory during the period.

The method of infection is at present unknown, but human agency can be ruled out, since the stock of virulent yellow fever virus is under strict control and can be fully accounted for. Mosquitoes were entirely absent from the animal houses, but certain ectoparasites, monkey lice and rat fleas, *Ceratophyllus fasciatus*, were found. In addition, cockroaches, *Blatella germanica*, and a small ant, *Monomorium pharaonis*, were present. Experiments are at present being carried out to determine whether these arthropods were in any way responsible for the spontaneous infection of the monkeys.

G. M. Findlay.
F. O. MacCallum.

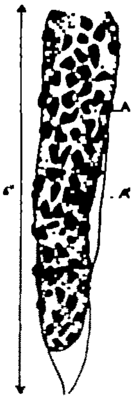
Wellcome Bureau of Scientific Research,
London, N.W.1. July 12.

Reproductive Cycle in *Salmo salar* Linn.

It is known that in *Salmo salar* Linn. there occurs regularly a very small percentage, possibly of the order of 0·1 per cent, of mature female fish in which discharge of ova may be delayed or does not take place. Such fish are found many months after the normal spawning time heavy with ripe ova. In certain parts of Scotland they are termed 'baggots' or 'baggits' by fishermen.

Beyond the tacit assumption by some that a high rate of mortality supervenes, data of the subsequent behaviour and condition of such fish are scanty.

It is desirable, therefore, to record an instance where a marked degree of recovery appears to have taken place. Part of an ovary and some scales fro an outwardly normal 16 lb. spring fish caught b rod in the River Dee near Llangollen in March wer sent by Mr. G. M. King to Mr. W. J. Menzies, chie inspector of salmon fisheries, Edinburgh, from who I received the former specimen, accompanied by the following data:



"The scales show the fish to hav been a two years' smolt, and then t have ascended into fresh water as a small spring fish, after approximatel two years in the sea, in 1937.

"There is a perfectly good spawning mark for the winter of 1937–3 since when the fish has made approximately a year's normal growth in th sea."

External examination showed th ovary to have an apparently ful normal complement of aged ova opaque and straw-coloured, betwee which were visible abundan young healthy ova—coral pink in colour—o the type normally present in female fish ascendin in the spring. A section of the ovary (see accompanying diagram) showed a compact mass of old (A) an new (A^1) ova, the former in various stages of resorption, most of them shrunken and further distorte in shape by the pressure of the infiltrating new crop.

The general condition of the specimen was consistent with the probability that had the fish remained in the river the young ova would hav developed to full maturity by the autumn spawnin period. Whether they in turn would have been undischarged remains uncertain pending knowledge o the controlling mechanism in teleostean fishes.

R. M. Neill.

Natural History Department,
University,
Aberdeen.
June 29.

Large-scale Plankton Culture

The new Oceanographic Institute which Göteborg' Vetenskaps- och Vitterhetssamhälle owes to th munificence of the late Mr. K. A. Wallenberg i provided with a vertical plankton shaft, two metre in diameter and twelve metres deep, which afford facilities for culture experiments on a fairly larg scale. Sea water is passed through a sand filter an sterilized by a powerful quartz lamp before enterin the shaft from below. It is cooled by means of refrigerating plant which sends cold brine to tw systems of cooling coils, one near the top, the othe halfway down the shaft. The illumination plant consists of two mercury lamps of 50,000 lumen each an four sodium lamps of 10,000 lumen, mounted unde a large reflector.

In our experiments, the shaft was filled with stratified sea water: an upper column of 28 per mill salinity, 5·5 m. high, to which nitrate, phosphate silicate and soil extract had been added, and a lowe column of 35 per mille salinity which served to rais the column of culture medium to near the top o the shaft. The temperature was kept at about 9° C in the experiments with phytoplankton and at 6° wit zooplankton. With half the set of lamps burning surface illumination of about 30,000 lux was maintained for 8–10 hours per diem. At 1 m. depth th intensity was reduced to one half or less.

Raw plankton from the fjords or the open Kattegat ollected during the spring increase was repeatedly ntroduced into the culture column and the growth f the population followed by plankton counts. The istribution of suspended particles was also observed y means of a small transparency meter[1]. Water mples from the shaft were inoculated with pure ltures of diatoms, and their growth, which was uite rapid, was recorded photometrically. This roved that the water in the shaft retained its non-xic properties for at least several weeks.

Of the diatoms, *Skeletonema costatum* showed bundant growth; the number of cells introduced creased from 43 millions to about 3,120 millions, at is, seventy-three times, in the course of twenty-ne days. In another experiment the number of *hizosolenia alata* f. *gracillima* increased fivefold in ght days while other diatoms remained in good ndition during the same time although without crease in number. Several autotroph flagellates, -6 μ in length, showed an enormous increase during e first experiment. Convection currents deposited any diatoms on the cooling coils and these, together ith the flagellates, formed a green coating around the pes. It is hoped in future to eliminate this comication.

In later experiments the plankton samples introced consisted mainly of copepods which thrived ell in the shaft, a considerable number remaining ive as long as three weeks. They showed a remarkly uniform phototactic response involving rapid igrations towards or away from sources of light of fferent intensity.

Experiments are now being undertaken with pure ltures of diatoms in order to investigate the intertion between the plant cells and the surrounding edium under carefully controlled conditions. Later, tempts will be made to grow fish larvæ in the aft and to study their growth and their distribution der varying light, temperature and salinity nditions.

H. PETTERSSON.
F. GROSS.
F. KOCZY.

Oceanografiska Institutet,
Goteborg.

---

[1] ATURE, 137, 68 (1936).

Demes: a Suggested New Terminology

IN the course of work on the experimental deitation of botanical groups, the need has arisen a term which can be applied to any specified semblage of taxonomically closely related indiduals. Such phrases as 'local intrabreeding populans' or 'populations occupying a specific ecological bitat' are cumbersome, and it is felt that a more ncise terminology would be useful and, further, uld focus attention on certain concepts undoubtedly great importance in the study of intra-group riation. We propose the term *deme** (from the eek δῆμος) for this purpose, with appropriate prees to denote particular kinds of demes. For mple, in a taxonomic group consisting of a number potentially interfertile individuals all the indiduals do not have an equal chance of interbreeding nature. The tendency is for individuals in close ximity to interbreed more frequently with each er than with individuals at a distance, and thus all, more or less isolated intrabreeding colonies set up. The distinctive features so commonly exhibited by local communities, for example, of sea plantain, provide evidence of this. These 'breeding communities' are likely to become increasingly important in the intensive study of evolutionary problems and we propose to name them *gamodemes*. It is clear that there are various degrees of isolation between such gamodemes, and when more experimental work has been done on this point it should be possible to devise a method of expressing degree of isolation quantitatively. At present, however, the concepts must remain somewhat vague, as is indicated in the definition given below.

Similarly we propose the terms *topodeme* and *ecodeme* to denote demes occupying specified geographical areas and specified ecological habitats respectively. These demes, however, must not be confused with the categories of experimental taxonomy. For example, the term ecodeme is not a substitute for the experimental taxonomic term ecotype. Ecotypes can be established only after an examination of numerous habitat populations, whereas the term ecodeme has reference to any habitat population irrespective of whether its ecotypic significance is or is not known. Whether the deme concept may entail a system of nomenclature for naming individual demes is a matter for future experience; but we would emphasize that any such system should be kept quite separate, both in form and in function, from systems of taxonomic nomenclature.

It should also be emphasized that these concepts do not necessarily imply the possession of any morphological characters in common between the individuals comprising a gamo-, topo- or ecodeme, other than those characters possessed in virtue of membership of the taxonomic group under consideration. For example, the populations of *Helianthemum polifolium* in Somerset and Devon would belong to separate gamodemes in virtue of the impossibility of their interbreeding in nature, even if no morphological differences could be discovered between them. The same considerations apply to topodemes and ecodemes. For example, two populations of a species from sand-dunes in Devon and in Scotland would belong to the same 'sand-dune ecodeme', even if the morphological differences between them were considerable.

At the same time, there will frequently, of course, be some degree of correlation between demes and intra-specific categories based on morphological criteria. It is hoped that one of the advantages resulting from this new terminology will be to bring out the degree of correlation in particular cases.

The definitions of the new terms are as follows:

Deme: any assemblage of taxonomically closely related individuals.

Gamodeme: a deme forming a more or less isolated local intrabreeding community.

Topodeme: a deme occupying any specified geographical area.

Ecodeme: a deme occupying any specified ecological habitat.

J. S. L. GILMOUR.

Royal Botanic Gardens,
Kew.

J. W. GREGOR.

Scottish Plant Breeding Station,
Edinburgh, 12.
July 18.

---

* This word has already been used by Geddes ("Encycl. Brit.", 16, p. 843; 1883) and by Perrier ("Les colonies animales et la formation des organismes", p. 721; 1898), to denote an aggregate of single cells, but so far as we can discover this use is now quite obsolete, and it appears permissible to revive it in another sense.

Effect of the Fungicide 'Granosan' on Atypical Growth and Chromosome Doubling in Plants

IN studying the effect of several insecticides and fungicides upon the procedure of meiotic processes I found that they induce a series of abnormalities, which further lead to production of hereditary variations, thus speeding up the process of the 'degeneration of the pure lines' in various degrees[1,2].

I studied recently the effect of the fungicide 'Granosan' (2 parts of CH_3CH_2HgCl + 98 parts of talc) upon mitosis. Treating germinating grains of *Secale cereale*, *Triticum vulgare*, *T. persicum*, *T. durum*, *T. polonicum*, and *T. ægilopoides* with 0·5–0·1 per cent Granosan (that is, 0·01–0·002 per cent ethyl mercury chloride) for 3–6 days (some experiments were continued for three weeks) swellings of the root tips and of the whole seedlings occurred. Studying these seedlings cytologically, I found that the agent has induced abnormal mitosis similar to those induced by colchicine and acenaphthene, namely, failure of (rather abnormal) achromatic figures, chromosome multiplications, multinucleations, and formation of large amœboid nuclei.

Occasionally chromosome doubling and larg nuclei in the root tips of similarly treated seedling of *Pisum sativum* occurred; but amœboid nuclei an multinucleations were not so frequently observec Consequently, Granosan is a more effective agent treating leguminous plants than acenaphthen Germinating seeds treated by Granosan for inductio of polyploidy are not attacked by fungi, whi those treated by colchicine are usually severel attacked.

The induction of atypical growth and chromosom doubling in Gramineæ by Granosan, and in a degre of colchicine and acenaphthene, shows that thes biologically active properties of the compounds hav nothing to do with the cyclic or heterocyclic structur of the molecules of the active compounds.

DONTCHO KOSTOFF.

Institute of Genetics,
Academy of Sciences of U.S.S.R.,
Moscow.

---

[1] Kostoff, D., "The Degeneration of the Pure Lines", Sofia (1930).

[2] Kostoff, D., *Bull. Soc. Bot. Bulgarie*, 4, 87–92 (1931).

Points from Foregoing Letters

H. Carmichael and C.-N. Chou have measured cosmic ray ionization bursts underground and have calculated the rate of production of such bursts by mesons; they obtain fair agreement. Their measurements of bursts at sea-level, however, provide evidence of wide cosmic ray showers which originate in the atmosphere but evidently do not come from mesons. These wide air showers may be of two kinds.

In order to explain the anomalous dense spacing of nuclear resonance levels in the region of the rare earths, I. Gurevich suggests that nuclear matter undergoes a phase-transition at a certain temperature in a similar way as liquid helium and conductivity electrons in metals.

E. J. W. Verwey finds that the transition point in magnetite at about 120° K. is of electronic nature, and is probably connected with an order-disorder transition in the distribution of 8 electrons about 16 equivalent metal ions in the unit crystal cell. When a sample of pure, sintered magnetite is cooled a sudden increase of the electrical resistance by a factor of the order 100 occurs at the transition temperature; this phenomenon can be suppressed, however, by an excess of oxygen in the lattice.

In his investigations of the change in the coefficient of expansion α of CS_2 at low temperatures (+ 20° to − 112°), J. Mazur finds that the minimum of α is reached at a temperature of −80° C.

R. O. Carter and J. L. Hall find the molecular weight of calf thymus nucleohistone to be approximately 2,100,000 and the molecule to be highly elongated. The protein is electrophoretically homogeneous but the effective charge of the molecule calculated from titration data is not in agreement with the charge calculated from mobility data alone.

Contrary to our present views, Kurt G. Stern and Joseph L. Melnick have found that a heart muscle preparation containing succinic dehydrogenase, cytochromes *a*, *b* and *c*, and cytochrome oxidase is unable to catalyse the oxidation of succinate by molecular oxygen. When an activating principle of prote nature is added to the system, the aerobic activit towards succinate is restored.

M. Frankel and E. Katchalski state that certai amino acid esters (glycine ethyl ester, alanine eth ester) can under suitable conditions be condense to hitherto unknown polypeptide esters of conside able chain length.

L. Zechmeister and O. Frehden find that tl accumulation and isolation of two interesting com pounds can be carried out by submitting a petroleu extract of lignite to the chromatographic analysi one, showing high reducing power and belonging the ascorbic acid-reducing acid-reductone group, a another, which seems to belong to the triterpene

J. B. Gatenby and Olive E. Aykroyd have show that curettings from early interrupted pregnan cases may be recognized by the presence of lar secretion granules in the uterine gland cells.

G. M. Findlay and F. O. MacCallum state th spontaneous yellow fever has occurred, at an interv of 71 days, in two rhesus monkeys, *Macaca mulat* kept under laboratory conditions in separate anim houses. Mosquitoes were not present, but certa arthropods, which must be considered as possib vectors, were found.

An instance is recorded by R. M. Neill of a fema salmon (*S. salar*) returning to sea, after spawni migration with matured ova undischarged and aft a year's normal growth in the sea, reascending in fresh water; when the ovary showed in addition undischarged ova in an advanced stage of resorptc a new crop of young developing ova normal to fl ascending in spring.

H. Pettersson, F. Gross and F. Koczy describe vertical plankton shaft which affords facilities culture experiments on a large scale. Satisfacto results were obtained with both phyto- and z plankton.

RESEARCH ITEMS

Skin of Rebirth

Dr. Maurice Canney has collected a number of examples of the magical significance of animal skins among modern primitive peoples and compares it with belief current in ancient Egypt (*Man*, July 1939). Among the Bantus, children before reaching the age of circumcision had to go through a ceremony, the name of which means "to be born again". The child was invested in part of the skin and skin of the big stomach of a male sheep which had been killed by the father. It then had to go and lie on a bed by its mother and cry like a new-born infant. In funeral ceremonies of the elders, burial was not complete without a skin of a sheep or a bullock if the family could afford it. The corpse was laid out in the prenatal position and the skin, hair upward, laid upon it. Among the Ila-speaking peoples a corpse was first put in three dry skins. A great slaughter of beasts took place at a funeral. Five large oxen were called the wrapping-up cattle, because their skins were laid in the bottom of the grave, and wrapped around the corpse arranged in the prenatal position. Among the Lango it is noted that the corpse was carried to the grave in the sleeping hide of the deceased, and it was buried with him. Over the grave a sheep was killed for the funeral meal. The skin of this was worn afterwards on the head of the nearest relative. This evidence suggests the survival of an idea prevalent in ancient Egypt. In the legend of the Wandering of Isis in the Delta the goddess said to Horus *inter alia* that he was "the son of him that is in Mesqet" this being the name of the bull's skin, in which the deceased was placed to secure for him the new life. In the Egyptian religion the most important of the rites of initiation was one called the mystery of animal rebirth; and in it as depicted in the Theban tombs a priest is shown in a sleigh crouching under a skin in the position of a foetus. When he comes forth from the skin, he is supposed to be reborn. Skins have the same significance in belief in India.

The Last of the Dinosaurs

The Smithsonian Institution reports that in Upper Cretaceous rocks in central Utah explorations by palæontologists from the Institution have revealed considerable fossil skeletal remains of titanosaurs. The discovery is interesting because, although the presence of these gigantic plant-eating dinosaurs had been known from a wide area, including India, Indo-China, Madagascar, France and South America, only two bones found in New Mexico in 1921 had indicated their habitation of North America, until the Utah finds of the past two summers. Moreover, they and the horned dinosaurs and 'duck-bills' also represented in the same beds were amongst the latest to survive of the giant reptiles, and although no break has been found in geological conditions between these Upper Cretaceous beds and the succeeding Palæocene sufficient to suggest a cause for their sudden disappearance, there is a possibility that the formation constitutes a bridge between the closing of the great reptilian age and the dawn of the mammalian epoch. It may therefore yet yield a clue to two of the most momentous steps in the evolution of animal life.

Cytology and Taxonomy of Calochortus

The genus Calochortus is a difficult one for systematists. By combined cytological and morphological study, J. M. Beal (*Bot. Gaz.*, 100, 528–547; 1939) has defined the limits of some sections of the genus. Of 28 species, those with $n = 10$ and capsules winged on the angles are placed in Eucalochortus, while the remainder with a basic chromosome number other than 10 are placed in Mariposa, except one, *C. plummeræ*, $n = 9$, which is placed in Cyclobothra. Seven is considered to be the basic number of Mariposa and possibly of the genus. Evidence is given suggesting ways in which other chromosome numbers have been derived from seven.

Food Value of Broccoli

E. Vanstone and C. E. H. Knapman (*J. Pom.*, 17, 85; 1939) have determined the amounts of nitrogen, phosphorus, potash and lime removed from the soil by Roscoff broccoli grown in different localities on commercial farms and on experimental plots at Seale Hayne. They found that the composition of the plant was approximately constant regardless of location and manuring. The average amounts of minerals removed from the soil per acre were: potash 240 lb., nitrogen 204 lb., lime 110 lb., and phosphoric acid 70 lb. Good quality curds differed from those of inferior quality ('soft curds') by having a higher percentage of potash and lower nitrogen. Plants sown in April and transplanted in June, grew most rapidly during September, October and November and matured the following April. Minerals were absorbed continuously throughout the growing period. The composition of the dry matter of the curd was compared with that of dried milk and found to be higher in protein (40 per cent), higher in ash (12 per cent) and equal in carbohydrate (36 per cent). The curd is evidently a highly nutritious food, rich in protein and mineral matter but deficient in fat. The leaves of the broccoli plant account for half the total dry weight, and though these are not used for human consumption they represent a valuable food for cattle, especially for dairy stock. They compare favourably in protein, oil and carbohydrate content with palm kernel cake and young grass, and are superior to these in that they contain less fibre and more mineral matter.

Nodule Organisms of the Leguminosæ

The discovery, towards the end of last century, of the peculiar symbiotic nitrogen metabolism of leguminous plants was quickly followed by the knowledge that each plant species required a particular strain of the appropriate organism, *Pseudomonas radicicola*. This led in practice to the tabulation of plant-bacteria groups, but certain difficulties arose, and necessitated a re-survey of the whole question. J. K. Wilson undertook this task upon an adequate scale, and his results have recently been published (*Cornell Univ. Agr. Exp. Sta. Mem.* 221, Ithaca, U.S.A., March 1939). More than 12,000 tests were made with about 200 plant species from 70 genera, and 32 strains of the organism, all made under sterile conditions. This imposing volume of experimental result leads to the conclusion that plant-bacteria groups are likely to be somewhat tentative. They should still be useful in practice, but several plants which had not previously been assigned to a group could be placed in the present investigation, in as many as twelve of them. Other plants, moreover, will symbiose with almost any of the strains. *Phaseolus coccineus* and other species have symbiosed simultaneously with four or five strains of the organism. Morphological studies have also been prosecuted, and it is further suggested that organisms with restricted range of symbiosis are predominantly monotrichic, whereas those with extended symbiosis include also forms with several flagella.

Structure of Proteins

THE picture of the structure of proteins proposed by Emil Fischer regards them as polypeptide chains, and this has been extended by the assumption of hydrogen bonds and other weak interatomic forces acting between chains and their parts. The so-called cyclol hypothesis postulates hexagonal rings resulting from the transfer of hydrogen atoms from secondary amino to carbonyl groups with the formation of single C—N bonds. In a comprehensive paper, L. Pauling and C. Niemann (*J. Amer. Chem. Soc.*, 61, 1860; 1939) review several lines of experimental evidence bearing on this question. X-ray work is not regarded as providing satisfactory evidence for the cyclol theory, and several investigations have provided strong (but not rigorous) evidence for polypeptide chains in fibrous proteins. The great complexity of proteins, however, makes it unlikely that a complete structure determination by X-ray methods is possible. Heats of combustion and bond energies show that the cyclol structure cannot be of primary importance for proteins; a cyclol structure would be considerably less stable than a polypeptide one. Interatomic distances in the cyclol structure have improbable values, and the presence of large numbers of hydroxyl groups postulated in it seems to be negatived by experiments on the acylation and alkylation of proteins. No simple substances with the cyclol structure have been synthesized so far. Among the arguments used in favour of the cyclol hypothesis, that of the total number of amino acid residues per molecule, and a further modification involving imino acids, are said to lack force. Recent evidence shows that proteins in films have the polypeptide structure. The authors give a concise summary of their own views on the protein problem. They believe that the chains or rings contain many amino acid residues, usually several hundred. A native protein molecule possesses a definite configuration involving the coiling of the polypeptide chain or chains in a definite way, brought about mainly by hydrogen bonds. A wide range of configurations is regarded as probable. The number of each individual amino acid residue and the total number of all amino acid residues in the molecule can be expressed as powers of the integers two and three, and there is perhaps some significance in the number 288 of residues in the simple proteins.

Reactions of Methyl Radicals

AN extension of previous work on the reactions of methyl radicals has just been published by H. S. Taylor and J. O. Smith (*J. Chem. Phys.*, 7, 390; 1939). Methyl radicals, produced by the photolysis of mercury dimethyl, were allowed to react with deuterium, ethane, normal and *iso*-butane, and neopentane, and the amounts of methane and ethane formed were determined. The plot of the logarithm of the rate of formation of methane against 1/temperature (abs.) is a straight line for all the reactions. To obtain a satisfactory mechanism for the reaction between mercury dimethyl and hydrogen or deuterium proved troublesome because of the number and variety of facts which the mechanism was required to satisfy, but it has been successfully accomplished. The most important of these facts are that both in the absence and in the presence of hydrogen or deuterium the formation of ethane remains unchanged; formation of methane increases with temperature and so does the rate of decomposition of the mercury dimethyl; formation of ethane shows first-order dependence on light intensity, whilst formation of methane shows an order between one-half and the first power, tending to the first power with increased temperature; packing the vessel, at 200°, cuts down the amount of methane formed but does not affect the amount of ethane; and the rate of decomposition of mercury dimethyl is independent of its concentration. For the interactions with the hydrocarbons the suggested mechanism is (i) $CH_3 + RH = CH_4 + R$; (ii) $R + CH_3 = RCH_3$; (iii) $CH_3 + CH_3 = C_2H_6$. From the rate of formation of methane the following activation energies for the reactions of methyl radicals with hydrocarbons, assuming zero activation for ethane formation, have been deduced: ethane and neopentane, 8·3; *n*-butane, 5·5; *iso*-butane, 4·2 kg.-cal. The differences in activation energies are attributed to differences in bond energies, particularly because of the closely analogous differences observed by Kistiakowsky in the heats of hydrogenation of substituted ethylenes.

Motion Pictures of Small Chromospheric Flocculi

SOME interesting facts on chromospheric phenomena are given by Robert R. McMath in a recent paper with the above title (*Mon. Not. Roy. Astro. Soc.*, 99, 7; May 1939). In August 1938, Mr. H. E. Sawyer was taking motion pictures of a dark hydrogen flocculus at the McMath-Hulbert Observatory, and displaced the second slit one half angstrom towards the violet with the object of registering a portion of the flocculus which showed velocity in the line of sight when examined in the spectrohelioscope. Sufficient exposures were made to provide a run on the screen when the spectroheliograms were shown by means of a motion picture projector. The motions of the small, dark flocculi were clearly seen, and it was obvious that a motion picture of the fine chromospheric detail had been secured. When the experiment was repeated with the second slit displaced one half angstrom towards the red, the pictures showed the same phenomena, but not so definitely. The author describes the surface of the sun seen in these pictures as like "an ocean viewed directly from above, and covered completely with short and choppy billows in a constant progression of irregular growth and recession". Accurate determination of the mean life-period of the flocculi involves careful identification of the markings measured on successive motion picture frames. For this purpose a high speed in taking individual frames is necessary, perhaps as high as eight per second, and it is hoped that sufficient material will be at hand this summer to undertake such research.

THE LEONARDO DA VINCI EXHIBITION AT MILAN

THE Exhibition of Leonardo da Vinci (1452–1519) which has been staged in the Palazzo dell' Arte n Milan is a truly comprehensive and magnificent estimony to the many-sided activities of the great master. Endeavour has been made not only to ollect exhaustive examples of his multifarious nterests, but also to illustrate his personal environment and record, and thus ensure a finer appreciation f the man himself. There are galleries devoted to ocuments connected with his life-history, to his brary, and to portraiture of him both in painting nd sculpture. To provide background, other rooms now the work of his masters, his contemporaries at lorence and at Milan, and the pupils of his school.

In the Hall of Honour there are numerous drawings nd designs of da Vinci, and in other galleries examples of his sculpture and some copies of his paintngs. This splendid symposium, generously subscribed rom public and private collections in many countries, manifest his superb mastery in drawing and design.

None the less staggering are his manifold achievements in the field of science. Anatomy and botany ach occupy a gallery; these two subjects of natural cience are known to have stirred Leonardo deeply, nd the far-seeing results of his investigations are ell portrayed.

In the realm of physics and mathematics he was head of his age. In several rooms there can be een models and charts and diagrams of his work n astronomy, optics, mathematics, or again on eology and geophysics. His service under various masters necessitated his turning his mind to architecture and town-planning: a series of fine models nd drawings bear testimony to his power of blending balanced and artistic outline with the practical eeds of utility.

It is perhaps natural that much space in the xhibition has been devoted to a record of his ngineering qualities. Two hundred models, some full size and some on a reduced scale, have been faithfully reconstructed from da Vinci's own elaborate notes, drawings and dimensions in the "Codice Atlantico" and other documents, and bear ample witness to his amazing versatility.

The flight of birds aroused his keenest interest and study, and he was convinced that man could achieve flight with mechanical aid: the models and records of his designs in this direction are indications of his insight into the future. Similarly his realization of natural forces prompted his investigations of the action of the waves and the winds: his designs for ships, with single or double hulls, and for paddle steamers, were the outcome of this research and betray a mind more fertile and far-seeing than any of his contemporaries.

Innumerable models and drawings give evidence of da Vinci's ingenuity and power of invention in mechanical devices of almost every kind. Pumps and all manner of hydraulics are notable examples, and one is tempted to run the gamut of all his varied achievements in mechanical engineering: it must suffice, however, to mention only a few examples, such as a printing-press, differential gear, cranes, water wheels, fire-escape ladder, belt-driven machines, in order to disclose his grasp of mechanical forces and the multifarious uses to which they could be put.

The wars of the period inevitably drew a man of his ability into their net, and his genious as a military engineer made his services invaluable to his chiefs. His study of ballistics stood him in great stead, and models of his multiple gun, bridges and fortifications are records of the adaptability of his great knowledge. It only remains to say that space has not been stinted at the Exhibition: the lay-out is good and modern. Skilful use has been made of murals and drawings and appropriate wall or ceiling decoration: the result is not only attractive but intensely interesting. The Exhibition remains open until October 1.

UNIVERSITY STATISTICS IN GREAT BRITAIN, 1937-38*

THE returns recently published by the University Grants Committee show that the total number f full-time university students in Great Britain coninues to diminish. A gradual decline has been ontinuous since 1934 and would have been more noticeable after 1935 but for a simultaneous increase n the number of students from overseas. The actual igures are as follows:

	From overseas	Other full-time students
1933–34	4,670	46,067
1934–35	4,653	45,985
1935–36	4,718	45,811
1936–37	4,989	44,700
1937–38	5,096	44,093

The decline has been most marked in Wales, where the number fell by 15 per cent between 1935 and 1938, after a rise of 18 per cent in the preceding four years. The falling off in the Scottish universities, to which attention was directed in the Grants Committee's last quinquennial report (for 1929–35), has continued but was very slight last year when, moreover, admissions showed a sharp rise of 248. Admissions in Great Britain as a whole showed a rise of 295 following decreases of 423, 296, 374 and 189 in the four preceding years.

Distribution of the whole body of full-time students over the different subject groups during recent years is shown in the accompanying diagram. It exhibits a remarkable upward trend under the head of medicine (including dentistry). During the years in question the proportion of women students of medicine and dentistry increased from 12 to 14. Research and other advanced studies continue to occupy an increasing number of full-time students. The years 1929–35 showed an increase of no less than 35 per cent in their number, although in the preceding quinquennium there had been practically no increase. Since 1935 there has been a further rise of 5 per cent and they now constitute more than 6 per cent of the total of all full-time students.

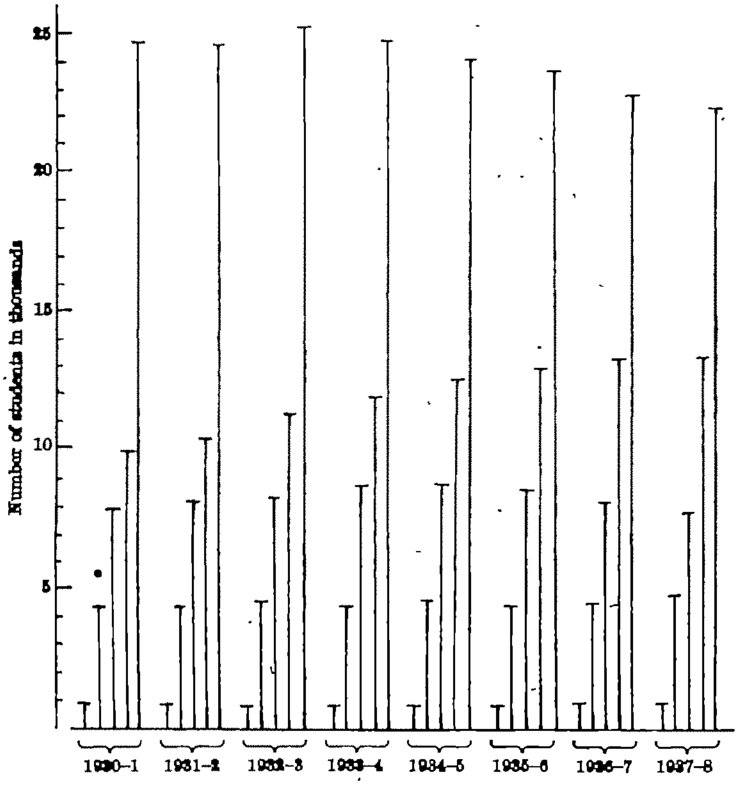
---

* Returns from Universities and University Colleges in receipt of reasury Grant, Academic Year 1937–38. Pp. 28. (London: H.M. tationery Office, 1939.) 1s. net.

Conditions of residence of full-time students are indicated by the following figures: residing in colleges and hostels, men 8,124, women 4,314; in lodgings, men 14,190, women 2,163; at home, men 15,576, women 4,822. The subject was discussed at considerable length in the quinquennial report 1929–35 and the Commissioners extolled the value of properly equipped and managed halls of residence. Recently their opinions have been echoed in the National Union of Teachers' report on the training of teachers, which points out that for prospective teachers who live at home while taking the four years approved course, university life becomes little more than a prolongation of school-days, while lacking such elements of community life as school provided, and where the journey between home and university is a matter of hours, as is often the case, these precious years tend to be squandered in an incessant rush of trains, lectures and preparation of work. The report goes so far as to recommend that *all* students attending this course should live either in a residential college or a college hostel, and that residence fees should be brought within the means of the poorest student. The following table shows that Sheffield and St. Andrews are the only universities in which there has been any marked advance in this respec since 1935:

Students in colleges and hostels.

	Increase or decrease since 1935	Percentage ratio to all full-time students 1935	1938
England (excluding Oxford and Cambridge)	+112	18·9	19·8
Wales	−26	15·3	17·2
Scotland	+61	8·2	9·1
Total	+147	15·8	16·9
Reading	+21	68·3	76·4
Bristol	−17	37·2	35·9
Durham	−18	31·0	32·2
Leeds	−12	23·4	21·1
Manchester	−56	20·7	20 9
Sheffield	+82	9 5	20 2
Birmingham	+1	12 5	13·7
London	+54	12·0	12·4
Liverpool	−3	10·1	10·4
St. Andrews	+64	24·0	31·2
Edinburgh	−31	13·9	13·7
Glasgow	+21	3·5	4·3
Aberdeen	—	—	—



Groups of five vertical lines represent number of students in one academic year in agriculture, technology, pure science, medicine and arts respectively, reading from left to right.

NUMBER OF STUDENTS ARRANGED BY SUBJECTS.

The most interesting feature c the returns is their inclusion fo the first time of information as t the educational origins of newl admitted students. This significan innovation takes the form of tabular statement of full-time graduating and diploma students entering for the first time in 1937–3 (i) whose homes were in the Unite Kingdom, and (ii) how many o these began their education in public elementary school. From Oxford and Cambridge and the Institute of Education, London, thi information was not forthcoming bu will be given in future returns. Th following table summarizes the figure for all the other institutions:

	(i)	(ii)	Percentag ratio (ii) to (
University of London	2,905	822	28·3
England	6,071	2,761	45·5
Wales	674	600	89·0
Scotland	2,221	1,371	61·7
Great Britain (Total)	8,966	4,732	52·8

Women included in the figures unde (ii) were: 252, 697, 166, 406 an 1,269 respectively.

Although the figures are far in deed from indicating approximatio to equality of educational oppor tunity, they show that there ha been much progress since the Cros Enquiry Commission of fifty year ago was told by a witness unde examination as to the prospects c a public elementary school pupil eve reaching a university: that it would be next t expecting him to take wings.

By way of supplement to this information, th Grants Committee publishes a table showing th proportion of 'assisted' to other full-time student this expression implying assistance from outsid sources (that is, other than personal and private namely, scholarships, exhibitions and other award and allowances providing wholly or in part for th payment of fees. The percentages are: Oxford an Cambridge, 44·7; London, 26·4; England, 38·5 Wales, 58·8; Scotland, 45·7; total, 41·9. The pe centage of assisted women students was 46; of men 4

PROGRESS IN BUILDING RESEARCH

ROGRESS towards the solution of many building problems is recorded in the annual report for 38 of the Building Research Board recently issued y the Department of Scientific and Industrial esearch (London : H.M. Stationery Office. 3*s.* 6*d.* net). ne of those pressing most urgently for investigation that of sound transmission in buildings, and in this here of activity the report claims that the position these inquiries has been very much advanced uring the past year. It has been made clear that buildings with a normal continuous rigid con- ruction it is virtually impossible to obtain a higher egree of sound insulation between two neighbouring oms greater than that obtainable with 9-inch brick alls on a concrete floor resting on sound insulators. eviewing, therefore, the results of experiments in e small steel frame building at the Research tation, in which various types of construction can tested, it is claimed that practical suggestions for nstruction to cut down sound transmission can w be advanced.

Special interest is attached to the work done in e preparation of artificial pozzolanas. The value the European natural pozzolanas has long been nown, the name being derived from the volcanic ust from the region of Pozzuole which the Romans ed in their mortars. These natural earths or olcanic tuffs have the ability to combine with lime d thereby to produce a hydraulic set which gave the ancients a cementing material suitable for a-walls, aqueducts and the like. A more important evelopment is their use with Portland cement hich, when used in soils containing sulphate salts, ffers serious deterioration from chemical attack. he work of the Research Station has provided the ethod whereby artificial pozzolanas have been roduced from certain clays and from refuse from e Scottish shale oil industry. Used with cement ortar these materials greatly increase its resistance sulphate attack, but somewhat diminish its early rength. Both natural and artificial pozzolanas ave been included in tests on the corrosion of steel inforcement in concrete piles exposed to sea-water, which are being carried out in conjunction with the Sea Action Committee of the Institution of Civil Engineers. The report notes that the manufacture of these materials is now beginning to be undertaken by the cement makers.

The spray method of cleaning buildings has been applied with success and its efficacy in particular circumstances has been the subject of experimental investigations. Most noteworthy among the latter is the cleaning of the Admiralty Screen in Whitehall, a Portland stone structure about 150 years old and the work of John Adams. Being almost completely soot-blackened it offered a severe test of the efficacy of the treatment.

A new branch of the work deals with ventilation problems, which are especially worthy of study in the interests of health and comfort. It is a subject which has received little attention and not much is known as to the distribution of air in buildings provided with the different mechanical ventilation or air-conditioning methods of to-day. The relative degree of purity of air supplied by upward or by downward ventilation is of considerable importance. The work in hand is primarily directed to the development of methods of testing the efficiency of different types of air filter, for with an inefficient filter there may, when air is re-circulated, be an accumulation of impurities in the building affected. The extension of the work in this section is commended to the interest and backing of the organizations concerned. With the help of the British Electrical and Allied Industries' Research Association experiments were made possible on the ventilation in a room when warmed by different methods.

Among the new apparatus described in the report is a rain gauge, used for experiments on damp penetration, which records the amount of rain received from different points of the compass. There are also described a machine for comparing the slipperiness of different types of floor and an apparatus for measuring the efficiencies of various treatments for minimizing the condensation of water on walls.

RADIO-TELEGRAPHY AND RADIO-TELEPHONY

N the *Proceedings* of the Wireless Section of the Institution of Electrical Engineers of June there a review of the progress made in radio-telegraphy d telephony during the last few years by C. E. ickard of Marconi's Wireless Co., Ltd. As this eriod has been notable for steady advance rather an outstanding invention, he was faced with two ain problems (1) where to start and where to finish relating this progress, and (2) what relative im- ortance to attach to the numerous branches and mifications which together make up the science, t and practice which provide the subject-matter such a review. Progress in the science of radio vers advances of knowledge in theory and technique, but progress in the art, although dependent on progress in the science, also depends largely upon the commercial application of such improvements as may have been made in the past. In addition, the commercial aspect of progress in the art of radio, although mainly controlled by economics, is also governed by the application of international regulations in the practice of radio communication. Seeing that a new international agreement has recently been reached at Cairo, the occasion to discuss the effects of the 1938 convention is opportune.

The recent plenary International Conference to review the Telecommunications Convention, and General Regulations made at Madrid in 1932 was held at Cairo in the spring of 1938. The Conference commenced on February 1 and was opened by H.M. King Farouk at the Heliopolis Palace Hotel. The work of the Conference entailed much study of the business aspects of telecommunication, including telegraph and telephone tariffs, communication procedure, traffic routing, and many other factors in the art and practice of telecommunication in all its branches. It also included a very important item, the revision of the Madrid General Radio Communications in the light of present-day needs, resulting from progress made during the past five years. This progress had led to increasing congestion in the ether, owing to the tremendous expansion of radio services during this period. Of particular importance was (*a*) the growth of aerial transport, of which radiocommunication in all its forms is a most important ancillary service; (*b*) the ever-insistent demands of broadcasting, which have gathered added strength from the increasing weight of public opinion and political activity; (*c*) the further development of the marine services in all branches, but especially in the short-wave trawler telephony and radiogoniometric services.

The actual modifications made at Cairo, although large, were much smaller than expected. These were mainly due to the modifications made in the allocation of frequencies to the various services, and to the tightening up of the regulations in respect to the frequency tolerances, attributable to the various types of transmitter corresponding to the different services they perform.

The first real allocation of frequencies was made at Washington in 1927 and was largely the result of experience gained during the Great War and subsequent years. It was a tentative effort to distribute the available frequencies among the claimants whose services at that time had begun comparatively recently, namely, radiogoniometry, broadcasting, radiotelephony for small ships, short-wave point-to-point services and amateur activities. Th frequency allocations thus adopted were largel influenced by the positions in the radio frequenc spectrum required by these new services. At Madri the frequency allocations were slightly modified t meet growing needs, but the frequencies still remaine allocated in comparatively wide bands which wer shared among various classes of services. This le to crowding in the case of mobile bands the frequencies of which were shared by marine and aircraf services, notwithstanding the fact that the types o apparatus practicable for these very different vessel vary largely in size and weight and consequentl in their technical characteristics. At Cairo furthe efforts were made to facilitate the solution of th problem of the expansion of the aeronautical service by specifying exclusive bands of frequencies to th various aircraft routes at present in contemplatio

The addition of the *Queen Mary* to the mercantil marine has been a milestone from the radio engineer' point of view. This ship is designed to meet th special requirements of vessels of her class for whic it will serve as a model. Developments of the direction finding services have been continuously taking place especially in Adcock direction-finders. The study c traffic requirements and the development of engineering and organization methods hand-in-hand hav enabled excellent services from an economical poin of view between many points on the earth's surfac to be found. Printing telegraph methods employe in submarine cable telegraphy are now also employe for radio purposes. The approach of the next sunspo maximum has enabled the P.O. engineers to provid additional plant and aerials so as to meet the antic pated adverse conditions such as frequency 'wobbling In ionospheric investigations, important theoretic and experimental discoveries have been made. M Rickard concludes by discussing vacuum tubes an high-frequency cables which can now be constructe so as to be semi-flexible.

TYŌKŌ AND HIS SEISMOSCOPE

A. IMAMURA has recently translated relevant passages concerning the life of Tyōkō and his seismoscope from the Chinese history "Gokanzyo" and discusses this very interesting topic[1].

Tyōkō was born in A.D. 78 in Si-o, Nan-yang Province, China, during the later period of the Post-Han dynasty, and held during his life several important governmental posts including that of the director of the Bureau of Almanac and History during A.D. 115–121, and A.D. 126–133. He was an excellent astronomer and a great literary man, and one of his duties besides constructing almanacs and writing history was to record the great events which happened in the country. About that time, parts of China were seismically active, which may account for his interest in seismology. He is said to have invented, in addition to his seismoscope, an instrument resembling in some respects the modern theodolite, a clock, a tricycle, and a so-called self-flying bird.

In the original Chinese history the seismoscope is not figured but only described. J. Milne in his "Earthquakes and Other Earth Movements" reconstructed a figure and gave a description. Imamura corrects some parts of Milne's figure and descriptio and also comments on interpretations by Mr. Wan Chen-to and Mr. T. Hagiwara, and on a seismoscop constructed by himself.

Tyōkō's seismoscope consisted of a pendulu device which caused a copper ball to fall out of on of eight dragon's heads into the mouth of a waitin toad, according to the direction of the epicentre the shock. Imamura states that the central pill was in all probability an inverted pendulum, th no record of the earthquake was made by the instrument, that only one ball dropped at each earthquak and fell into the mouth of a toad, not a frog. In th original description the dimension of the diameter the supporting barrel was given as 8 units. Imamur states that the unit mentioned was likely to have bee one third of a foot whereas Milne took it to be a foo

Tyōkō's seismoscope, invented in A.D. 132, probably being the first seismological instrument, will ran equal with his theodolite in scientific achievemen and points him out as having been a man of geniu He died in A.D. 139 at the age of sixty-two years.

---

[1] *Jap. J. Astro. and Geophys.*, 16, Nos. 2–3 (1939).

ELECTRICAL PROGRESS IN POLAND

N the *Electrical Times* of August 3, A. G. Moss describes the rapid and confident way in which oland is developing hydro-electric power schemes ithin her boundaries on a long-term basis, and hav-g obviously the utmost confidence in the future. In reat Britain, on the other hand, the tendency at resent seems to be to limit financial forecasts to e next few uncertain months due to possibilities f war.

In a recent tour through Poland, Mr. Moss saw e many plans which are being carried out for arnessing the various sources of industrial power the country for the benefit of the national economic ystem. Although primarily an agricultural country, oland was the last of the great European powers utilize their native fuel and water-power; but ow, for about the last twenty years, rapid progress as been made and this notwithstanding the crippling nancial burden which the Polish army and arms roduction has, of necessity, laid on the country uring this period.

Poland's power resources consist of great coalfields the Silesia, Krakow and Dabrowa regions in the outh-west. In addition there is hydro-electric ower distributed along the rivers of the Carpathian othills, and, a little farther north, vast fields of atural gas which are easily tapped for direct supply r domestic and industrial use. The presence of hese three sources of power might have led, as in ther countries, to harmful commercial competition etween those specially interested in them. In oland it was considered that electrical power was uch the most desirable.

The Polish Government is therefore considering lectrification on a national basis within the next ew years. This presents difficulties when we emember that nearly 70 per cent of the population agricultural and lives at a low peasant standard. evertheless, in spite of these serious difficulties, it going ahead very energetically with this end in iew.

In some parts of south Poland, natural gas is apped straight from fields into the home at a very ow cost to the consumer. In some cases, street amps are left on all day as it is cheaper to let them urn than to pay a man to put them out. Considered rom the national point of view, the Government has ecided that electricity is the most economical ethod to use. In an official document published in Varsaw a few weeks ago it is stated "The Polish epublic and the Polish Government fully realize hat backwardness in electrification must be made ood in the very near future in order to enable due rogress to be made by the whole economic life of he country".

The average increase in the electrical output ver the last six years amounts to nearly forty er cent. In Belgium the corresponding percentage 33, and in France 22. It has to be remembered hat Poland only recovered its present independence in 1919, and spent the next two years de-nding it. This increased demand for electricity as already necessitated large-scale extensions to the olish high-tension zone grid systems and also the onstruction of a considerable number of new electric ower stations.

SCIENCE NEWS A CENTURY AGO

Daguerre's Discovery Described

ON August 19, 1839, Arago at a meeting of the Paris Academy of Sciences "in the presence of a crowded audience, which had besieged the doors of the Institute three hours before the commencement of the sitting, divulged the secret of M. Daguerre's invention, which has now, as you are all aware, become public property. Three drawings having been exhibited by way of Specimens, M. Arago began by capitulating the discoveries—or rather hints towards discoveries, of former chemists; he afterwards dwelt upon the progressive experiments of M. Niepce since carried out by M. Daguerre. . . ." After dealing with Daguerre's process Arago proceeded "to speculate upon the improvements which this beautiful application of optics was capable. . . . The question arose, too, whether it will be possible to take portraits by this method. M. Arago was disposed to answer in the affirmative.

"In physics, M. Arago indicated some of the more immediate applications of Daguerreotype. . . . He instanced some of the complex phenomena exhibited by the solar spectrum. We know, for example, that the different coloured rays are separated by black transversal lines, indicating the absence of these rays at certain parts; and the question arises whether there are also similar interruptions in the continuity of the chemical rays? M. Arago proposes as a simple solution of this question, to expose one of M. Daguerre's prepared plates to the action of a spectrum; an experiment which will prove whether the action of these rays is continuous or interrupted by blank spaces" (*Athenæum*, Aug. 24, 1839).

Completion of Pulkowa Observatory

THE earliest observatory in Russia was built at St. Petersburg in 1725, under the auspices of Peter the Great, and the French astronomer J. N. Delisle (1688–1768) was made director. This observatory was burnt down in 1747, but though reconstructed it remained of minor importance. In 1827 the Academy of Sciences put forward the idea of a new central observatory and three years later the Emperor Nicholas declared through his minister, "that the honour of the country appeared to him to demand the establishment, near the capital, of a new astronomical observatory, conformable to the actual state of the science, and capable of contributing to its ulterior advancement." A site was chosen at Pulkowa, about twelve miles south-west of St. Petersburg, and Fredrick Georg Wilhelm Struve (1793–1864), the director of the Dorpat Observatory, was appointed to superintend the erection of the observatory. "The design of the establishment was upon a scale of unprecedented magnificence. The foundation stone of the building was laid on the 21st of June 1835, and it was finally completed on the 19th of August 1839" (Grant). The instruments installed included a vertical circle and a transit instrument by Ertel, of Munich, a meridian circle and a prime vertical telescope by the Repsolds, of Hamburg, and an equatorial telescope by Merz and Mahler, of Munich. Struve began his observations in September, having among his earliest assistants his son Otto and C. A. F. Peters (1806–80). From its formation the Observatory took a lead in the exact measurements relating to the motion of the earth and the positions of the principal stars, and it was once called "the astronomical capital of the world". The elder Struve retiring in 1861, he was succeeded in the directorship by his son Otto Wilhelm von Struve (1819–1905) and among his successors have been Theodor Alexandrovitch Bredichin (1831–1904) and Johan Oscar Backlund (1846–1916).

The British Association at Birmingham

OWING to the Chartist riots in Birmingham in July 1839, doubts were expressed as to the advisability of holding the meeting of the British Association, but the meeting took place and was successful. On August 24 the correspondent of the *Athenæum* wrote: "Many circumstances combined to throw a gloom over the opening of the Birmingham session of the British Association. The recent disturbances had rendered it doubtful whether the meeting might not be adjourned to another time and place; foreigners were alarmed by the exaggerated accounts of the riots; and the members of the Local Committee, having their attention engaged by the exciting events around them, could not bestow much of their time in preparations for the reception of the Association. Indeed, under the circumstances, it was surprising that their arrangements were so perfect as we found them. Many members, however, were disappointed at the very limited number of manufactories opened to general inspection; and it was thought to be most strange, and a subject of general remark, that no one of the great engineering establishments, for which Birmingham is so renowned, were found in the list. The Local Committee, however, and all who aided them, deserve great credit for their exertions in collecting together the 'Illustrations of Manufactures, Inventions and Models'."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN MECHANICAL ENGINEERING at the Hull Municipal Technical College—The Director of Education, Guildhall, Hull (August 22).

DEMONSTRATOR IN BOTANY—The Secretary, King's College, Strand, W.C.2 (August 26).

ASSISTANTS II (Male) in the Meteorological Office—The Under-Secretary of State (S.2.B.Met.), Air Ministry, Adastral House, Kingsway, W.C.2 (August 28).

MASTER TO TEACH MATHEMATICS in the Government Technical School, Baghdad—The Secretary (I.P.R./CA), Board of Education, Alexandra House, Kingsway, W.C.2 (August 28).

A SENIOR SCIENTIFIC OFFICER, A JUNIOR SCIENTIFIC OFFICER, AND AN ASSISTANT I, in the staff for Scientific Research—The Ministry of Supply, Adelphi, W.C.2 (quoting Appts. No. 03/S.E.3) (August 31).

ASSISTANT PROFESSOR OF SOCIOLOGY in the Fuad el Awal University—The Dean of the Faculty of Arts, Giza, Egypt (September 1).

ASSISTANT LECTURER IN ORGANIC CHEMISTRY—The Registrar, University College of the South-West, Exeter (September 9).

VETERINARY INVESTIGATION OFFICER under the Advisory Scheme for the Ministry of Agriculture—The Registrar, University, Leeds (September 13).

LIBRARIAN—The Secretary, Chartered Surveyors' Institution, 12 Great George Street, S.W.1 (September 30).

LECTURER IN PHYSIOLOGY—The Registrar, Municipal College, Portsmouth.

ASSISTANT ENGINEERS for the Posts and Telegraphs Department of Kenya, Uganda and Tanganyika Territory—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/8137).

ASSISTANT ENGINEER for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/5765).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Rubber in Chemical Engineering. By Dr. Henry P. Stevens and M. B. Donald. Pp. iv+58+15 plates. (London: British Rubber Publicity Association.) Free. [118

The Board of Greenkeeping Research. Report for 1938 and General Account of the Work in Progress. Pp. 78. (Bingley: St. I Research Station.) 2s. [1

Historic Tinned Foods. (Publication No. 85.) Second editi Pp. 70. (Greenford: International Tin Research and Developm Council.) [1

Other Countries

U.S. Department of the Interior: Office of Education. Bullet 1937, No. 2: Statistical Summary of Education, 1935–36. Prepar by Emery M. Foster. Pp. 30. (Washington, D.C.: Governme Printing Office.) 10 cents. [

Proceedings of the California Academy of Sciences, Fourth Seri Vol. 22, No. 8: The Templeton Crocker Expedition of the Califor Academy of Sciences, 1932. No. 37: The Cyperaceae. By H. Svenson. Pp. 187–194. Vol. 22, No. 9: The Templeton Crocker Expediti of the California Academy of Sciences, 1932. No. 38: Fungi from t Galapagos and other Pacific Coastal Islands. By Leo Bonar. P 195–200. Vol. 22, No. 10: The Templeton Crocker Expedition of t California Academy of Sciences, 1932. No. 39: Two New Flagellat from Termites in the Genera *Coronympha* Kirby and *Metacoronymp* Kirby, New Genus. By Harold Kirby, Jr. Pp. 207–220+plates 36–3 Vol. 23, No. 24: Marine Pleistocene Mollusks from the Galapag Islands. By Leo George Hertlein. Pp. 367–380+plate 32. (S Francisco, Calif.: California Academy of Sciences.) [

Smithsonian Miscellaneous Collections. Vol. 98, No. 18: Notes Hiller's Photographs of the Paiute and Ute Indians taken on t Powell Expedition of 1873. By Julian H. Steward. (Publicati 3543.) Pp. 23+31 plates. (Washington, D.C.: Smithsonian Instit tion.) [

Papers of the Michigan Academy of Science, Arts and Lett Edited by Eugene S. McCartney and Robert Burnett Hall. Vol. (1938). Part 1. Botany and Forestry. Pp. ix+vii+208+25 plate Part 2: Zoology. Pp. vii+221+6 plates; Part 3: Geography. P ix+134+24 plates; Part 4: General. Pp. vii+152+5 plates+ (Ann Arbor, Mich.: University of Michigan Press; London: Oxfo University Press.) 21s. net. [

Sveriges Geologiska Undersökning. Ser. Ca, No. 29: A Gene Earth Magnetic Investigation of Sweden, carried out during t Period 1928–1934 by the Geological Survey of Sweden. Part Inclination. By Kurt Molin. Pp. 119+4 plates. (Stockholm: P. Norstedt and Söner.) 10.00 kr. [

Union of South Africa. Report of the South African Museum f the Year ended 31st December 1938. Pp. 20+2 plates. (Pretori Government Printer.) [

University of Illinois: Engineering Experiment Station. Bullet No. 311: The Surface Tension of Molten Glass. By Prof. Cullen W Parmelee, Kenneth C. Lyon and Cameron G. Harman. Pp. 47. cents. Circular No. 37: Papers presented at the Second Conferen on Air Conditioning held at the University of Illinois, March 8 and 1939. Pp. 151. 50 cents. Circular No. 38: Papers presented the Twenty-sixth Annual Conference on Highway Engineering, he at the University of Illinois, March 1–3, 1939. Pp. 116. 50 cen (Urbana, Ill.: University of Illinois Engineering Experime Station.) [

Southern Rhodesia. Memoirs of the Department of Agricultu No. 1: Studies in the Physiology and Behaviour of *Glossina morsitan* Westw. By Rupert W. Jack. Pp. iv+203+vii. (Salisbury: Gover ment Stationery Office.) [

Ceylon. Sessional Paper XI, 1939: Report and Accounts of t Coconut Research Scheme for 1938. Pp. 22. (Colombo: Governme Record Office.) 25 cents. [

University of Mysore. Studies in Physics, 1: The Atmosphe Electric Field and the Electric Conductivity of the Air at Bangal on specified days during the International Polar Year August 19 to August 1933. By Prof. A. Venkat Rao Talang and A. Ananthapa manabha Rao. Pp. ii+34. (Bangalore: University of Mysore.) [

Bulletin of the American Museum of Natural History. Vol. Art. 3: The Indo-Malayan Species of *Trigona*. By Herbert F. Schwa Pp. 83–141. (New York: American Museum of Natural History.) [

Instytut Geofizyki i Meteorologii Uniwersytetu Jana Kazimier Komunikaty, Tom 10, Nr. 119 do 133: Wyników prac Henry Arctowskiego i jego współpracowników. Pp. v+229. (Lwów: U wersytetu Jana Kazimierza.) [

Publications of the South African Institute for Medical Researc No. 43: The Larval Trematoda found in certain South Afric Mollusca, with Special Reference to Schistosomiasis (Bilharzias By Dr. Annie Porter. Pp. 492+83 plates. No. 44: Blood Groups Africa. By Dr. Ronald Elsdon-Dew. Pp. 29–94. (Johannesbur South African Institute for Medical Research.) [

Statens Meteorologisk-Hydrografiska Anstalt. Årsberättelse f 1938. Pp. 20. Årsbok, 18, 1936. 7: Meteorologiska iakttagelser Riksgränsen. Pp. 44. 4.00 kr. Årsbok, 20, 1938. 1: Månadsöversi över väderlek och vattentillgång. Pp. 80. 2.50 kr. 2: Nederbörd i Sverige. Pp. 16. 2.50 kr. Meddelanden, Band 7, No. 5: O sambandet mellan isläggningen vid Svenska ostkusten och meteor logiska faktorer. Av C. J. Östman. Pp. 16. 1.00 kr. (Stockhol P. A. Norstedt and Söner.) [1

Ministry of Agriculture, Egypt: Technical and Scientific Servi Bulletin No. 196: Sugar Cane Planting Experiments, 1933–19 By Arthur H. Rosenfeld. Pp. ii+32+8 plates. P.T.7. Bulletin N 199: A Spacing Experiment with Egyptian Wheats. By Dr. Jam Philp. Pp. ii+49+28 plates. P.T.10. (Cairo: Governme Press.) [1

Conseil International des Unions scientifiques. Cinquième rapp de la Commission pour l'étude des relations entre les phénomè solaires et terrestres. Pp. 203+4 plates. (Firenze: Tipogra Barbera.) [1

Koninklijk Magnetisch en Meteorologisch Observatorium Batavia. Jaarverslag 1938. Pp. 29. (Batavia: Koninklijk Magnetis en Meteorologisch Observatorium.) [1

Editorial & Publishing Offices:
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

Telegraphic Address:
Phusis, Lesquare, London

Telephone Number:
Whitehall 8831

Vol. 144 SATURDAY, AUGUST 26, 1939 No. 3643

THE BASIS OF LEADERSHIP

NO more fundamental question is raised in Sir Arthur Salter's stimulating book "Security: can we retrieve it?" than that of the selection and training of leaders in our democratic systems. Many of the dangers to which we are exposed at the present time, he maintains, are the result of defective leadership and not of inherent defects in our democratic institutions. We cannot assume too readily with Prof. Whitehead that the problem is not that of producing great men but of creating great societies, for the great society will put up the men for the occasion.

The present testing time for democracy is forcing us to realize that the two problems are linked inseparably. The question of educating for democracy involves the problems of selection and training for the ever more arduous duties and responsibilities which the growing complexity of the modern State is forcing upon the administrator and statesman. If we have to consider education for citizenship in the sense that the efficient functioning of a democratic system depends upon an intelligent and educated electorate capable of taking independent and unprejudiced views, we have equally to consider it in the sense of providing training which will fit men and women for the many posts in local and central government which under a democracy demand wise judgment, respect for human personality, impartiality and a sense of justice and human values.

The future of democracy may well depend on whether it can put up leaders of the requisite calibre alike in municipal or national affairs, free from party prejudices and capable of taking long views and resolute action. We are being driven to consider again the Platonic view of education—whether, in fact, our system of education should not include some special provision and training for those destined to carry the responsibilities of leadership and administration. The question of a ruling class has once again to be faced fairly and dispassionately.

This is the central problem which Mr. J. M. Murry has raised in a stimulating little book recently published*, and he insists on the necessity of a moral basis for leadership. It is indeed to the separation of religion from the social tradition of Christianity and the acceptance of the complete secularization of society that he attributes a large measure of responsibility for the dangers and difficulties which confront us to-day. There is a striking parallel between the absorption of the Puritan in private religious observances and its consequences, and the absorption of scientific workers in their own special branch of knowledge and their neglect of, or indifference to, the social consequences of their work Both alike impoverish and cramp man's capacities and experience. Mr. Murry makes a passionate attack on the departmentalization of life from the religious side, an attack which should assist as much in bringing science and religion and ethics into that harmony so essential for man to regain his control over events as do the increasing efforts of leading men of science themselves to raise their fellows to a sense of their social and moral responsibilities, of which Sir William Bragg's Pilgrim Trust Lecture before the United States National Academy of Sciences provides a recent admirable illustration.

Mr. Murry argues that, broadly speaking, there are two educational systems in Great

---

*The Price of Leadership. By John Middleton Murry. Pp. 190. (London: Student Christian Movement Press, 1939.) 5s. net.

Britain. The first includes the education of the elementary school, that of the secondary school and finally university education, mainly scientific or technical. The second system, which begins with the preparatory school, and is followed by the public school and then by the university, leads to positions which can only be adequately described as those of the ruling class. Roughly it is true that the ruling class in the main receives a type of education entirely different from that of the rest of the people, and whereas the first system is almost exclusively an intellectual system, in the second intellectual values are definitely subordinated to training in character.

Mr. Murry considers that however lop-sided the public school system of values may be, it is much more realistic and effective than the system of values which prevails through elementary and secondary education, and that the insistence on its codes and traditions as more important than mere intellectual distinction makes for a real social coherence. He is accordingly concerned that we should attempt to preserve its virtues and to incorporate the public schools into the State system in a way that would render them no longer the preserve of the rich. He would achieve this either by bodily incorporating them into the State educational system and by drafting off to them boys who showed proof of a generalized rather than a specialized intelligence, or by founding at least two dozen State public schools which should take over the boy as completely as he is taken over by the existing public schools but should set themselves much more determinedly to discover the boy's real aptitudes.

The fundamental premiss in Mr. Murry's argument is that we should recognize both the existence and necessity in a democracy of a ruling class, and concern ourselves with the education by which a ruling class is formed. The necessity for a class of men educated and trained for administration is widely recognized in industry to-day, where the future of large-scale industrial combines and of the public utility corporation may well depend upon its solution, and less widely in modern society generally. The idea is inherent in the many discussions which have taken place in the last twenty years regarding the place of the scientific or technical expert in administration, and in such reports as that of the Departmental Committee on the Qualifications, Recruitment, Training and Promotion of Local Government Officers.

None the less, even those who are most alive to the social implications of the industrial combine of the public utility company are frequently blind to what is involved in the provision of leadership, and the reception given to the report on recruitment of local government officers indicates how far we yet are from appreciation of what is involved even in training for local administration.

This position is doubly dangerous. It undermines the efficiency of democracy by making it more difficult to secure and operate the regional planning of services such as health, transport, water supply, etc., which are becoming more essential in the general interest and may be vital as defensive measures in war time. Moreover, it hinders the linking of social privilege and social responsibility which has been so marked a characteristic of the development of the democratic system in Great Britain, and is more than ever essential if respect for human personality is to be preserved in the face of totalitarianism.

Mr. Murry indeed writes scathingly of many who profess to be leaders of democracy, and he demands clear and fundamental thinking on the two-party system and democracy as a whole to-day. What he is concerned to find is a system of education which will provide, not merely technically competent leaders, but also leaders who will safeguard for us the great values we have inherited. It is this view of life as a whole, in which moral and ethical no less than social, scientific, technical and artistic elements are respected and blended that leads him to place his main emphasis on the recognition by Christianity of its social relations and implications.

Already in other countries a new ruling class is coming into being, and the need in Great Britain is immediate. The character of the State is determined by the conception of its social responsibilities held by the ruling class. It can select, and under totalitarian impulses it does select, the elements of man's lower nature for embodiment in the character and purpose of the whole social order. Under Christian impulses it can equally reconstruct the State to serve the highest ideals of which humanity is capable. The choice made by the ruling class is determined by the training given to the minds of its members in the schools.

Mr. Murry asserts that the acceptance in Great Britain of State action solely as a channel of personal advantage without any philosophical or religious conception of the State as representative of the higher selves of man to whom duties are primarily owed, has left the moral initiative in

Europe to the new totalitarian nations. The conception of the State as the instrument by which a democratic society is educated to the knowledge of its own nature and purpose is, however, a Christian conception, and Mr. Murry clinches his argument by contending that the religious basis of social life at which he aims can be realized in the schools, and was realized by Dr. Arnold and others. Moreover, when the new industrialists entered the ruling class, they found that individualistic morality was insufficient, and from their ranks came the leaders of a new movement towards a social religion able to meet Marxian materialists on their own ground.

For Mr. Murry democracy cannot exist without Christianity. Unless democracy is constantly revivified by the regeneration of its individual members by Christian education, it must degenerate into totalitarianism. Either the individual must learn to conquer his lower self and attain his true personality as a citizen of a Christian society, or the democratic State, abandoned to be the instrument of the lower selves of its members, will enforce upon him a uniformity which is destructive of his whole personality. "A modern industrial and democratic society by reason of its economic complexity, cannot suffer itself to become anarchical. If it is not permitted to develop creatively into a Christian society it must become a totalitarian tyranny." Like Sir Cyril Norwood in his suggestive address last year on the relevance of Christianity in the modern world at the conference for young public schoolmasters, he claims that national education should be frankly based on Christianity conceived broadly in terms of the spiritual values of truth, beauty, and goodness—values which are increased by being shared.

With very much in Mr. Murry's argument scientific workers will find themselves in real sympathy. They are profoundly concerned with all that makes for the maintenance of freedom of thought, of speech and of investigation and the preservation of spiritual values. Respect for human personality should be as cardinal a principle with them as loyalty to the truth and disinterested search for the facts. In their growing concern for the social consequences of their work they are conscious that, as Sir William Bragg pointed out, in his Pilgrim Trust Lecture, the spirit in which knowledge is sought and the manner in which it is used may be more important than knowledge itself. They themselves have to supply the natural knowledge for a solution of the problems of society, and help in its application. Their effectiveness depends equally, however, on their moral influence, on the devotion, wisdom and good will which they bring to their task. They may well be grateful to Mr. Murry for the clarity with which he displays the moral issues, for the force of his challenge to discard cant about democracy and to think out all that is involved in the training and selection of leaders for democracy not merely as we know it to-day, but as it might be in an ideal society. Nor should they forget that such fundamental thinking will point the way for them to make their own contribution to leadership and to secure the more effective utilization in the service of the community of the knowledge already available and increasingly being placed at its disposal.

STATE-CRAFT AND MEDICINE

The Building of a Nation's Health

By Sir George Newman. Pp. xiv + 479 + 8 plates. (London: Macmillan and Co., Ltd., 1939.) 21*s*. net.

SIR GEORGE NEWMAN, until recently Chief Medical Officer of the Ministry of Health and of the Board of Education, in a preface to his latest work, entitled "The Building of a Nation's Health", states that he intends it to be a "summary record of how statecraft and medical knowledge took council together at the opening of a new epoch of preventive medicine". From one point of view this admirably describes the task which the author has so excellently performed. The responsibility for building and maintaining health in Great Britain may be said to be shared between the medical profession, the State, and the individual citizen. The part of the last named, though it is of essential importance and though it may even be obscured by some activities of the other two agencies, is not dealt with in Sir George Newman's book. This is legitimate, for the responsibility of the individual for his own health, and therefore to some extent for the common health, is somewhat apart from that of those other agencies, and may well be approached from a different angle and separately described or enforced. The responsibility of the State and of the medical profession cannot, however, be so dissevered; and, indeed, one of the main features of Sir George's book is the clearness with which it brings out, and the force with which it emphasizes the unity of the field of medicine, and the need for the intimate co-operation of various bodies of persons within the wider field of health. This leads one even to hope that the phrase "preventive medicine", however convenient when carefully used, may be abandoned wherever possible, and the phrase "the preventive aspects of medicine" used in its stead. For "preventive medicine" cannot be separated either from "curative medicine" on one hand or from "constructive medicine" on the other. It is false to regard the State as being concerned with prevention and the medical profession with cure, or one class of medical practitioner as dealing with the former and another class with the latter. These are merely aspects, and not very clearly defined ones at that, of something which is essentially a unit.

It is but little more than a century since the State began to realize its responsibility for the public health and actively to exercise its functions in relation thereto. During that century, and especially during the last thirty-five years or so, it has taken a constantly widening and more serious view of these responsibilities and functions. It was at first concerned, and is still perhaps primarily concerned, with environmental factors and the control of epidemic disease; but it is now enlarging its conception even of these so that the nutrition of the people and the opportunities for physical exercise and training are now regarded as its business. Further it has interested itself in the better education, regulation, and organization of the medical profession, and of ancillary health workers, so that their services may be more easily available for the public and more effective when used. It has brought medical advice and treatment within the means not only of the very poor but also of every worker, and has provided medical attention for other classes of the population and for certain abnormal conditions or diseases of more than ordinary communal importance. It is the whole of this field which Sir George Newman surveys in his book. No other person could have done it so appropriately, so comprehensively, or so well. It is not only that he has held positions in the public service which have afforded him unrivalled opportunities for knowing or observing almost every movement in this extensive sphere, but that he himself, in those positions, has been a motive, a controlling, or a directive force during twenty-five years or more of official life. Moreover the interested public has long recognized, through his series of annual reports as Chief Medical Officer to the two Government Departments most concerned with health matters in England and Wales and through his other writings, that he has a faculty of marshalling and setting out his material, and of attractive statement of facts and expression of ideas and opinions which add to the value of what he has to say and commend it to his readers. All these qualities are evident in his latest book, which, though it is to be hoped that it is not his last, may be regarded as his most important contribution to an understanding and appreciation of the national movement towards health with which he has been associated.

Very properly, and with evident deliberation, Sir George Newman places the medical profession in the forefront of the picture. He traces its governance and regulation through the Medical Acts and the General Medical Council, expounds recent movements and the new spirit in medical education, and discusses the status, duties, and privileges of medical officers and private practitioners in relation to communal requirements and public authorities. "Nothing is more remarkable," he says, "in the history of the public medical service in Britain, than the great and continuing contribution made by the medical practitioner." The delay by the State in making use of these contributions cannot fail to be noted. There is a lag between the acquirement of knowledge by research and the application of this knowledge in actual medical practice. There is a further lag between this application and the action of the State towards making it more easily and widely available. This is natural enough, and may even be advantageous, provided the lag is not too great, and that it is not due to professional negligence, obstruction, or claims to the sole occupancy of fields which are not wholly medical.

Next in importance to medical work and influence in the building of the nation's health has been that of voluntary societies and movements. This is shown in almost all the chapters in which the various public health services are surveyed. Thirdly comes the influence of certain great personalities, both medical and lay, to whose initiative and activities the author pays tribute. It is well that the public should be reminded of these men and informed, even though very succinctly, of their life and work. There are portraits of some: Sir John Simon, Medical Officer of Health, City of London, 1848–55; Sir Donald Macalister; Sir William Osler; Sir Robert Philip; and Sir Robert Morant. Sir George Newman's book is alike an interesting history, a guide to the principles which should influence future developments, and a work of reference. The volume should be welcomed as one of much importance and value.

THE THEORY OF NUMBERS

An Introduction to the Theory of Numbers
By Prof. G. M. Hardy and Prof. E. M. Wright. Pp. xvi+404. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 25s. net.

THE theory of numbers has an appeal to general interest, not shared by other branches of mathematics, in that most of the great unsolved problems of the subject are formulated in terms intelligible to everybody. There must be many people of limited mathematical attainments who have felt attracted to the subject, but whose interest has died away for the want of just such a book as this to stimulate it.

The point of view from which the book is written can best be described in the authors' own words.

> "It is not in any sense (as an expert can see by reading the table of contents) a systematic treatise on the theory of numbers. It does not even contain a fully reasoned account of any one side of that many sided theory, but is an introduction, or a series of introductions, to almost all of these sides in turn. We say something about each of a number of subjects which are not usually combined in a single volume, and about some which are not always regarded as forming part of the theory of numbers at all. . . . We have often allowed our personal interests to decide our programme, and have selected subjects less because of their importance (though most of them are important enough) than because we found them congenial and because other writers have left us something to say."

There can be no doubt that the authors have carried out their programme with marked success. In spite of their modest disclaimer, the book is really as systematic as any elementary account of so extensive a subject can be, or ought to be. It presupposes, for the most part, no more knowledge of mathematics than is possessed by a first-year university student, and yet it introduces the reader to almost all branches of the theory of numbers, including some which have only been developed in recent times. Naturally, in some branches, the deeper results have to be stated without proof; but the book does contain proofs of practically all theorems that are genuinely elementary (using the word in its non-technical sense). Mathematicians of all kinds will find the book pleasant and stimulating reading, and even experts on the theory of numbers will find that the authors have something new to say on many of the topics they have selected.

The selection of topics, and the general approach to the subject, have a slight analytical bias, as will be seen from the list of contents. The reader is introduced at the outset to the O, o and $\sim$ notation of modern analysis, and later to the notions of 'almost all integers', 'sets of measure zero', and 'uniform distribution'.

Each chapter is a model of clear exposition, and the notes at the ends of the chapters, with their references and suggestions for further reading, are invaluable. The only points in the book which the reviewer feels any inclination to criticize are (1) the section on integral quaternions, where the exposition of Dickson has been preferred to the more elegant theory of Hurwitz; (2) the definition of a convex area, which is obscured by the mention of a convex *curve* (a convex area or body is a much simpler thing than a curve, let alone a simple, closed, continuous curve); (3) the absence of an explicit theorem on the existence of primitive roots (mod p).

The printing is excellent, and has not that squashed appearance which is such a common fault of present-day English mathematical printing.

In the following summary of the contents, chapters which deal with the same side of the subject are grouped together.

Chapters i, ii, xxii (first half): the series of primes. A fairly complete account of what is known and what is conjectured about the distribution of the primes, with proofs where these are of an elementary character.

Chapters v, vi, vii, viii: congruences. The classical elements of the theory of numbers.

Chapters iv, ix, x, xi, xxiii: Diophantine approximation. Accounts are given of decimals and continued fractions, proofs of the transcendence of e and π, and three proofs of Kronecker's theorem.

Chapters xii, xiii, xiv, xv: quadratic fields. A few particular fields are treated, and the field $k(\sqrt{-3})$ is used to prove the insolubility of the equation $x^3 + y^3 = z^3$ $(xyz \neq 0)$.

Chapters xvi, xvii, xviii, xxii (second half): arithmetical functions. The formal properties of various arithmetical functions are considered, together with the associated Dirichlet series, also the order of magnitude, average order of magnitude, and normal order of magnitude of some of them.

Chapters xix, xx, xxi: additive theory. One chapter is devoted to partitions, one to representations by two or four squares, and one to Waring's problem. The chapter on partitions is one of the most attractive in the book.

Chapters iii, xxiv: geometry of numbers. Minkowski's theorems on lattices and linear forms.

H. DAVENPORT.

STATISTICAL MECHANICS: ANCIENT AND MODERN

The Principles of Statistical Mechanics

By Prof. Richard C. Tolman. (International Series of Monographs on Physics.) Pp. xix + 662. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 40s. net.

NOT so long ago, statistical mechanics was almost synonymous with the somewhat arid topic of the dynamical theory of gases, but the development of the quantum theory has vastly increased the number of subjects which can be treated by statistical methods. Nowadays statistical mechanics deals with the properties of matter in its widest sense, and there has been a steady stream of books concerned with the applications. But although the great development of the subject has been mainly due to the success of the quantum theory in dealing with the interactions of atoms and to the introduction of the Fermi-Dirac and Einstein-Bose distribution functions, yet the repercussions upon the foundations of statistical mechanics have been not less important. So far this part of the theory has been almost completely neglected; Prof. Tolman's important book is meant to fill this gap, and it leaves off where most books begin. The word "principles" in the title of the book does not mean that the book is an introduction to the subject—far from it—but that it is concerned with the logical development of the fundamental principles.

The student of the foundations of statistical mechanics has always been in a rather difficult position. The subject is by no means an easy one, and the presentations given in the classic treatises differ so widely that it requires profound thinking to be able to see that they refer to the same subject. Further, there is no systematic account of the foundations of quantal statistical mechanics (the topic is dismissed in a few pages in the modern treatises on the applications), and the student usually gives up the task of reconciling the various accounts and contents himself with learning to use the distribution laws and to calculate partition functions.

Of the various possible ways of developing the subject, Prof. Tolman adopts that favoured by Gibbs, and discusses the properties of ensembles of systems. This has the advantage that the treatment of quantal statistical mechanics is analogous to that of classical statistical mechanics; indeed in the book the classical theory is given in Chapters i–vi and the quantal treatment in Chapters vii–xii, corresponding chapters having almost identical titles. Now, although Gibbs's method is most satisfying to pure mathematicians in that all the necessary assumptions can be very easily introduced and the whole theory developed in a very logical manner, yet it has always seemed to many physicists to lack that physical plausibility which gives a feeling of life to a subject. Gibbs himself gives to the not too inquiring reader the feeling that statistical mechanics is not concerned with real things. For example, the only justification which Gibbs gives when introducing the canonical distribution ("Elementary Principles in Statistical Mechanics", p. 33) is that this distribution "seems to represent the most simple case conceivable, since it has the property that when the system consists of parts with separate energies, the laws of the distribution in phase of the separate parts are of the same nature—a property which enormously simplifies the discussion, and is the foundation of extremely important relations to thermodynamics". He does indeed show later on, almost at the end of the book, that the familiar thermodynamic equations can be derived from his statistical mechanics, but to many physicists this is very like putting the cart before the horse; they feel that a better procedure is to put thermodynamics right in the forefront of the theory and to deduce the statistical temperature and entropy in as direct a manner as possible. This method of exposition, however, often loses much of its force because the empirical temperature is taken as an intuitive idea instead of being defined thermodynamically as a function of the state of a body which is the same for all bodies in thermal equilibrium with one another. In the reviewer's opinion, the ideal exposition would be one in which this latter more physical approach is introduced at the beginning, while Gibbs's method is used for the subsequent developments.

Those of the 'physical' school of thought will feel regret that Prof. Tolman has chosen to follow Gibbs, but it will be regret tempered by pleasure in that Prof. Tolman's exposition goes a long way towards removing many of the objections to the method. As one example of this we may quote the full discussion of the relation between the canonical and the micro-canonical ensembles and of the justification for using the canonical ensemble. The plan of the book is as follows. Part 1 deals with the classical theory, and, after chapters on the Hamiltonian theory of general dynamics and on statistical ensembles, the Maxwell distribution aw is derived and Boltzmann's H-theorem is proved. The discussion of the latter topic is much more detailed and precise than is usually given.

Part 2, on the quantal statistical mechanics, is the most important part of the book. It is, however, marred, in the reviewer's opinion, by the inclusion of an exposition of quantum mechanics occupying about 150 pages. Most of this is quite irrelevant, breaks the continuity of the book and expands it into a volume which is too bulky. There would perhaps have been a good deal to say for the inclusion of some general theory starting from a fairly advanced point, since some of the results required are not readily available in a convenient orm, but discussions of such topics as one-dimensional collisions and the hydrogen atom are quite out of place. The writer of a book such as this must assume that his readers are well versed n the elements of quantum mechanics and, in all probability, in the more advanced theory also. If they are not, they will find the going rather heavy. As in Part 1, the main objects are the derivation of the distribution functions and the proof of the H-theorem. Part 3 deals with the relation of statistical mechanics and thermodynamics.

The book has been most carefully and, for the most part, well written, but the reviewer found himself sometimes fogged by the wealth of explanation. In dealing with a difficult subject, it is by no means easy to know how much explanation to give, since over-exposition is almost as bad as under-exposition, but the book would probably be improved by being shortened. It is, however, a valuable addition to the literature, and will be indispensable to those who wish to understand the principles of statistical mechanics, especially of quantal statistical mechanics.

A. H. W.

GROWING-POINTS OF ORGANIC CHEMISTRY

The Chemistry of the Carbon Compounds
By Victor von Richter. Edited by the late Prof. Richard Anschütz. Vol. 2: The Alicyclic Compounds and Natural Products. Translated from he twelfth German edition (compiled by Prof. A. Butenandt, Dr. M. Lipp, Dr. K. Niederländer, Prof. F. Reindel and Dr. F. Rochussen) and evised by T. W. J. Taylor and Dr. A. F. Millidge. Third edition. Pp. xiii+656. (Amsterdam: N.V. Uitgevers-Maatschappij "Elsevier", 1939.) n.p.

IN his introduction, Mr. Taylor explains that this book is a translation and revision of the first part of volume 2 of the twelfth edition of Richter-Anschütz's "Chemie der Kohlenstoffverbindungen", he German original of which appeared in 1935. The closely related fields of work here selected for treatment are of the first importance in modern rganic chemistry. Section A, comprising about 50 pages, deals with alicyclic compounds, and iscusses in the first instance such fundamental matters as the formation and stability of ring structures, ring transitions, and general methods f preparing alicyclic compounds. The detailed consideration of monocyclic compounds is then taken up, ranging systematically from the *cyclo*-propane group to compounds containing 34 carbon atoms in the ring. The succeeding description of polynuclear alicyclic compounds embraces rings directly united and those separated by a chain, spirane structures, condensed cyclic systems, and bridged rings. Terpenes and resins are then treated under the headings of olefinic terpenes, monocyclic terpenes, bicyclic terpenes, and sesquiterpenes and polyterpenes.

Section B, comprising the rest of the book, is devoted to the successive consideration of various classes of important naturally occurring compounds, including glycosides, tannins, lichen acids, the active principles of the peppers, natural colouring matters, nitrogen-free poisons, sterols, bile acids and scymnol, vitamins, and hormones.

In the preparation of this valuable edition the original authors revised their contributions to the German edition, and the English translation was subjected to a final revision by Mr. Taylor and Dr. Millidge, with assistance from Prof. A. R. Todd, Dr. S. G. P. Plant, and others. The result is a reliable and surprisingly detailed and up-to-date account of a vast and ever-growing region of organic chemistry. So far as the reviewer has put the text to the proof, the important advances of the last few years in these many fruitful fields of endeavour find here an admirable presentation. As a compact and yet comprehensive work of reference the volume will be of outstanding value to specialists and research workers in the many subjects of which it treats. The continued references to the *Zentralblatt* which formed a somewhat irritating feature of earlier editions of Richter-Anschütz have been happily replaced by direct references to the original papers, including the names of the authors. The text and formulæ are well printed, and there is a good subject index of fifty pages.

John Read.

THE MORPHOLOGY OF THE FLOWER

Floral Morphology

A New Outlook with Special Reference to the Interpretation of the Gynæceum. By E. R. Saunders. Vol. 2. Pp. xiv+133–609+vii. (Cambridge: W. Heffer and Sons, Ltd., 1939.) 10*s*. 6*d*. net.

THE first volume of Miss Saunders's review and summary of her studies on floral morphology was published in 1937 and was reviewed in NATURE of July 24, 1937, p. 132. The second volume is much larger in size and higher in price. Its pagination continues from that of volume one.

In the first volume the author outlined the essential structure of the flower and explained the theory of carpel polymorphism. This, with various consequences of its acceptance, was exemplified by details of a limited number of families (thirty-nine) and selected genera within the families. The general aim was "to serve as a guide to the study of types in the laboratory".

The second volume brings the number of families described up to 190, that is, the vast majority of families of Angiosperms are considered in greater or less detail. The families were, in the first volume, arranged in a sequence adapted to a scheme of laboratory work; in the second volume the arrangement is more taxonomic. The taxonomist would have preferred that the sequence throughout had been according to one of the widely recognized taxonomic classifications. The inclusion of what appears to be a very adequate index largely recompenses for the peculiarities of arrangement.

Miss Saunders has, since 1923, published a large number of papers dealing with floral morphology and especially with that of the gynœcium. She has emphasized the relation of the vascular ground-plan to the floral ground-plan. The fundamental principles of her interpretations are briefly recapitulated in a two-page introduction to the present volume.

Typically and most simply a single vascular bundle turns out from the central cylinder of the axis, traverses the cortex, and is continued into the corresponding floral member as the midrib. Lateral branching may or may not follow or precede exertion. Thus there depart from the central axial cylinder bundles corresponding in number and in radial disposition with the number and arrangement of the floral members. Owing to space conditions of the short receptacle, fusion, breaking-up, degeneration, or loss of vascular strands may occur and result in complications, yet "the formation of whorls of midrib bundles and their correspondence with the whorls of floral members is a fundamental feature of floral construction and the fact that these midrib bundles originate on definite radii provides a means of determining the number of members in a whorl".

A study of the vascular system of flowers, together with a consideration of various morphological features, many of which have long been known and have puzzled morphologists, led Miss Saunders to accept and expound the theory of carpel polymorphism. In an appendix (pp. i–vii), under the title "A Century's Challenge to Orthodoxy in Ten Chapters", she shows that various botanists had long ago proposed, at least for special or limited groups, interpretations of flower structure definitely or by implication in agreement with the theory of carpel polymorphism.

A very great deal of the present volume is quite 'orthodox'—is indeed descriptive in the ordinary taxonomic sense. The theory of carpel polymorphism is, at present, heterodox, but has now been so lucidly stated with a wealth of examples that floral morphologists who remain orthodox, or who favour some other heterodoxy, must feel they have to meet a challenge worthy of their best efforts.

The need for a reconsideration of morphologica concepts and terminology, especially of the flower is now widely recognized, partly owing to Mis Saunders's own published researches. If agreement could be reached among morphologists and anatomists on the interpretation of the major fact there is no doubt that the conservative taxonomis would, in time, revise his descriptive methods. A present he is somewhat confused by a multiplicity of views. He is told, by different authors, tha carpels are leaves, that they are branches, tha they are organs *sui generis*, that they are all o one kind, that they are of several kinds, or even that they do not exist. For the present, th taxonomist would be wise to use, so far as i reasonably possible, only neutral terms and phrases, that is, descriptive terms and phrases th use of which does not imply acceptance of any 'explanatory' theory.

It is somewhat disappointing that in this volume Miss Saunders has not published an account o the relationships between the theory of carpe polymorphism and floral evolution. It would be nteresting if she could connect up divergence of carpel form with possible phylogenetic lines and developmental tendencies. Does carpel polymorphism help in interpreting 'convergence', 'parallelism', 'reticulation' and other supposed modifications of what is often considered the ideal type of phylogenetic tree? Does the theory support the view of a monophyletic origin of the Angiosperms? Does it give new or detailed suggestions as to the nature of 'primitive' carpels? Again, it is probable that in the course of her work Miss Saunders found cause to criticize not only the morphology but also the taxonomy of the taxonomist. He would welcome her criticisms. There really seems to be a need for a third volume of floral morphology.

W. B. Turrill.

INTRODUCING HUMAN ANATOMY

The Tissues of the Body

An Introduction to the Study of Anatomy. By Prof. W. E. Le Gros Clark. Pp. xi+372. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 15s. net.

Of late years there has been a rather depressing spate of books that purport to be introductions to the study of anatomy. For the most part these works tend to recapitulate the type of book that was formerly addressed to nurses or students of massage but which is now dished up for the benefit of the medical student. As such they are symptomatic of what in the United States has been termed "the eclipse of Anatomy" and are the outcome of the present tendency to abbreviate the medical student's course in the study of human anatomy. They can only be classed as the products of expediency in a period during which the teaching of anatomy to medical students is definitely undergoing eclipse. If the student is to have his study of anatomy curtailed n an overcrowded curriculum it is but natural that the text-books read by a former generation may prove to be beyond his capacity and his needs.

It is merely a question of relative values. There are those who still fancy that the time devoted to anatomy by the student of some forty years ago was not altogether wasted in the education of a practitioner of medicine.

There are those who think that some three hundred hours are sufficient for learning as much of the intricate structure of the human body as is necessary for one who is afterwards to treat the derangements of this complicated structure. Maybe there were those of an older generation who attached too much importance to the minutiæ of structure and a swing back of the pendulum is but natural. In any event, we have to realize that the present tendency is to reduce the time devoted to the study of anatomy and so to render, for the medical student, the older masterpieces of descriptive anatomy redundant in his library. It is this state of affairs that has produced a host of minor books to meet the lessened need of knowledge demanded from the medical student: and these books are mostly the products of authors to whom the production of a more complete and authoritative work would prove a matter of some embarrassment.

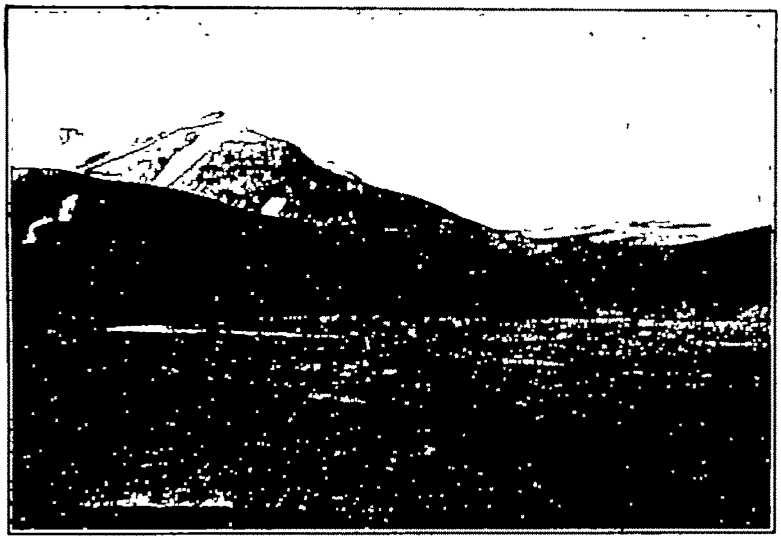
It is therefore an occasion of some satisfaction to meet with a book, written designedly as an introduction to the study of human anatomy, that does not presuppose a lowering of the standard of the student's knowledge and one that is written without an eye to minimum requirements in the medical curriculum and in the examination room. Moreover this book is not the product of one to whom the production of a mere introductory handbook could be pictured as the maximum scientific enterprise. Prof. Le Gros Clark has, in this volume, adopted an almost Hunterian outlook, and in reading his book one is tempted to think that it is only a matter of time before another British anatomist pays open homage to an older tradition in British anatomy and so helps in a renaissance—long overdue—that would end the period of "the eclipse of Anatomy".

The "Tissues of the Body" is not a work on histology, for Le Gros Clark, like Bichat, treats of tissues as the basis of animal organization: moreover he treats of them, so far as present knowledge permits, as living and functional elements. It may be permitted for a reviewer to regard this book as one of the most welcome contributions that has been made to the science of anatomy for many years and to express the hope that it will replace, on the shelves of the medical student's library, several minor works that at present appeal to him under the guise of being introductions to this subject.

F. Wood Jones.

ARCTIC PLANTS IN THE BRITISH ISLES

By Dr. Nicholas Polunin, Herbarium, University of Oxford



[*N. Polunin.*

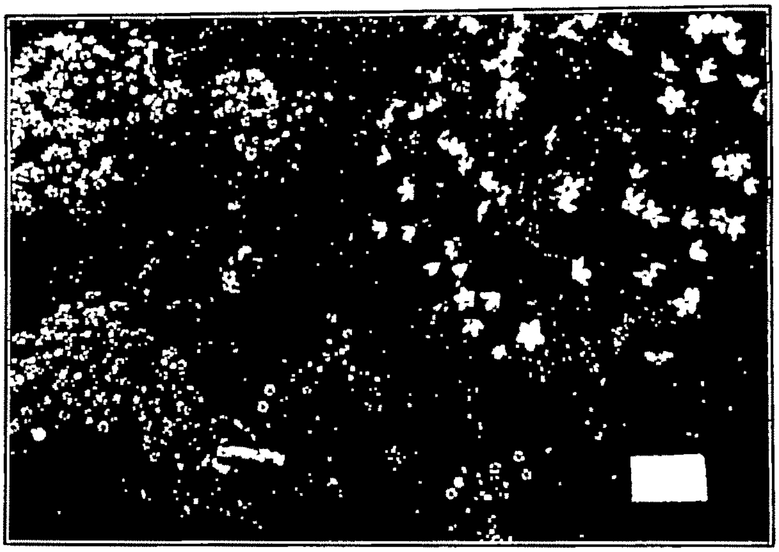
Typical arctic terrain in summer: an inland valley in Spitsbergen. Perennial patches of snow are frequent almost to sea-level, a tongue of glacier being visible in the distance on the right. The ground is stony and 'barren' except in especially favourable situations, where tracts of marsh or heath may develop, as in the foreground and around the grazing reindeer in the centre

IT is well known that, after the final retreat of the Pleistocene ice in western Europe, the flora of the British Isles was for a time much more like that of the arctic regions of the present day than is now the case. The same must be true of the vegetation and its component plant communities. Following the subsequent amelioration of climate, there came waves of relatively mesothermic dominants before which the smaller and less aggressive microthermic species retreated. The picture is clear and our knowledge of the story seems sufficiently complete. But we still do not know what proportion of the present British flora persisted through the Pleistocene maximum; nor have we investigated the mechanisms which enabled certain plants of 'arctic' affinity to survive in Britain to the present day. My object here is to deal with aspects of this latter problem—in a manner which I would scarcely dare attempt if I had not spent much of the last decade in various arctic and subarctic lands—first by deciding which plants are to be considered as truly arctic and then by analysing the resultant list of species.

It has always seemed to me that the so-called arctic element in the British flora is grossly exaggerated, since it is allowed to include many species which, even if they persist far north of the Arctic Circle, do so only in regions which are unusually favourable in climate and often actually forested—hence not really arctic at all. A fairer criterion would be to take such a line as the southern limit of the 'outer arctic zone', within which the mean temperature of the warmest month does not normally exceed 5° C.; and since this line in general lies around the 75th parallel of latitude I have taken this parallel as the least unsatisfactory principle of delimitation in the present instance. The result is that my arctic species are in most cases the

[*N. Polunin*

An arctic sea coast: Devon Island in northernmost America. In the foreground a glacier is discharging into the sea. Behind are poorly vegetated coastal plains and hills with perennial patches of snow



[N. Polunin.

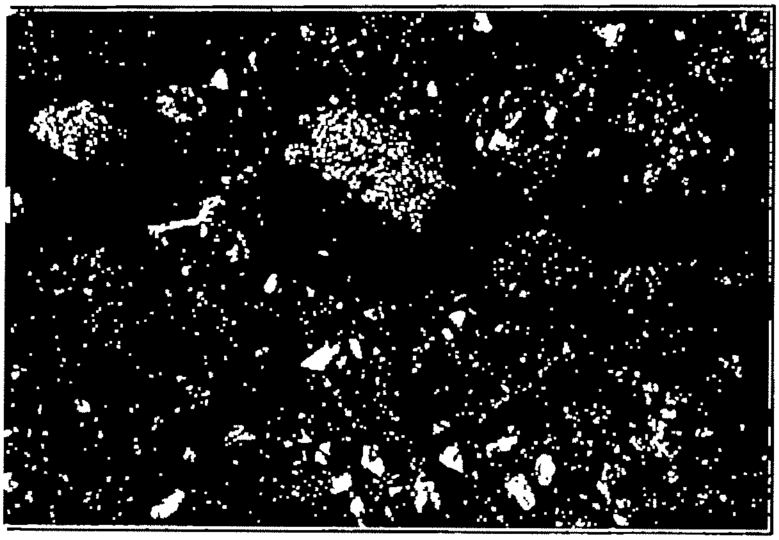
A manuring effect: dense mossy sward including *Saxifraga caespitosa* (on left) and *S. Hirculus* (on right) developed around the nests of wildfowl even in exposed and otherwise barren places, and indicating that a lack of nutrient salts is one of the chief factors inhibiting plant growth in the Arctic. The scale is shown by matchbox.

'high-arctic' ones of other authors—whose attempted subdivision of the element according to the supposed history and place of origin of the individual species ought probably to be shelved pending further research.

Altogether, sixty-two species or geographical varieties of vascular plants in the native British flora are now known to persist north of the 75th parallel of latitude and hence to be truly arctic. This is an addition of five (which *just* qualify) to the number of my preliminary analysis[1]; it does not include such aggregates as *Cardamine pratensis*, *Arenaria ciliata*, *Saxifraga stellaris*, *Chrysosplenium alternifolium*, *Matricaria inodora*, and *Carex salina*, which are represented in the north only by a variety that is subspecifically distinct from any form occurring in Britain, and which may accordingly be expected to have different ecological relationships in the two regions. The lower cryptogams present rather different problems and, being moreover much less known as regards distribution, seem best ignored for the present reckoning.

These sixty-two truly arctic vascular plants occurring in the British flora are all perennials. Many of them reproduce chiefly by vegetative means—a tendency which becomes more and more apparent the farther north we go. Classification of the sixty-two according to their most characteristic habitat in Britain, which is almost always comparable if not identical with that occupied in the Far North, gives the following categories and figures.[2]

1. *Plants of Open Soil or Rock Crevices*—competition generally negligible whether conditions are predominantly dry or damp. (*a*) Of general arctic distribution including high latitudes (*c.* 80° N.). This category comprises twenty-five species, of which three are frequently to be found also in closed communities. (*b*) Of fairly wide arctic distribution (for example, North Greenland and Ellesmere, or Spitsbergen and Novaya Zemlya). These are represented by eleven species, of which two are frequently to be found also in closed communities. (*c*) Extending far north only in Spitsbergen—tempered by Gulf Stream. Represented by four species, making a total of forty characteristic of open soil or rock crevices.



[N. Polunin.

An arctic 'compass plant': *Silene acaulis* in northern Spitsbergen flowering so regularly on the south-facing side of its domed tussocks that it enables a careful traveller to keep a very good 'line'. The boundaries of the non-flowering parts of the tussocks have been inked over. Note the lack of plant-covering on most of the ground.

2. *Plants of Seashore and Lake Margins*—community open, competition again at a minimum. In these habitats are found seven species or varieties which are common to the British Isles and

the Arctic, making a total of forty-seven characteristic of open habitats.

3. *Plants Characteristic of Other Habitats* but frequently found in open areas in both north and south. Of these there are eight species, making a total of fifty-five which are to be found in open areas.

4. *Marsh or 'Heath' Plants.* Of these there are seven species.

The more important conclusions to be drawn from these statistics are as follows: an overwhelming majority of the sixty-two native British vascular plants which reach high latitudes grow chiefly in the absence of competition—both towards their northern limit where the vegetation is generally open and towards their southern limit where under natural conditions it is almost always closed. No fewer than forty-seven (75·8 per cent) are plants predominantly of open soil (or rock crevices, which are ecologically similar in that competition is generally lacking), another eight being frequently found in such situations both in the north and in the south (total 88·7 per cent).

Of the seven remaining plants (which are rarely if ever to be found in open areas in the British Isles) I have seen one (*Eriophorum angustifolium*) colonizing damp open soil in the Far North both in Spitsbergen and Ellesmere, and to the south in Iceland, Labrador and southern Greenland; the larger phase of temperate regions may well be taxonomically as well as ecologically distinct. Exactly the same remarks apply in the case of *Calamagrostis neglecta* when Devon Island is substituted for the more northern Ellesmere (where this species is not known to occur). Like *Calamagrostis neglecta*, two more of the five remaining 'marsh or heath' plants, namely, *Rubus Chamæmorus* and *Tofieldia palustris*, reach north of 75° only as depauperated relics eking out a precarious existence in one or two localities in West Spitsbergen where the climate is much tempered by the Gulf Stream, while the remaining three also are characteristically more southern plants which merely straggle northwards in a few favourable healthy areas.

It may accordingly be said that truly arctic vascular plants are usually perennial dwarfs which can propagate vegetatively or flower and ripen seed in the short cool summer obtaining north of 75°, and can endure cold and rapid changes in water-relationships, but are unable to withstand competition. They flourish in the Far North where the communities are generally open; to the south they rather naturally persist chiefly where conditions prevent the growth of ranker dominants. and where the growing season is not too long and warm for their normal metabolism. Thus in the British Isles the majority are rare alpines of rock crevices or other 'open' habitats. It is without doubt only the persistence of such habitats in Britain which has allowed the survival (or perhaps in some cases recent introduction) of so considerable an arctic element in the British flora.

---

[1] *Proc. Linn. Soc.*, Session 151, 131 (1939).

[2] Names and other details of the individual species and varieties concerned will be published in the *Journal of Botany*, 77 (September 1939).

WILLIAM SMITH (1769-1839), THE FATHER OF ENGLISH GEOLOGY

On August 28, 1839, 'Strata' Smith, as he was familiarly known, died at the house of a friend in Northampton. He was on his way to a meeting of the British Association in Birmingham, to which he had been specially invited, but was taken ill before he could continue his journey. Thus passed away, at the age of seventy years, one of the greatest figures in British geology.

Smith's contributions to science are too well known to need more than brief mention here. After establishing that the different rock strata encountered in the course of his work as a land surveyor always occurred superposed in a particular order, he also discovered that individual strata could be recognized by the fossils they contained. He tested these fundamental observations in various parts of England and everywhere found support for his theory. His conclusions, and the extensive observations on which they were based laid the foundations on which the whole structure of British stratigraphy is built. Further, as has been pointed out by Bather, the recognition of a regular succession of strata introduced the idea of relative time, and without this premiss, no proof of evolution is possible. Thus, it can fairly be claimed that Smith had an indirect though very important influence on the birth and development of the theory of evolution.

At an early date Smith formed the habit of recording his stratigraphical observations accurately on topographical maps. He evolved the idea of showing, by different colours, not only the area distribution of the various strata, but also their structural relationship, that is, the vertical order in which they occur. Some of his early maps were exhibited to various societies, but the first to be published was his famous "Delineation of the Strata of England and Wales, with part of Scotland" (1815). This is a large-scale detailed map embodying the results of Smith's labours over a period of some twenty years, and is the first published geological map of England and Wales. Smith was thus one of the pioneers, if not the actual founder, of geological cartography in Britain.

In order to understand how Smith came to make his discoveries, and to appreciate their influence on contemporary thought, some knowledge of his early life is necessary. He came of farming stock, and, in 1787, at the age of eighteen years, he became assistant to a surveyor at Stow-on-the-Wold, in Gloucestershire. Four years later, in 1791, he was entrusted with the survey of an estate in Somerset. Smith records that this was the year in which his first observations on stratigraphy were made, as a result of having been particularly impressed by the regular stratification of the Lias in the latter county. He continued to work in Somerset for some years, and during this period took the opportunity of acquainting himself with the principles of canal construction, a branch of engineering then much to the fore.

Afterwards he obtained an appointment as engineer to the projected Somerset Coal Canal, and Phillips, his nephew and biographer, says "it was the necessity of a close and accurate knowledge of the different sorts of rock, sand, and clay, which were to be cut through on the line of the canal, which led him to examine minutely and scrupulously into the distribution of the 'extraneous fossils' which he had been in the habit of collecting". Work on the canal commenced in 1794, and by 1799, at the latest, Smith was convinced that different strata in the neighbourhood of Bath could be identified by their fossils.

At this time geology had only just begun to establish itself as a separate science, and Smith's discovery was entirely novel, at all events in Great Britain. Yet he was able to support his conclusions with such strong evidence that he had no difficulty in converting to his views two enthusiastic and well-informed local geologists, the Rev. Benjamin Richardson and the Rev. Joseph Townsend. These gentlemen at once realized the importance of his discovery, and induced him to draw up a table of the strata around Bath, from the Coal Measures to the Chalk. This historically important document was copied and widely circulated both in Great Britain and abroad, but, unfortunately, it was not immediately published. As there was no formal publication of Smith's discoveries until a number of years later, his claim to be regarded as their author passed unrecognized except by his intimate friends, and it was long before he received the honours that were his due.

Meantime, Cuvier and Brogniart had begun to study the Tertiary deposits of the Paris Basin, and they arrived at the same conclusions as those which Smith had deduced from an examination of the English Jurassic rocks. Their results were published in 1808, and it is interesting that the same principles should have been discovered independently at approximately the same time in England and France. There is no doubt of Smith's priority, and it is clear that he achieved his results uninfluenced by the ideas of other workers. Whether the circulation of his views had had any influence on the Continent is not known.

Although Smith's claim to fame rests on his pioneer discoveries in geology, it should not be overlooked that he achieved distinction in his profession as surveyor and engineer. For many years his services were much in demand in an advisory capacity for problems of land drainage, schemes for protection from the inroads of the sea, water supply, and canal engineering. In fact, his first publication (1806) was an account of the draining of Brisley Bog, for which achievement he had received a medal from the Society of Arts. His application of geological principles to these problems undoubtedly contributed largely to his professional success. He was always alive to the economic possibilities of his knowledge of geology and his discoveries had an important bearing on, for example, the development of the British coal fields.

Rather surprisingly, Smith never became a member of the Geological Society of London, although he was resident in London for some years after its formation in 1807; and this Society was somewhat slow in affording him adequate recognition. In later life, however, it made him the first recipient of the Wollaston Medal. The announcement of this honour was made in Smith's presence at the first meeting of the British Association, held in York in 1831. He received the medal in 1832 from the hands of Sedgwick, who, in a laudatory address, referred to him as the "Father of English Geology". In 1835 Trinity College, Dublin, conferred on Smith an honorary LL.D.

It is satisfactory to be able to record that suitable honours were accorded to Smith during his lifetime. Later a monument to his memory was erected at Churchill, Oxfordshire, his birthplace; and memorial tablets have been placed on a house occupied by him at Midford, near Bath, and in Bath itself, on the former residence of the Rev. Joseph Townsend, in which he dictated his famous table of the strata near Bath.

V. A. E.

PHOTOGRAPHY IN SCIENTIFIC RESEARCH

A conference was held in Manchester during July 3–4, under the auspices of the Manchester and District Branch of the Institute of Physics, and under the chairmanship of Dr. F. C. Toy, and was devoted solely to photography, with the principal object of giving an opportunity for discussion of the many photographic problems met with in scientific research, where photography plays so large a part. A large amount of time was necessarily given to reviews on the various aspects of photography and its applications, but in the first session fundamental problems of latent image formation were discussed and some original work was reported; this will occupy most of the space available for the present report.

Prof. N. F. Mott opened the session by a "Description of the Photographic Processes in Terms of Atomic Physics", Dr. J. L. M. Brentano, Dr. W. F. Berg and others contributing to the discussion. Dr. S. O. Rawling gave a paper on "Some Theories of the Action of Developers". Much of the matter dealt with has already been reported in NATURE[1] and elsewhere. The latent image which can so far be revealed only by the process of development was assumed to be a small speck of silver. Modern atomic theory enables a more detailed model of the flocking together of the isolated silver atoms formed by light to be given[2]. The silver halides are photo-conductors, that is, mobile electrons are formed if light is absorbed.[2] The silver halides are also electrolytic conductors: some silver ions (in 'interstitial' positions) will move through the crystal if an electric field is applied. Thus, if there is a place in the crystal where electrons can be collected and held 'trapped', a field will be set up and the ions will move up and neutralize the electrons, thus forming metallic silver. A piece of silver in contact with silver halide constitutes such an electron trap. In this way, once a small speck of silver is formed it will continue to grow if light is absorbed by the crystal. During that process the halogen atoms must escape, otherwise a regression would occur. It is important that in the model suggested the halogen will escape through the crystal surface and will not be liberated at the interface of silver and silver halide. The depth of the electron traps can be determined optically by the Herschel effect: red light will release electrons from the traps and thus bleach the latent image. Thermal energy would not be enough to release electrons, and thus a silver speck in contact with silver halide is stable.

The migration of atoms through solid bodies by a process in which electrons and ions move separately, is a fairly general phenomenon. It occurs, for example, in the atmospheric oxidation of metals, as is shown by the dependence of the rate of that process upon the oxygen pressure[3]. A similar mechanism is responsible for the thermal disintegration of certain azide compounds at 100° C.[4].

To understand the formation of the photographic latent image itself it is necessary to assume the existence of an electron trap before exposure. This probably consists of impurities like silver sulphide, the so-called sensitivity specks[5]. A very small silver speck is considered to be not as stable as a larger one; electrons and ions may 'evaporate' from, and thus break up, a small speck[6]. This process was regarded as responsible for the 'reciprocity failure' at low intensities; at constant exposure (intensity × time) the density depends on the intensity level, because at low intensities a speck may partly evaporate, and thus be too small to make the grain developable, whereas at higher intensity the speck reaches a stable size more quickly without losing matter by evaporation.

Some of the experiments reported by Dr. Brentano appeared to require at least some qualification of this picture. These experiments were made on diluted emulsions, thus avoiding the complications due to the multi-layer nature of commercial materials. The shape of the foot of experimental characteristic curves required the assumption that a grain must absorb 10 or more quanta to be made developable. This is of importance for the consideration of low intensity reciprocity failure and suggested experiments in which a certain exposure was given in a few instalments, with varying intervals of time in between. Below and near the threshold, exposures were additive, even when separated by intervals up to 300 hours. Thus, a markedly stable result is obtained already at the very first stages of an exposure. At higher densities, an interruption of an exposure causes a regression, which is greatest where the characteristic curve is steepest. For small exposures an interruption after ⅓, ½ or ⅔ of the exposure has been given causes the same amount of regression. Several breaks even when close together cause a larger regression than a single break. These findings might be accounted for in two ways. One is to assume that the last electron or ion joining a growing speck is for some time in a less consolidated state. The other is to modify the assumption of the small specks breaking up and getting lost by a hypothesis introducing a certain delay in the early stages of latent image formation.

Two groups of experiments were made with the intention of showing whether such a delay could be due to a process of temporary trapping of electrons outside the latent image. Experiments in which exposures to light of different wavelength, balanced to produce the same density for the same time of exposure, were added, showed a small but distinct difference in density if the order of the exposures was reversed; this was interpreted as demonstrating a small amount of trapping[8]. An X-ray examination of the state of crystalline perfection of a number of emulsions showed that in general the more sensitive emulsion grains are subdivided into smaller crystallites as indicated by the broadening of the X-ray lines. Another possible interpretation is the existence of a bigger strain in the more sensitive grains. As a particular instance it was mentioned that sensitizing by mercury vapour produced such a broadening. This may be cause or part-effect of the increase in sensitivity.

Reciprocity failure has been shown to be, at least to some extent, a development effect, the rate of development depending on the intensity of the exposure[9]. This effect has not been explained satisfactorily, requiring a deeper insight into the mechanism of development.

The process of development may be explained by a mechanism similar to that of latent image formation, the developer being regarded as a medium that will hand over electrons to the latent image. Thus, a field will be set up, and interstitial silver ions will move through the silver halide. For this process to work, the developer must come into intimate contact with the silver speck. The difference in adsorption between various agents, which might otherwise be suitable as developers, may be regarded as responsible for the differences in their behaviour. Another point of view considers the reduction of the silver to occur in the solution, which soon becomes supersaturated and deposits silver on to the latent image. Since the solubility of silver halides in ordinary developers is low, this is probably not the most common process. According to still another view, the silver speck is only incidental to latent image formation, which is considered as being the removal of some of the surface charge of the grains. This charge ordinarily inhibits contact between the developer and the grain, but when it is removed, contact becomes possible.

The Gurney-Mott theory[4] has given rise to a series of papers undertaken to test that theory. Application of low temperature seemed the obvious means of doing this, since ionic movement is then slowed down or arrested. The experiments lead to the following views[9]. At low temperatures free electrons are formed and then trapped, partly in the sensitivity specks, partly in other less stable trapping centres in the grain. The depth of the traps could be investigated by releasing the trapped electrons by red and infra-red light. Ionic movements occur on warming up only and depend solely on the total number of electrons trapped, which in turn depends only on the total number of quanta absorbed. Thus, no reciprocity failure should occur at these temperatures, as has actually been shown[10,11]. These experiments, while compatible with the Gurney-Mott theory, cannot be regarded as proving it, since several additional hypotheses were required for their explanation. The value of the theory as a working hypothesis that had given new stimulus to research into photographic problems was stressed.

Mr. E. R. Davies's paper on "Some Important Properties of Photographic Materials" in which the basis for many applications of photographic methods in scientific research were given, and the advantages and dangers of these methods pointed out, was given in his absence by Dr. Berg[12]. Mr. C. W. Bradley, Dr. J. G. Wilson, Dr. C. A. Adams, Dr. C. A. Bruck and Prof. W. H. Lang then gave examples of the application of photographic methods to specific problems. The three principal advantages of the photographic method lie in the high amplification factor of about 10^{10}: a few quanta striking a grain make the whole grain developable; in the possibility of integrating weak light over long periods—in astronomy the photographic method enables stars to be detected that are ten times weaker than the weakest detectable by the eye; and finally, in the possibility of recording radiation outside the visual range. Some of these advantages have to be paid for; the granular structure leads to loss of resolution due to the graininess and the scattering of light causing 'image spread'. This, however, may sometimes be useful: stellar magnitudes can be determined by the spread of the pin-point images. Many difficulties arise from penetration and exhaustion effects during development, making photographic photometry a difficult problem.

This is further complicated by reciprocity failure, intermittency, and wave-length effects, so that photometry should be based solely on the matching of densities produced by exposures of the same duration and the same degree of intermittency, to light of the same quality and on the same piece of photographic material. Furthermore, the density should be constant over not too small an area. As a beautiful example of this, was mentioned the method of street lighting photography developed in the G.E.C. laboratories[13].

During an evening session, to which a much wider audience had been invited, Dr. D. A. Spencer gave an account of present-day colour photography, illustrated by a cartoon film. This lecture was very much appreciated, and the large attendance showed the widespread interest created. The whole of the conference was very well attended, and the discussion was often very lively, demonstrating the need of informal meetings of this type, in which the aim is partly to bring forward new pieces of research, but partly also to relate already published information of the type not easily accessible to the physicist in industry. The hospitality and general arrangements provided by the Physics Department of the University of Manchester were very much appreciated by al participants.

W. F. BERG.

---

[1] NATURE, 140, 997 (1937).

[2] Gurney and Mott, *Proc. Roy. Soc.*, A, 164, 151 (1938).

[3] Wagner, *Z. phys. Chem.*, B, 21, 25 (1933).

[4] Papers by Garner, Wischin and Mott, *Proc. Roy. Soc.* In the Press.

[5] Sheppard, *Phot. J.*, 65, 380 (1925).

[6] Evans and Webb, *J. Opt. Soc. Amer.*, 28, 431 (1938)

[7] Webb, *Phot. J.*, 76, 78 (1936).

[8] Stroock, Skrifter utgitt av det Norsk Videnskaps-Akademi i Oslo (I) Mat.-Naturv. Klasse, No. 10 (1938).

[9] Berg, *Trans. Farad. Soc.*, 35, 445 (1939).

[9a] *Ibid.*, footnote, p. 458.

[10] Berg and Mendelssohn, *Proc. Roy. Soc.*, A, 168, 168 (1938).

[11] Evans and Hirschlaff, *J. Opt. Soc. Amer.*, 29, 164 (1939).

[12] Much of the matter of this lecture may be found in Ross, "Th Physics of the Developed Photographic Image" (New York, 1924).

[13] Hopkinson, *Phot. J.*, 76, 323 (1936).

OBITUARIES

Prof. J. Mellanby

THE death of Prof. John Mellanby on July 15 at the age of sixty years takes from us not only a great physiologist but also a notably genial and kindly personality. He will long be remembered by his colleagues and his students for his penetrating wisdom as well as for his ever-ready willingness to help.

Mellanby went up to Emmanuel College, Cambridge, in 1896 and took Part II of the Science Tripos in 1900, having been an early student under Gowland Hopkins, who had just begun to teach biochemistry at Cambridge at that time. From Cambridge he went to the research laboratory newly founded by Burroughs and Wellcome at Brockwell Hall, and worked there chiefly on the properties of serum proteins and their relation to antitoxins. He left there to complete his clinical course at Manchester and took his M.D. at Cambridge in 1907 and returned to the Cambridge laboratory as George Henry Lewes student. He was still engaged on protein solutions, and in particular on the phenomenon of clotting in blood and milk.

In 1909 Mellanby left Cambridge to take charge of the Physiological Department of St. Thomas's Hospital and began to use the measurement of the clotting-time of milk as a sensitive method for determining the quantity of active trypsin in pancreatic juice, and thus to work out the details of the formation of trypsin from trypsinogen. From the properties of the juice he went on to elucidate the mechanism of its secretion, and it is perhaps his work on this and on the purification of secretin which, together with his earlier investigation of clotting, form his best-known contributions to knowledge.

Mellanby became a fellow of the Royal Society in 1929 and at the time of his death was a member of its Council and of the Medical Research Council. But his purely physiological work was only one part of his activity. What was always in his mind was the encouragement of research from the clinical side, and he was at all times anxious to help, both by advice and in practice, in any problem that might be brought to him. He felt that problems in medicine were problems in physiology and that both were only to be solved by experiment. Such problems arose in the most varied fields and were responsible for example, for his work with Anwyl-Davies on the anti-coagulant action of arsenobenzol and the making of colloidal gold solution, and with C. R. Box on glycosuria.

In 1937 Mellanby became professor of physiology at Oxford and continued there the work on visceral movement to the study of which he had been led by his work on the effects of secretin. He finished an investigation of the changes in size of the spleen shortly before his death. In Oxford, as in London, he was in close touch with his clinical colleagues and his influence on the future of the Nuffield Foundation would have been of immense value. As a researcher he was outstandingly original and versatile, and it is safe to say that time will enhance his reputation in the fields which he made his own.

V. J. WOOLLEY.

Dr. M. A. Usov

THE death occurred on July 26 of one of the most eminent Soviet geologists, Mikhail Antonovich Usov, member of the Academy of Sciences of the U.S.S.R., and director of the All-Union Institute of Co-ordinated Geological Research.

Usov's work was mainly concerned with questions of tectonics and petrology. He elaborated a new method for the study of the tectonics of coal deposits, making use of the vast materials available from underground workings, to which geologists had until then paid little attention. An analysis of the break he had observed induced him to make an exhaustive classification of the forms of volcanic dislocations This resulted in the appearance of several works on the tectonics both of individual mines and of the entire Kuznetsk Basin. In these works he revealed the movement of the Cambrian formations from the direction of the Salair mountain range and the movement of the Devonian formations to the River Tom. These works have become standard guides for mining geologists working in the Kuznetsk Basin. Later, Usov extended his investigations to other parts of the West Siberian Territory. He made a thorough study of the phases and cycles of the tectogenesis of the territory from ancient times to the present day, laid down the principles for distinguishing them and surveyed the tectonic history of the region.

In two of Usov's published works on petrology, "Phases of Effusives" and "Faces and Phases of Intrusives" Usov synthesized the research of the most eminent petrographers, also giving the results of his own research, giving geologists working in the field a method for studying these rocks on the spot.

Usov created a big school of geologists at the Kirov Industrial Institute of Tomsk. He was very interested in the popularization of science, and wrote a number of popular works on geology. He was elected a member of the Academy of Sciences of the U.S.S.R. on January 30, 1939.

NEWS AND VIEWS

National Trust, 1938-39

It is significant of the increased interest of the public in Great Britain's treasures of natural beauty and historic interest—an interest that has grown in proportion as the dangers from building-development have increased—that in the last ten years the properties held by the National Trust or protected under covenant have more than doubled; they now total over 80,000 acres. The gross cost of upkeep, improvements and agents' salaries, according to the Annual Report for 1938–39, exceeds £29,000, while the income from letting, etc., of the properties amounts to £24,650, the difference being met by subscription. The new properties acquired in the period June 1938 to June 1939 number 37 and cover 2,965 acres. Among the more interesting or important acquisitions are 81 acres on Dunstable Downs, 224 acres at Hindhead, Surrey, and more than 900 acres of Dovedale and the Manifold Valley. In addition, 25 properties, covering 7,142 acres, were protected by covenant within the period. Extensive areas are now owned or protected in districts which have been mentioned as prospective national parks. In the Lake District, for example, the Trust now owns 12,000, and protects a further 19,150 acres, while on Exmoor it owns more than 9,000, and protects a further 900 acres. Of Dovedale and the Manifold Valley it owns or protects more than 4,600 acres. At present Cornwall has more coast owned or protected by the Trust than any county; but a considerable stretch of coast in Pembrokeshire will be affected by the recent appeal. The activities of the Trust have been greatly increased by the facilities for cooperation with local authorities under the National Trust Act of 1937, which is now working. Local authorities have already contributed large sums towards preservation schemes in their respective areas. One of the more important undertakings of the Trust, at least from the point of view of the archæologist, is the custody of Stonehenge. Here additional fencing has been carried out and the café demolished; but work on the aerodrome is proceeding only very slowly.

Leadership in Democracy

The seventh Walker Trust Lecture on Leadership entitled "Leadership in Democracy" delivered before the University of St. Andrews by Lord Lloyd on November 14 has been issued in pamphlet form (Oxford University Press. 2*s*.). Lord Lloyd insists that leadership is not the art of becoming and remaining a leader, but the art of leading. It is the opposite of dictatorship, inspiring free men with the feeling of moral obligation to follow. It requires will directed to a high purpose, clearly realized and defined, and courageously pursued. The need for leadership in a democracy, moreover, is even more urgent than in other forms of government because democracy as we know it in Great Britain is a new and untried system of government with no legal restrictions of rights on majority opinion. Lord Lloyd attributes the difficulties and dangers confronting us to-day largely to the absence of leaders who are able to inspire and guide the wills of men to the accomplishment of a high and disinterested purpose. Failure to make up our minds to positive action and to educate and enlighten public opinion has involved incalculable risks. The peril of democracy is its own failure to find the leadership necessary to make its high and necessary ideals triumphant in a world where men are neither naturally wise nor naturally virtuous.

The worst sign of our loss of leadership is the tendency to regard democracy as synonymous with this or that piece of political machinery, regardless of whether the machinery is serving or is capable of serving the aims and ideals for which it was set up. Lord Lloyd urges that in a democracy a leader can only lead if he has the courage to be loyal to faith and conscience and to base all his principles upon them. The first task is to set before the people clearly the ends which they should seek and to show how these ends are shaped and determined by the requirements of Christian morality. Peace at home and abroad can only be based on justice, and if we are to play our part in the preservation of liberty here and its restoration abroad it can only be by promoting a clear understanding of the ends to be pursued and of the kind of society necessary for human well-being. Justice and freedom must first be established before peace can be secured. A peaceful civilization can only be built on a foundation of free men; men subject to misgovernment are no more free men than men subject to a tyranny. We are in danger of losing our great heritage of freedom by surrendering to political expediency, and lack of courage and candour have brought us to the edge of catastrophe.

Damage by Rabbits

THE economic loss to farmers and others through damage caused by rabbits reaches a large annual sum, and it has long been a grievance that much of the damage was done by rabbits bred on adjoining property, over which the sufferer had no control. The "Prevention of Damage by Rabbits Act", passed through Parliament in July, helps to right this state of affairs. It empowers county councils to serve a notice requiring an occupier of land either to destroy his rabbits or to fence them in, and the penalty for non-compliance with such a notice is £25 together with £5 per diem for a continuing offence. County councils are also empowered to provide men and equipment for assisting occupiers to keep down their rabbits, and cyanide fumigation and similar methods of rabbit-control are legalized. The Act also imposes a heavy penalty (£20 for a first offence) for using or permitting the use of spring traps for rabbits elsewhere than in rabbit holes, that is to say, "under the roof" of a rabbit hole. The Bill was promoted at the instigation of the Universities Federation for Animal Welfare, and the secretary of the Federation is prepared to send "Instructions for Dealing with Rabbits" to any person interested who may apply to him at Gordon House, 29 Gordon Square, London, W.C.1.

Ancient Greek Measures and Athletic Records

A REVISED estimate of Greek units of linear measurement would appear to emerge from a study of the records of feats accomplished in the long jump by athletes of ancient Greece in the great festival games. M. Evangelos Kalfarentzos, Inspector-General of Physical Education at Athens, in a communication presented at the conference in connexion with the Lingiad Gymnastic Festival (*The Times*, July 31) arrives at the conclusion that the length of the remarkable jumps attributed to certain famous performers must be computed in terms of a 'foot' which was not uniform in all parts of the Greek world. He bases his argument on the evidence of a comparison of the reputed size of the stadium with the measurements of the various stadia as shown in the results of modern excavations. While it is true that the stadium at Olympia measured 600 'feet', it is an error, M. Kalfarentzos maintains, to hold that all stadia were of this length. Thus the stadium at Delphi was 1,000 'feet'. The actual length of the Delphi stadium was 177·55 metres which, divided by 1,000, gives a 'foot' of 17·76 centimetres. Phaullus, the winner at the Pythian games, as he is named by contemporary writers, is universally accredited with a 'record' jump of 55 'feet' and he is said to have been the first to clear the ditch of soft earth of 30 ft. breadth. Calculated on the revised estimate of the Delphic foot, this jump measures 9·77 metres, or almost exactly 32 feet according to British measurement; while the jump of Chionis, winner at the Olympic games in 664 B.C., is computed at 7·05 metres, or 23 ft. 1 in., on the basis of a 'foot' of which a nominal 600 went to a stadium length, which has been shown to be 192·25 metres.

Further Discoveries in Mycenean Greece

EXCAVATORS on Mycenean sites in Greece during the past season have indeed been fortunate. No fewer than three discoveries of major importance have been made—the inscribed tablets from the "Palace of Nestor", the first from a Mycenean site, which, though later, may throw light on Cretan script, the Mycenean Royal tomb at Athens, and now a Mycenean royal burial, probably of a queen, which has been found by the Swedish Archæological Expedition under Prof. Axel W. Persson of the University of Uppsala at Dendra in the Peloponnese (*Illustrated London News*, August 19). The expedition, which had set out with the intention of excavating at Mylassa in south-west Asia Minor, but was prevented by the political situation, attacked as its second string, the site of Midea, near Nauplia, with which the director was already acquainted, and where he had opened a royal tomb in 1926, finding the gold 'octopus' cup. Midea, according to Thucydides, was a vassal state of the Mycenean rulers.

THE expedition first located the royal palace, and then opened five tombs, one of which, relatively small, contained a beautiful collection of late Mycenean pottery. Three of the tombs were of exceptional size and all had much to offer of interest to archæologists. Three had been more or less stripped by grave robbers; but one of them from an unplundered pit yielded a fine collection of bronzes, knives, swords and cups, while in another were the first known wooden coffin and bronze helmet of Mycenean date. The fourth grave, however, in which the entrance, approached by a dromos of considerable dimensions, had not been touched since it was sealed, contained a wealth of gold and silver objects of great artistic merit, with which no finds in Mycenean Greece since the days of Schliemann will bear comparison. In the smaller of two pits, which contained the badly preserved remains of a skeleton, were golden necklaces, a large gold cup weighing 100 gr., a signet ring of gold, and a number of gold rosettes, rings and pendants. More than two hundred gold ornaments belonged to five necklaces of different types, and there were more than 1,000 pearls of glass paste, and about one hundred of Baltic amber, the first to be known as of Mycenean date. The second pit contained burial gifts, including terracotta and silver vases, and the first known Mycenean spoon. The pottery suggests a preliminary dating of 1400 B.C.

Cornish Promontory Forts

INTEREST in the promontory forts of Cornwall has been much stimulated by the results of Dr. Mortimer Wheeler's excavations in Brittany. One of them, the large and evidently important fort of Trevelgue Head and Porth Island, Newquay, has been under excavation since July 3. Its investigation is being carried on under the direction of Mr. C. K. Croft Andrew on behalf of the Cornwall Excavations Committee. Excavation is still in progress, though much hampered through lack of funds; but the finds reported to date (*The Times*, Aug. 15), ranging from Neolithic to Early Iron Age, fully bear out anticipation of the importance of the site, based partly on its superficial resemblance to Hengistbury Head, Hampshire, partly on the imposing character of its septuple line of defences. The main defences are now assigned to the third century B.C., when there supervened an occupation rich in artistic and metallurgical attainments. The pottery is akin to that of Glastonbury Lake Village, displaying curvilinear and lenticular decoration, as well as naturalistic leaf and vegetable forms. It would appear that in order that the outermost defences should include a native iron mine, they were given an eccentric form. At the back of the sixth, the innermost, rampart was banked the refuse of a considerable Iron Age town. This consisted of houses, or large huts, arranged terrace-wise on the slope rising from the back of the sixth bank to the apex of the island. The best example of a house cleared as yet was occupied from about 200 B.C. to A.D. 100. It is nearly circular and 46 ft. across, the upper sector being sunk two feet deep in the soft slate rock. It shows some fine examples of dry-walling. The wall was probably never more than 4 ft. or 5 ft. high, but it was 6 ft. thick. The roof ran up from eaves which were supported on a ring of external posts, while the span, being too great for early carpenters, was supported by rings of inner posts.

Radio for Short Distances

THE use of ultra-short waves in radio transmission for keeping police cars in touch with headquarters has proved itself of great value. A.R.P. necessities are increasing the demand for this system of communication. There are also a number of uses to which it can be usefully employed in connexion with switching on and off street lamps, water heaters during peak loads, calling air raid wardens and firemen and there would still be space in the high-frequency band for further applications, which are sure to be suggested within the next few years. Had the cost of these installations not been so high the progress made would probably have been more rapid. Sudden changes in the temperature will also encourage the installation of load-controlling equipment. One of its most useful applications is in connexion with fire-fighting. Experience gained in a recent local blackout shows that ordinary telephone communications can break down under the stress of a sudden emergency. The *Electrician* of August 18 says the Post Office has allotted a limited range of frequencies in the ultra-short wave band for police and fire-brigade purposes and that experimental work is being carried out by the Post Office in association with the Home Office to ascertain the possibility of developing local systems of this type. In dealing with emergencies, speed of communication is of the highest importance and wherever it is feasible to provide an effective means by which police, fire-brigade and ambulance headquarters can keep constantly in touch with their mobile units, this should be done.

Broadcasting over the Power Mains

DEMONSTRATIONS have recently been made of the broadcasting of messages over the electric light and power mains. In 1927 the method was conceived by Captain P. P. Eckersley, who, at that time, thought that the B.B.C. should deal with this special transmission. There is no technical defect in the method. For example, a message can be sent from any sub-station to all the consumers with which it is connected. The messages traverse one of the underground mains and get back to earth by a leakage circuit which contains the signalling device. This system has the advantage that it can be applied very readily. It needs no overhead wiring and so is less vulnerable to attack during a war. It could reach the nine million people in Great Britain who are supplied by a company with electric lighting in their homes. If domestic telephones were used, only two million homes would be available. The following objection to the method has been urged by some engineers. It is said that in time of war or civil commotion, enemy agents could easily inject messages into a power mains system and that it would be difficult to locate where they were working until the mischief had been done. Similarly, they might be able to jam any official message to the public. Seeing that power networks are sectionalized it is improbable that pirate messages would reach more than two or three hundred people at most. If a telephone service were used the number of listeners affected would be about the same as with the power mains system. In either case it would not be difficult to devise a method of locating and cutting off the offender. Electric supply engineers are quite enthusiastic about the broadcasting method. Captain Eckersley and Mr. W. B. Woodhouse are urging that a conference of all bodies interested should be called in order to decide, without further delay, what is best to be done.

Vocational Training for Firemen

A BULLETIN, "Vocational Training for Firemen" (Vocational Division Bulletin, No. 199, Trade and Industrial Series, No. 57. G.P.O., Washington, D.C. 10 cents) issued by the Office of Education, U.S. Department of the Interior, gives a general account of the present status of firemen training in the United States, particularly with reference to programmes developed in co-operation with public vocational education. The estimated loss by fire in the United States in 1937 was 285 million dollars, and the growing demands upon the fire service have increased the importance of training all members of fire departments sufficiently to enable them to utilize the results of technical progress and to apply scientific knowledge in fire-fighting and prevention. Since 1930, the International Association of Fire Chiefs has been responsible for a programme of training and development, and in 1937 fireman training schools were organized in connexion with State programmes of vocational education in twenty-two States, in which 5,441 firemen were enrolled. The training programmes include a system of zone or regional schools for training within a wide area; extension classes, chiefly in connexion with a State college or university; short courses or institutes providing three to five days of instruction annually; and local training programmes in the larger cities. Vocational training agencies appear to be of assistance chiefly in the training of instructors or conference leaders; the organization of instructors' conferences; the supervision of training programmes, particularly in the zone schools; the provision of instruction in practical and technical subjects through extension classes or short courses and the supply of literature for instruction and teaching. The bulletin also discusses the methods of assisting a local fire department in organizing a training programme and the possibilities of co-operation with other agencies. Details of the organization and administration of the Massachusetts zone schools are appended and also of the California programme.

Hygiene and Public Health in India

THE annual report of the All-India Institute of Hygiene and Public Health, Calcutta, recently issued, summarizes the teaching and research work for the year 1937. Statistical investigations on cholera have been pursued; for example, forecasts of epidemics, and research on variations in the chemical structure and antigenic properties of the cholera vibrio. An inquiry into the nature of an obscure disease, epidemic dropsy, has incriminated mustard oil (much used in cooking) as the causative agent, though what constituent of it is responsible still remains to be discovered. An account of the work of the Maternity and Child Welfare Centre is included.

Tuberculosis in Cyprus

THE National Association for the Prevention of Tuberculosis has published an interim report on the incidence and means of control of tuberculosis in Cyprus ("Tuberculosis in Cyprus", by N. D. Bardswell. M. D. Adlard and Son, Ltd., 21 Hart Street, W.C.1. 2*s*. 6*d*.). Tuberculosis was said to be rife in the island and to be increasing rapidly; the assistance of the National Association was requested, and Dr. Bardswell was appointed to conduct an inquiry in the island. A total of 250–300 notifications of pulmonary tuberculosis a year is recorded in a population of some 360,000. If a correct record, this would give a notification rate for pulmonary tuberculosis of less than 1·0 per 1,000 living—not a high rate, for the present rate (1935) for England and Wales is 0·97, and for London 1·27, per 1,000 living. There is reason to think, however, that the notification returns are inaccurate, and do not represent more than onequarter to one-half of the new cases occurring annually, owing to failures to notify all cases and to inaccuracies in diagnosis. Dr. Bardswell has surveyed the whole island, and the results of tuberculin testing in some districts are given. The report contains a mass of details, and is well illustrated with maps, plans, charts and photographs. It is difficult, however, to gather the actual facts and conclusions from this report of 228 pages, for it contains no table of contents, no index, and no general summary; these omissions should be made good in any further report.

Scientific Uses of Cinematography

THE British Film Institute, 4 Great Russell Street, London, W.C.1, one of the objects of which is to collect and disseminate information concerning the use of films for educational purposes, is engaged in compiling a bibliography on the scientific uses of cinematography. Very few books have been written on the subject and the list will consist almost entirely of references to reports of scientific associations and to articles which have appeared in scientific and film journals. The Institute would be glad to receive any information bearing on the undertaking.

Water Speed Record

SIR MALCOLM CAMPBELL set up a new record for speed on water on August 19 with his motor-boat *Bluebird II* on Coniston Water. The speeds reached over a statute mile in opposite directions were 142·85 and 140·62 miles an hour respectively, the average being returned as 141·74 miles an hour. Sir Malcolm's boat, in the design of which some novel features were embodied, was driven by a twelve-year-old engine intended for practice runs.

Recent Sunspot Activity

THE appearance this week of a large group of sunspots serves as a reminder that the sun is still very active though past the peak of the present 11-year sunspot cycle. This sunspot group, in latitude 13° N., crossed the central meridian on August 21·9 and will pass off the western edge of the disk on August 28. The aggregate area of the component spots on August 18 was 1,300 millionths of the sun's visible hemisphere. Since the last note on sunspots (NATURE, July 15, p. 109) a number of fair-sized spots have appeared of area greater than 500 millionths but less than 1,000 millionths. The respective times of central meridian passage (communicated by Greenwich) are as follows: July 17·1^d, 17·7^d, 20·1^d, 23·4^d, August 4·3^d, 7·5^d and 11·1^d U.T.

The Night Sky in September

THE autumnal equinox on September 23 brings equality of day and night the world over; thereafter (until December 22) the nights increase their duration in the northern hemisphere. The moon is new on September 13 and full (the Harvest Moon) on September 28. Jupiter is in conjunction with the moon on September 1 and 28: Saturn on September 3 and

(*Continued on p.* 375)

NATURE

SUPPLEMENT

Vol. 144 SATURDAY, AUGUST 26, 1939 No. 3643

SHORT REVIEWS

Anthropology

Singing for Power

The Song Magic of the Papago Indians of Southern Arizona. By Ruth Murray Underhill. Pp. vii+159. (Berkeley, Cal.: University of California Press; London: Cambridge University Press, 1938.) 9*s*. net.

MISS UNDERHILL here collects some of the songs which are a characteristic feature in the life of the Papago Indians of southern Arizona. The collection is part of a more elaborate study of Papago ceremonial, for which the material was collected in two expeditions undertaken under the ægis of the Humanistic Council of Columbia University, and occupying fourteen months in 1931 and 1933.

The songs are an essential part of the ceremonial ritual which is concerned with every department of daily tribal life, of rain-making, and in the preparation and first drinking of cactus spirit, 'singing up' the corn, war and scalping ceremonial, puberty and the like. It is interesting to note that the man who has taken a scalp, thereby acquiring magical power, is a danger to others. He has to learn a code of behaviour, whereby he may avoid harmful direction of his powers against fellow members of his group.

In addition to a translation, each group of songs has explanatory notes making clear its position and function in life and belief.

The Native Tribes of Central Australia

By Prof. Sir Baldwin Spencer and F. J. Gillen. New edition. Pp. xxiv+671+9 plates. (London: Macmillan and Co., Ltd., 1938.) 25*s*. net.

A REPRINT of "The Native Tribes of Central Australia" by the late Sir Baldwin Spencer and F. J. Gillen is more than welcome. The original edition appeared in 1899 and has long been out of print. It is now reproduced without change, but with an introduction by Sir James Frazer, to whose inspiration, counsel and friendship Spencer's work as an anthropologist was so deeply indebted.

"The Native Tribes of Central Australia" may without exaggeration be described as the most important ethnographical treatise on a primitive people ever written. Dealing mainly with the Arunta, it included material relating to other tribes of Central Australia, which Spencer did not incorporate in his later books.

Among the author's discoveries, the record of the classificatory system of relationship current among the Arunta, which effectually prevented intermarriage within the 'forbidden degrees', fully confirmed the earlier work of Fison and Howitt in other parts of Australia; but the outstanding achievement of the investigators lay in eliciting that the Arunta were ignorant of the facts of paternity and of the nature of the process of procreation, and in establishing that the totemic ritual was a magical ceremonial for the increase of the totem—plant or animal. Hereby Spencer and Gillen opened up new vistas in the exploration of the primitive mind in its social and religious orientation, and initiated a new conception of the totemic problem, which for so long had exercised the ingenuity of the anthropologist in speculation.

"The Native Tribes of Central Australia" indeed proved to be in a very real sense an epoch-making book.

Biology

Salmacis (The Indian Sea-Urchin)

(Indian Zoological Memoirs on Indian Animal Types, edited by Dr. K. N. Bahl, 7). By Prof. R. Gopala Aiyar. Pp. ix+69+1 plate. (Lucknow: Lucknow Publishing House, 1938.) 2 rupees.

THIS memoir gives an account of a common Indian sea-urchin which is a fairly typical example of the class Echinoidea. The introductory chapter deals with systematics and so with the position of the genus Salmacis among the Echinoderms. The definitions of the various orders of the Echinoidea are given, and with each order a list of the commoner Indian forms. The example belongs to the family Temnopleuridæ, and a key is provided for the separation of the genera of this family. The next nine chapters provide a systematic account of Salmacis under a succession of headings; external characters, skeleton, alimentary canal, cœlom, connective tissues, respiratory and excretory organs, nervous system, receptor organs and reproductive system. The next three chapters treat of the development of the Echinoidea (some of it based on the classical account by Prof.

E. W. MacBride in the "Cambridge Natural History"), the bionomics and directions for practical work.

Thus it will be seen that the book provides a complete manual for the use of the student of zoology. Its exact utility must be tested by experience, but it certainly appears to be full of promise. It is now twelve years since the appearance of the first of the Indian Zoological Memoirs, and this is the seventh to appear. All of them have exhibited a high degree of technical excellence. The present memoir does not fall below this high level, and the only criticism from this aspect is that, in the example submitted for review, the photograph of breeding Salmacis is not well reproduced; it is not up to the standard of the remainder of the illustrations. Zoologists in India owe a debt of gratitude to Prof. Bahl, to whose enthusiasm this series of memoirs is due.

Further thanks and congratulations are due to Prof. R. Gopala Aiyar for the excellent and workmanlike account of this Indian sea-urchin.

The Birds of Tropical West Africa

With Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria. By Dr. David Armitage Bannerman. (Published under the authority of the Secretary of State for the Colonies.) Vol. 5. Pp. xliii + 485 + 10 plates. (London: Crown Agents for the Colonies, 1939.) 22*s.* 6*d.*

FACTS mentioned in the preface to Dr. Bannerman's fifth volume bear witness to the success which the work has already attained. It is indeed remarkable evidence of widespread interest in ornithology that so ambitious a publication, dealing with the avifauna of a tropical area, should have sold beyond anticipation—to such an extent that the first volume is almost out of print. The stimulus given to the study of birds in West Africa, and in the African continent generally, must have been great; this is confirmed by the increasing amount of new material which has been reaching the author and has made it necessary to provide for a seventh volume not originally planned.

The present volume covers seven passerine families, of which the warblers account for 121 forms. The admirable coloured plates portray sixty-seven species, in addition to the many illustrations which accompany the text.

Elementi di genetica

Par Giuseppe Montalenti. Pp. vii + 452. (Bologna: L. Cappelli, 1939.) 50 lire.

HERE is an excellent text-book recording the facts relating to every side of genetics; its text is remarkably clear, scientific terms always explained, and its matter is adequately illustrated. A historical consideration of the position in the nineteenth century leads to the full account of Mendel's researches. Then follows the amplification of these. with many new branches, associated with the early years of the present century. The later-discovered chromosome phenomena lead to a clear account of the localization of the genes and the experimental production of mutations. Embryological and physiological sides are sufficiently treated, as are sex secondary sexual characters and other associated sides. A good bibliography, helpfully divided into sections, and adequate indexes of authors and of subjects complete a well-compiled work. Finally, the price of about 11 shillings as compared with about 2 shillings for a similar text-book in English suggests a wide and desirable circulation among those able to read Italian.

The British Caddis Flies (Trichoptera)

A Collector's Handbook. By Martin E. Mosely. Pp xiii + 320 + 4 plates. (London: George Routledge and Sons, Ltd., 1939.) 21*s.* net.

THE need for a handbook on the indigenous Trichoptera or Caddis flies has been long experienced by English entomologists. The present work, to a large extent, supplies this desideratum Its author is well qualified for the task, having been in charge of the collections of these insects in the British Museum for a period of ten years. All the 184 species known from Britain are described, and the letterpress is accompanied by some 633 very clear figures of the venation and genitalia. The descriptions are short and terse and are based on structural features, but little emphasis is laid upon wing-markings.

It is unfortunate that so little is said about the general structure and biology of these insects or about their remarkable larvæ and pupæ, the book being adapted essentially for the identification of the adult insects. Notwithstanding this criticism, a reliable and well-produced volume of this kind can scarcely fail to impart stimulus to the further study of the interesting creatures with which it deals, and English entomologists are under a debt to Mr. Mosely for having written it. The increasing number of workers in the field of fresh-water biology will also find that this book supplies a long-felt need.

Earth's Green Mantle

Plant Science for the General Reader. By Prof Sydney Mangham. Pp. 322 + 41 plates. (London English Universities Press, Ltd., 1939.) 10*s.* 6*d.* net

IT is no doubt a useful and laudable object to explain to the general reader the place in Nature and the importance to man of the plant world. Sir Arthur Hill states in his foreword, "Prof. Mangham has shed such a diffused and widespread light over the Green Mantle of the Earth that the minds of his readers, by a process of mental photosynthesis, should be able to acquire and assimilate vast stores of curious and unexpected information hitherto not fully appreciated." The variety of topics dealt with by the author is, however, so great that one wonders whether the reader will be able to digest this very ample meal.

Prof. Mangham attempts a *tour de force* by ndeavouring to deal with every aspect which plant fe opens out. Not only, for example, does he give n account of the plants of past ages but he also escribes in some detail the rock systems and geo- gical revolutions. It seems doubtful, too, whether he general reader will be able to appreciate fully a istory of botany from Aristotle to the present day nd a fairly detailed account of the structure of lants, recent and fossil.

The book is very fully illustrated, but one feels hat in this respect also the author has been too mbitious. Many of the ecological photographs —excellent in themselves—have lost a good deal of learness by reduction in size. By a more careful election of the illustrations as well as by some utting down of the subject-matter the author's raiseworthy attempt to enlighten the general public n the interest and importance of the plant life would robably be more successful.

oncise Flora of Britain for the use of Schools

Vith Explanatory Illustrations and Keys to Identifica- on. By F. K. Makins. Pp. xxviii+212. (Oxford: larendon Press; London: Oxford University Press, 939.) 4*s*. 6*d*.

N the preface to this book the author states that its object is to meet the demand for a modern lora of Britain suitable for use in schools and by eginners generally, and in describing how to use the lora he claims that its chief use is to enable the udent to identify plants for himself. Short de- riptions of more than 1,100 species are given, in- luding, therefore, the great majority of aggregate pecies of flowering plants and ferns found in Britain. ost of the rarities are excluded. The author has isely refrained from including illustrations which ould give a clue to the identity of any plant, and the ain series of drawings is intended to illustrate the chnical terms given in the glossary. The attention f the young student will very naturally be directed these drawings, and it is a pity that there is no dication of what they represent except by reference the glossary.

The synopsis of families follows fairly closely the rangement adopted in Bentham and Hooker's British Flora", but for the actual identification of milies and anomalous genera an artificial key is rovided which is so constructed that the beginner ould have little difficulty in referring any plant its proper family. Keys to the genera of the larger milies and to the species of the larger genera are ven throughout the book.

The author is to be congratulated on producing very compact form a book which is sure of a wel- me in schools where botany is taught and where udents require an easy guide to the identification the wild plants they are likely to find. The use of e Flora, however, should be supervised by the acher so that the artificial aids to identification ay not lead to a wrong impression of plant affinities.

J. R. M.

Chemistry

B.D.H. Reagents for Delicate Analysis including Spot-Tests

Seventh and enlarged edition. Pp. viii+120. (London: The British Drug Houses, Ltd., 1939.) 2*s*. 6*d*. net.

THE fact that a new edition of the popular and useful publication of the British Drug Houses has been called for annually is sufficient proof of the established position which this book has attained. The seventh edition has been carefully compiled to eliminate four reagents which have not stood up to the test of time, and to include four new reagents, for the determination respectively of palladium, magnesium, manganese and aluminium. The scope of the book, which now runs to 120 pages, has been augmented by expansion of the monographs of some of the more important reagents.

The reagents are carefully described, but it is suggested that if it were possible to represent the formula of each reagent graphically as in the case of acridine hydrochloride the value of the book would be enhanced, particularly to those whose interest now lies mainly in inorganic chemistry. Included in the book are separate leaflets, one describing the B.D.H. spot test outfit and the other the B.D.H. price list of the organic reagents described in the book.

This B.D.H. publication has proved of great value as a laboratory guide not only to analytical chemists but also to all research workers whose activities lead them to conduct delicate analysis. By supplying frequent editions of their book, the British Drug Houses keep abreast of the most recent advances in the field of analysis, render their publication the standard work on this topic, and summarize for the practical chemist much valuable but often scattered information. It is sufficient to say that the B.D.H. book should be available in every chemical laboratory.

Theoretical Qualitative Analysis

By Prof. J. H. Reedy. (International Chemical Series.) Pp. ix+451. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 18*s*.

PRACTICAL manuals on qualitative analysis are many, and usually consist of tables of practical directions with little or no explanation of the reactions underlying the processes used. Reedy's "Theoretical Qualitative Analysis" is one of the few books which seeks to give the student commencing a course of analysis a thorough understanding not only of such reactions but also of the general theories which form the basis of analytical chemistry, and indeed of inorganic chemistry as a whole.

General theoretical considerations form the first half of the book and include important chapters on the ionization theory, in which both complete and incomplete dissociation theories are discussed in an unbiased manner. For the most part, however, the author has based his applications on incomplete ionic dissociation, and in this connexion it is noteworthy that ionic equations are freely used in place of the older molecular equations.

Theories explained in the earlier part of the book are used in the second half in giving a full and clear description of reactions forming the classic group system of analysis for cations and anions. Division into chapters follows the group system, and each chapter contains a wealth of classified information, on the elements, cations, anions and compounds dealt with. Used in conjunction with a practical manual, this treatise should train the student to be a more intelligent and therefore a more efficient analyst.

The Structure and Composition of Foods

By Dr. Andrew L. Winton and Dr. Kate-Barber Winton. Vol. 4: Sugar, Sirup, Honey, Tea, Coffee, Cocoa, Spices, Extracts, Yeast, Baking Powder. Pp. xxxiii+580. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 45*s*. net.

THIS volume completes the authors' extensive labours, of which the first, second and third fruits were noticed in NATURE in March 1933, March 1936, and February 1938. The contents are indicated by the title: the method of treatment is congruous with that adopted in the earlier parts. Addenda (pp. xix–xxiii) bring up to date some of the chemical information contained in volumes 1 and 2. To search for printer's errors and other slips would be ungracious and an admission that adequately to appraise a work of this scope and magnitude is beyond the powers of one reviewer at any rate. He has, however, noted that the authors do not appear to have recorded the presence of vitamin D, presumably calciferol, in or on the shell of the cocoa-bean, which has consequently been advocated as a cattle food to increase the antirachitic activity of cows' milk.

The four volumes as they stand now constitute a complete standard work of reference on the subject. Every laboratory concerned with the examination and control of food, with the morphology and chemistry of its natural sources, whether animal or vegetable, with its proximate analysis and detailed chemical composition, will find in "Winton and Winton" an indispensable weapon.

A. L. BACHARACH.

Volumetric Analysis: including the Analysis of Gases

With a Chapter on Simple Gravimetric Determinations. By A. J. Berry. Fifth edition. Pp. vii+196. (Cambridge: At the University Press, 1939.) 7*s*. 6*d*. net.

THE principal part of Berry's well-known work on volumetric analysis remains unchanged in the fifth edition, following the usual division into chapters describing the use of the chief volumetric reagents and including a chapter on the theory of indicators as well as a short section on simple gravimetric analysis. The practical treatment adopted succeeds in its object of going beyond the scope of elementary text-books without entering into the mass of detail to be found in standard analytical reference works.

The chapter on gravimetric analysis contains new sections dealing with the determination of lead and of phosphates; but the most important additions a to be found in the entirely new chapters devoted modern developments and to the rudiments of g analysis. The former includes sections on the mo important new indicators, on the use of ceric sulpha as a quantitative oxidizing agent, and on dire titrations with potassium iodate, together with pra tical applications of these and several other ne methods. In introducing this particular chapter t author has brought his course of analysis complete up to date.

Systematic Qualitative Organic Analysis

By H. Middleton. Pp. viii+279. (London: Edwa Arnold and Co., 1939.) 8*s*. 6*d*. net.

THE title of this excellent book on qualitati organic analysis is fully justified by the co tents, in which a remarkable degree of system h been introduced into the tests for single organic cor pounds. The schemes of analysis and tabulat properties of groups of substances should be of gre value to all chemistry students in the final year an honours course, and it is claimed by the auth that particular attention has been given to pharm ceutical students in that rapid methods are given f identifying most of the organic compounds listed the "British Pharmacopœia". In working throu a course based on this book, the student wou undoubtedly become familiar with all the operatio commonly carried out by the organic chemist, a should acquire a good practical knowledge of ma tests and preparative reactions. A feature valuab to supervisors and examiners is found in a list hydrolysis times of some hundred esters.

Such criticisms as may be made are in a few matte of detail. Thus one cannot agree that acetates, give first of the derivatives of phenols, are the best mediu for the identification of monohydric phenols, t acetates of which are generally liquids. Again, the section on alcohols, melting points of the dinitr benzoates might well have been given under ea alcohol, instead of being referred to under speci reagents.

The book contains a short section on the separati of mixtures of organic compounds and conclud with two indexes—one of the processes and one of t substances described.

A Course in Chemical Spectroscopy

By Dr. H. W. Thompson. Pp. vii+86+8 plat (Oxford: Clarendon Press; London: Oxford U versity Press, 1938.) 6*s*. net.

THIS neat little volume is based on an elementa course in chemical spectroscopy recently intr duced at Oxford for undergraduates reading the fir honour school of chemistry. Eight experimen have been selected, and although no attempt is ma to describe the technical details of construction the various instruments used, sufficient informati is given to enable a student to carry out each expe ment successfully under the general supervision the teacher.

The principal lines in the atomic spectra of the ements are first measured in the visible region, the ilger constant deviation instrument being instanced very suitable. The student then passes on to study ries of lines in the ultra-violet spectra of elements, d a good knowledge of atomic structure is pre- umed. Electronic and rotation spectra come next, hilst the sixth experiment deals with the absorption ectra of gaseous molecules, notably hydrogen dide, chlorine, sulphur dioxide and oxides of itrogen. One would have liked to see also a study the absorption spectra of rare earth salt solutions cluded, in view of the increased attention now ing given to this branch of the subject. Perhaps e author will bear this in mind for future editions, hich we feel sure will be required. The two last periments deal with predissociation spectra and e structure of an infra-red absorption band.

On the whole, the experiments have been well lected. The book is tastefully got up, the type d diagrams are clear, whilst the eight photographs ave been very beautifully reproduced. Any student ho conscientiously completes the course of instruc- on may be regarded as possessing a sound know- dge of the elements of practical chemical spectro- opy.

J. N. F.

he Oxidation States of the Elements and their tentials in Aqueous Solutions

y Prof. Wendell M. Latimer. Pp. xiv+352. (New ork: Prentice-Hall, Inc., 1938.) 3 dollars.

THE contents of Prof. Latimer's book are much broader than might be inferred from the title. esides giving all the available information on oxida- on-reduction potentials in aqueous solutions, care- lly and critically sifted and presented on a uniform lan, it includes a great deal of numerical data based thermodynamic calculations as applied to reactions hich are not directly amenable to electrometric easurement. The volume will be extremely valuable many workers—chemists, physicists and biologists —and it may be cordially recommended to their tention. It is well printed, strongly bound, and ery moderately priced.

troductory Qualitative Analysis

y Prof. Warren C. Vosburgh. Revised edition. Pp. i+222. (New York: The Macmillan Company, 938.) 10s. net.

"INTRODUCTORY Qualitative Analysis", a revised edition of Cornog and Vosburgh's book under e same title, is an elementary laboratory manual imarily intended for students of a particular iversity in the United States. The detailed practical structions, suitable however for general use, include rections for analytical work on a semi-micro scale. ince the author states that qualitative analysis on is modified scale has been carried out at Duke niversity during the past four years, he might well ave taken the bold step of abandoning ordinary ale directions entirely in favour of the new micro ethods.

The theoretical part of the book, providing explanatory matter to be read contemporaneously with the practical exercises, covers the ground adequately and includes general chapters on electrolytic dissociation, chemical equilibrium and the theory of precipitation, in addition to a chapter dealing more particularly with the reactions used in qualitative analysis. It appears a defect that only the theory of complete ionic dissociation is presented, but, in general, the explanatory matter is treated with brevity and clearness.

Engineering

Stream and Channel Flow (Hydraulic Graphs and Tables)

By E. E. Morgan. Pp. xxii+240. (London: Chapman and Hall, Ltd., 1938.) 25s. net.

THIS manual is a convenient compendium of hydraulic graphs and tables for stream and channel flow, calculated from a modification of Manning's formula:

$$v = M\sqrt[3]{R^2}.\sqrt{S},$$

in which v is velocity of flow in feet per second; R, the hydraulic mean depth; and S, the sine of the angle of slope. M is the coefficient of roughness, corresponding to C, the coefficient of roughness in the Chezy formula, $v = C\sqrt{RS}$, which assumes so complex a form in the formula of Ganguillet and Kutter. The reasons for the adoption of the Manning formula, in preference to those of four other prominent authorities, are set out in Chapter xvi. The whole subject of velocity and discharge multipliers is examined at considerable length. The book is devised for ready reference with marginal finger cuts and a central subject indicator. There is also an index.

B. C.

Cement and Concrete

By Rahel Friedland. (Written in Hebrew.) Pp. xii+276. (Haifa: Hebrew Technical Institute, 1939.)

THIS book is claimed to be the first Hebrew textbook in its own field, and will answer a real need in Palestine's rapidly developing building industry. It is written by a member of the staff of the Hebrew Technical Institute, Haifa, presumably as a text-book for its own students. Its style and lay-out are simple and straightforward, and the importance of giving adequate attention to industrial application and practice is fully realized.

Part 1 deals with cement, and is mainly devoted to a consideration of Portland cement; mixed, aluminium, and special cements are dealt with briefly, and the corrosion of cement by acids, alkalis and salts discussed. In each case, the composition, manufacture, physical and chemical properties and methods of testing are adequately described.

Part 2 is concerned with concrete, and chiefly with the composition and properties of concrete, particle size and its relation to the quality of the concrete, the role of water, methods of preparation, the influence of physical factors, specifications for ingredients, and the analysis and testing of concrete.

A summary of Palestinian regulations for building materials and an interesting glossary of Hebrew technical terms are also given.

This book should be found very useful by all interested in the building industry in Palestine, and particularly by those who intend to study this subject in Palestine. It should also be of interest to the philologist, for is it not a miracle that the age-old Hebrew language, used for so long only as a vehicle for prayer and the study of Jewish sacred writings, should to-day be sufficiently revived to enable a scientific text-book to be written in it? N. G.

Industrial Electricity: Direct-Current Practice

By Prof. William H. Timbie. Second edition. Pp. xii+636. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 15*s*. net.

TECHNICAL students and industrial workers who desire to qualify for posts where a knowledge of electrical science is necessary will find this book very helpful as an introduction to the subject. Phrases used in everyday work such as voltage drop, potential gradient, floating batteries, dielectric constant, etc., are not easy to understand without some theoretical basis on which to build. In our opinion, the almost universally used phrase 'dielectric constant' is not very happily chosen as almost all, if not all, of this kind of *constant* varies with temperature. We like this book because it describes the underlying principles of such problems as the stresses in insulators, the action of vacuum tubes, and the phenomena of the karc, the spar and the corona. The object is not to help students to pass written examinations, although it will be a help in this direction as it is well written and thoroughly up to date. In describing electric heating, illustrations are given from electric toasters, stoves, apparatus for air-conditioning, etc.

We were interested to see in this book a photograph of a very up-to-date flat-iron made in America, where electric flat-irons are almost universally used. It was fitted with a device which automatically switched out the circuit when temperature rose to a definite desired value, less than 700° F., which is the highest permissible temperature if scorching is to be avoided. Beyond very elementary algebra, practically no demands are made on the mathematical knowledge of the reader.

Radio Laboratory Handbook

By M. G. Scroggie. Pp. x+384. (London: Iliffe and Sons, Ltd., n.d.) 8*s*. 6*d*. net.

THE methods and measurements used in a modern radio laboratory are described in this work, which includes details and illustrations of the available apparatus for making such measurements. The whole range of alternating current frequencies used in radio and acoustic technique is covered. Practica advice is included on the lay-out and equipment o a laboratory on scientific lines, and some usefu information is provided on the construction and us of many items and components which are auxiliar to the main sets of apparatus. The book should prov very helpful to all those engaged in the use of a radi laboratory, whether from a design and developmen or from a research point of view. R. L. S.-R.

Fundamentals of Radio

By Prof. Frederick Emmons Terman, with th collaboration of Lieut. F. W. Macdonald. Pp. viii-458. (New York and London: McGraw-Hill Boo Co., Inc., 1938.) 21*s*.

THIS book is essentially an abridged version o the author's "Radio Engineering". It present the basic principles of radio communication in form suitable for an introductory course for th physicist or engineer. The treatment is confine very closely to this objective, all reference to th practical applications being reduced to the absolut minimum. The work is, however, quite up to dat in so far as established principles are concerned, an the series of problems at the end of each chapte should be of great assistance to the student using th book. R. L. S.-R.

Geology

Geology and Allied Sciences

A Thesaurus and a Coordination of English an German Specific and General Terms. By Walth Huebner. Part 1: German–English. Pp. xvii+40 (New York: The Veritas Press, Inc.; London Thomas Murby and Co., 1939.) 7.50 dollars.

THE need for a comprehensive German–Englis dictionary of geological terms has long bee apparent to workers in this branch of science, an the work under notice is therefore welcome. Th author has been engaged in its preparation f fifteen years, and certainly the work is not lacking thoroughness. Indeed, so careful has the compil been that no slight shade of meaning should be ove looked, that he may be accused of under-estimatin the intelligence of his readers. It is not difficult find occasional faults in his rendering of Germa terms, and it may be suggested that specialists wou be doing a good service if they accede to the autho request to communicate corrections to him.

The price of the book is perhaps a little high f the average student, and a future edition, it may b suggested, could be shortened without loss b the omission of German terms the English equivalen of which are spelt so similarly as to make the tran lation obvious. Many composite words, too, ha been given though their meaning is so self-explanato as scarcely to call for inclusion in the thesaur Even a reader with the most elementary knowled of both German and geology should be able to dedu for example, through looking up the terms 'basa and 'gang', that 'basaltgang' means 'basalt dike'. In spite of these criticisms, there can be no doubt that this is an extremely useful contribution to geological literature.

The comparative table of the nomenclature of the Lower Palæozoic formations included at the end is incorrect, and, in any event, is unnecessary in a work of this sort.

Mathematics

101 Problems in Drawing-Board Geometry

By Prof. Frederic G. Higbee. Pp. 14+59 plates+26 blank pages. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 8*s*. 6*d*. net.

THERE is no more valuable exercise in clear thinking than the solution of a problem by a graphical method and, by presenting the problem in the form of a partial drawing accompanied by a brief description as Prof. Higbee has done, the value of the exercise is considerably enhanced. After receiving some explanation of the principle to be applied, the student is expected to complete the work in good quality draughtsmanship. He has, therefore, first to visualize the printed data in the few points and lines given, then to formulate a method of applying the principle involved and finally to work out a neat and accurate drawing-board solution. The principles had been demonstrated by the author in an earlier work "Drawing-Board Geometry" and are referred to in the present book, which consists of detachable drawing sheets ready for completion. It offers to the teacher opportunity to develop in his pupils the ability to recognize in the given points and lines the representation by projection of corners and edges of a geometrical figure or of an engineering detail.

Analyse mathématique

A l'usage des candidats au Certificat de mathématiques générales et aux Grandes Ecoles, d'après les Cours professés à l'Ecole centrale des Arts et Manufactures et à la Sorbonne. Par Paul Appell. (Cours de mathématiques générales.) Cinquième édition entièrement refondue par Prof. Georges Valiron. Tome 2: Equations différentielles, développements en séries, nombres complexes, intégrales multiples. Pp. vi+389–694. (Paris: Gauthier-Villars, 1938.) 70 francs.

THIS volume deals with differential equations (ordinary and partial), Taylor's theorem, convergence, Fourier series, complex numbers, double and triple integrals, and the theorems of Green and Stokes. The treatment is much less abstract than in the usual "Cours d'analyse"; worked examples are frequent, and the author uses geometrical arguments whenever they appear simpler than the formal mathematical treatment. There are also references to mechanics and mathematical physics. One of the concluding notes explains the principles of Amsler's and other planimeters, and of the integraph. The style is clear, the printing exceptionally good, and there are many diagrams.

Advanced Mathematics for Engineers

By Prof. H. W. Reddick and Prof. F. H. Miller. Pp. x+473. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 20*s*. net.

AMONG the various text-books which have appeared during recent years and which endeavour to bring advanced mathematical methods within the reach of the engineer this one appears to the reviewer to be of outstanding merit.

The presentation is exceptionally clear and easy to follow, since it indicates always in which direction and for what purpose an argument is being pursued, and the various steps are frequently illustrated by simple well-chosen examples. Not less will the engineering reader value the fact that the authors have shown how these methods work by applying them to a large number of problems covering a wide field of physics and engineering, and that in presenting proofs as well as applications they have considered his limited formal technique.

It is impossible to enumerate all the subjects dealt with. They range from a refresher course in differential equations and infinite series to elliptic gamma and Bessel functions, to the theory of probability, functions of a complex variable and operational calculus.

A. B.

Tables of Addition and Subtraction Logarithms with Six Decimals

By Dr. B. Cohn. Second edition. Pp. viii+68. (London: Scientific Computing Service, Ltd., 1939.) 10*s*.

IF we are given the logarithms of two numbers, to find the logarithm of their sum by the aid of ordinary logarithmic tables, we must use the tables three times and perform one addition. If, however, a table of addition logarithms is available, we have only to use them once and perform one addition and one subtraction. Similarly, we use subtraction logarithms to find the logarithm of a difference. The saving of time is appreciable in spherical trigonometry, as used in navigation and astronomy. Dr. Cohn's tables are clearly printed, and include brief instructions for their use, with numerical examples.

The Nomogram

The Theory and Practical Construction of Computation Charts. By H. J. Allcock and J. Reginald Jones. Second edition. Pp. viii+224. (London: Sir Isaac Pitman and Sons, Ltd., 1938.) 10*s*. 6*d*. net.

THE nomogram is very convenient for representing the values of a function of two or more variables. In its simplest form it consists of three lines (possibly curved), two graduated to represent the values of the variables, and the third to represent those of the function. To use it we have only to place a ruler through the two points representing the variables, and its intersection with the third curve will give the corresponding value of the function. The new edition includes circular and set-square-index nomograms. For the theory, the authors rely upon determinants and Cartesian co-ordinates.

Introduction to the Theory of Equations

By Prof. Louis Weisner. Pp. ix+188. (New York: The Macmillan Company, 1938.) 10*s.* net.

THE distinctive feature of this book is the emphasis on the concept of a field. This serves as a unifying principle connecting the various parts of an elementary course in the theory of equations, including complex numbers, the theorems of Sturm, Budan, and Descartes, elimination, symmetric functions, cubic and quartic equations, but excluding determinants, which are assumed to be known. The fundamental theorem of algebra is treated, rather unusually, by Gordan's method, reducing the theorem to a property of continuous functions which is stated without proof. The final chapter deals with ruler and compass constructions. There are many examples.

Gewöhnliche Differentialgleichungen

Von Prof. Dr. Guido Hoheisel. (Sammlung Göschen, Band 920.) Dritte neubearbeitete Auflage. Pp. 126. (Berlin: Walter de Gruyter und Co., 1938.) 1.62 gold marks.

THIS slender little volume covers much more ground than would be expected from its size. In addition to the usual elementary account of ordinary differential equations of the first and higher orders, including existence theorems, solution by series, and singular points, there is a chapter dealing with boundary value problems. This deals with Green's function, Sturm-Liouville expansions, proper values, and periodic boundary value systems. An appendix discusses the dependence of solutions of a system of differential equations upon a parameter, and upon the initial values of the variables.

Le superficie razionali

Per Fabio Conforto. Pp. xv+554. (Bologna: Nicola Zanichelli, 1939.) 80 lire.

THE present treatise is divided into two parts; the first, which occupies less than half the volume, is devoted to a systematic exposition, from the modern point of view, of the quadric, the cubic surface and the rational quartic surfaces. Here the reader will find a résumé of the classical results due to Cremona, Clebsch, Noether and others, with the various adjustments that critical considerations have necessitated. The second part deals with general theory; beginning with Noether's theorem on surfaces containing a pencil of rational curves, it proceeds to the discussion of surfaces having rational or elliptic sections, and thence to plane involutions and rational double planes. Of the latter important topic, the author gives a detailed account, the first that has ever appeared in book form. The work concludes with a chapter on Castelnuovo's theorem concerning the rationality of plane involutions.

As the author states in his preface, the work is based on lectures given by Prof. Enriques at the University of Rome; and in fact the book bears the hall marks of the collaborations (Enriques-Chisini, Enriques-Campedelli), which have provided the present generation of geometers with its standard text-books. There is the same leisurely exposition, interspersed with interesting historical information and critical notes, and the co-ordination of the material testifies to the master's skill. The work will be a valuable reference-book for every teacher of geometry.

Medicine

Vāgbhaṭa's Aṣṭāṅgahṛdayasaṃhitā

Ein altindisches Lehrbuch der Heilkunde, aus dem Sanskrit ins deutsche Übertragen mit Einleitung, Anmerkungen und Indices. Von Dr. Luise Hilgenberg und Prof. Willibald Kirfel. Lief. 5. Pp. 257–320. Lief. 6. Pp. 321–384. Lief 7. Pp. 385–448. (Leiden: E. J. Brill, Ltd., 1939.) 3.50 guilders each.

THESE three tracts form more instalments of Hilgenberg and Kirfel's scholarly translation from the Sanskrit into German of Vāgbhaṭa's treatise on medicine, the earlier parts of which have been noticed in NATURE.

The first half of Part 5 continues the discussion of the etiology and symptoms of diseases, such as boils and erysipelas, skin diseases including leprosy, abdominal swellings, which it is noted may be due to enlargement of the spleen, and rheumatism. Under rheumatism, the pain, stiffness and lameness, the involvement of the joints and of bone, are all mentioned.

The remainder of Part 5 and Parts 6 and 7 deal with treatment, mostly medicinal. The remedies prescribed are for the most part herbal ones, and have been identified by the translators; mineral remedies scarcely appear, and mixtures containing mice and other unpleasant ingredients, so commonly used in medieval medicine, are the exception. Another part should complete this work.

Modern Anæsthetic Practice

Edited by Sir Humphry Rolleston and Dr. Alan A. Moncrieff. (The Practitioner Handbooks, No. 3.) (Published on behalf of *The Practitioner*.) Pp. 231. (London: Eyre and Spottiswoode (Publishers), Ltd., 1938.) 10*s.* 6*d.* net.

THIS work consists of twelve articles, six of which had previously been published in *The Practitioner* and have since been revised by the authors, while six are new contributions. Every aspect of the subject has been discussed, including volatile anæsthetics, nitrous oxide anæsthesia in surgery, basal anæsthesia, endotracheal anæsthesia, spinal anæsthesia, anæsthesia and analgesia in midwifery, anæsthesia in the child, anæsthesia in dentistry, local anæsthesia and analgesia, the anæsthetic aspects of post-operation care, and the risks of explosion, so that the aim of the book to provide a practical manual for the general practitioner in his daily work has been admirably fulfilled.

Man against Microbe

By Prof. Joseph W. Bigger. Pp. 304+18 plates. (London: English Universities Press, Ltd., 1939.) 7*s.* 6*d.* net.

PROF. BIGGER, who is professor of bacteriology at Trinity College, Dublin, and author of a standard work on the subject, has set out to give educated readers who are not necessarily scientific investigators some idea of the nature of microbes, the methods of their study and their effects. He begins with a fascinating account of the first microbiologist, Antony van Leeuwenhoek, and then discusses the meaning and history of microbiology and the relation of microbiology to mankind, including a lucid description of the work of Koch, Pasteur, Ehrlich, Metchnikoff, Theobald Smith and Bordet among others. The text is liberally interspersed with portraits, illustrations of bacteriological equipment and microphotographs, and a glossary is appended. The work is written in an easy and familiar style, admirably suited for the class of readers for whom it is intended.

Brompton Hospital Reports

A Collection of Papers recently published from the Hospital. Vol. 7, 1938. Pp. iv+207+39 plates. (London: Brompton Hospital, 1939.) 5*s.*

BESIDES the annual medical report of the Hospital, this volume contains twenty articles, of which all but two, describing a method of inducing artificially selected collapse in pneumothorax therapy and an exhaustive account of the cauterization of pleuro-pulmonary lesions, have been published elsewhere. The other articles deal with various aspects of pulmonary tuberculosis, pneumonia and bronchiectasis, artificial pneumothorax, obstruction of the trachea, thoracoscopy and cauterization of adhesives, radiology and the surgery of inflammatory lesions of the lungs, cardiac emergencies and the prevention of minor ailments. The indexes of authors and subjects for vols. 1–7 are included.

Medicine in Modern Society

By David Riesman. Pp. vii+226. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1938.) 11*s.* 6*d.* net.

IN this work, which is based on his Vanuxem lectures delivered at Princeton University, Dr David Riesman, formerly professor of clinical medicine and now occupying the chair of the history of medicine in the University of Pennsylvania, has given the layman a clear and comprehensive account of the progress of medicine in the nineteenth and twentieth centuries and of the various problems which have arisen during that period. The subjects discussed include cancer, medical education, the prevalence of neurosis, superstitions and cults, with special reference to homœopathy, osteopathy and chiropractic, medicine as a career, the family doctor, medical ethics and preventive medicine.

Recent Advances in Forensic Medicine

By Dr. Sydney Smith and Dr. John Glaister. Second edition. Pp. viii+264+16 plates. (London: J. and A. Churchill, Ltd., 1939.) 15*s.*

THE principal subjects discussed in this well-known work, which should prove indispensable alike to medical jurists and barristers, are the diagnosis of injuries from projectiles, the identification of firearms, the examination of powders and the products of their production, the medico-legal application of the precipitin and other tests based on the action of precipitins and the individuality of the blood. The chief additions to the new edition, which contains seventy more pages and nineteen more figures than the last, are the incorporation of recent work on blood grouping, a chapter on the cuticular scales of hair by Prof. Alan R. Moritz of Harvard University, enlargement of the chapter on spectroscopy in medico-legal work, important additions to the chapter on alcohol in the blood, including an account of Widmark's method, and a note on larval infestation and putrefaction by Dr. A. G. Mearns.

Miscellany

If War Comes (an Essay on India's Military Problems)

By B. P. Adarkar. Pp. 41+xxxii+306+19 plates. (Allahabad: The Indian Press, Ltd., 1939.) 2.8 rupees.

THE central theme of this essay on problems of defence in India from the Indian point of view is that India's only hope of safety lies in full partnership and co-operation with Great Britain. The author argues that Indian and British interests are essentially the same in a world war, and that for India to remain outside, even if allowed, might merely result in her falling under a fresh foreign dominion. If, however, India needs Great Britain's help in defence he urges that Great Britain needs the help which India's man-power and natural resources could contribute. The effect of the rapidly changed conditions of modern warfare upon the individual problems of the defence of India is discussed, and Prof. Adarkar in a series of chapters urges the planning of Indian defence to ensure the most effective co-operation between Indian and non-Indian on terms of mutual respect, the efficient utilization of Indian resources and the stimulation of industry, trade and transport in India on lines designed to render her less vulnerable and more self-supporting or independent in the event of hostilities.

If his book is intended to bring home to his countrymen the reality of their danger it equally makes an appeal to Great Britain for yet more generous treatment the sincerity of which cannot be doubted. The community of interest between Great Britain and India offers an opportunity of developing yet further the spirit of national service, good will and co-operation which may overcome the difficulties in the way of full self-government whether from Hindu-Moslem jealousies, the problem of the Native States or embedded prejudices of the Services.

Gems and Gem Materials

By Prof. Edward Henry Kraus and Prof. Chester Baker Slawson. Third edition. Pp. xiii+287+4 plates. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 21*s*.

"KRAUS and Holden" has now become "Kraus and Slawson", as Prof. Kraus has been assisted in the preparation of this third edition of the book by Dr. Slawson, Dr. Holden having unfortunately died before the publication of even the first (1925) edition.

The features which have formerly made the book so popular have been still further strengthened, and there are twenty-seven additional pages and nineteen more illustrations in the text. The most immediately obvious improvement is the incorporation of four fine coloured plates of gem-stones, which originally appeared in Eppler's "Edelsteine und Schmucksteine". The chapters on cutting and polishing and on synthetic stones have been expanded and are now exceptionally good, and a short but useful chapter has been added on the metals used in jewellery.

Most of the small inaccuracies which were found in previous editions have now been corrected, but some still remain; notably in the diagram of absorption spectra and in the density figures given for synthetic and natural spinels. In the figures given throughout the book for specific gravity and refractive index the authors favour the broad values of the mineralogist rather than the more exact values which are often of diagnostic importance to the gemmologist.

Thanks to the clarity of the writing, the wide range covered by the book, and its many illustrations, "Gems and Gem Materials" is one of the most attractive texts on the subject that has yet appeared. It is a pity that so liberal a use of illustrations must inevitably entail a price which the needy jeweller's assistant will find it difficult to afford. B. W. A.

Evidence of Identity

By Kenneth Richmond. (Psychical Experiences Series.) Pp. viii+112. (London: G. Bell and Sons, Ltd., 1939.) 3*s*. 6*d*. net.

THIS is another of the short text-books on psychical research which have been recently issued to supply a demand for material of better quality than that usually provided by the majority of writers on spiritualism. The examples selected are mainly based upon cases collected and examined by the Society for Psychical Research, and thus their evidential value is somewhat enhanced.

In the present volume, Mr. Richmond is concerned with the question of identity, not so much from the point of view of the survival of personality after death as from that of the problem of the means by which any kind of identity can be established when considered in relation to mediumistic communications. In the course of his discussion, the author makes no attempt to minimize the difficulties involved; and his treatment will go some way to curb the enthusiasm of the uncritical believer and the seeker after miracles.

Apart from the fact that Mr. Richmond seems to lay a somewhat undue stress upon the rather dubious evidence supplied by the well-known American "Livre des Revenants", this little book is a good example of the work undertaken by the more sober among psychical researchers, and the author is to be congratulated upon the general level of criticism that he maintains throughout. A short glossary of terms most commonly used is appended, but there is no index.

Guide to Business Management Books

By G. E. Milward. Seventh edition. Pp. xiv+124. (London: Management Library, 1939.) 5*s*.

THE seventh edition of the *Guide to Business Management Books*, 1939, has been issued in cloth binding. It includes all notable books published during the six years up to and including November 1938. The Guide is arranged on the same lines as previous editions and the more outstanding books of 1938 are listed separately in the preface. The courses of reading printed in the Guide have again been expanded and are particularly adapted for staff training, although the biographical section might well be developed further, and include special studies which illustrate merits or defects of management in practice. A serious defect which should be rectified in subsequent editions is the absence of any dates of the editions of the works included.

The Subject Index to Periodicals, 1938

Pp. xxix+544. (London: The Library Association, 1939.) 70*s*.

THIS index, issued by the Library Association, is arranged under subject headings in alphabetical order, chosen from the alphabetical subject headings in the Library of Congress, U.S.A., with modifications and additions to suit British practice. With some important exceptions, periodicals covered by the *Agricultural Index*, *Engineering Abstracts*, *Engineering Index*, *Index Medicus*, *Journal of the Society of Dyers and Colourists*, *Photographic Abstracts*, *Science Abstracts*, *Journal of the Textile Institute*, *Royal Meteorological Society Bibliography* and the *Revue de Géologie, Minéralogie et Crystallographie* are not included. The location list first published in the 1937 volume has been retained and gives valuable information regarding the periodical holdings of more than a hundred and seventy of the national, municipal and institutional libraries in the United Kingdom. The locations are tabulated in seven columns, each covering a large area of the country, but the inclusion of a library in the location list implies no guarantee that it is prepared to issue periodicals to outside borrowers. Brief annotations are given where the titles do not sufficiently indicate the subjects of articles, but verse and fiction are not included. Under each heading, articles are arranged alphabetically by authors' names.

Iceland Papers, Vol. I

Scientific Results of Cambridge Expeditions to Iceland, 1932–38. Pp. vii+17 papers. (London: Oxford University Press, 1939.) 21*s.* net.

THERE is no better training for young men than to send them away from their families and teachers, giving them jobs that they feel to be incursions into the unknown. Such was the idea of the geographers of Oxford and Cambridge, but they found themselves restricted by university terms to the summers. Work in North Africa and to the South could be carried on at any season, but only in summer could the north be attacked. In consequence, we see year by year parties from Oxford going to Spitzbergen and from Cambridge to Iceland, while both universities, often using more experienced seniors, visit Greenland.

Geography includes nearly all science, and nothing comes amiss. In no section can much be accomplished in one northern season, and the torch is passed on from one party to another and so knowledge accumulates. In a series of separata, bound up together, we have the results of twelve Iceland visits from 1932 to 1938, usually two or three men together. They comprise five devoted to physical geography, six to birds, four oddments concerning spiders, worms, Collembola and freshwater algæ, and two stronger accounts of the Central Desert and of Grimsey Islet, necessarily on botanical lines.

We wish success to these ventures, and we approve of Iceland, for great profit may be foreseen in similar summer expeditions for several decades.

L'Année psychologique

Fondateurs: Henry Beaunis et Alfred Binet. Publiée par Prof. Henri Piéron. (Bibliothèque de philosophie contemporaine.) Année 37 (1936). Tome 1. Pp. xxiii +448. Tome 2. Pp. 449–844. (Paris: Félix Alcan, 1937.) 150 francs.

THIS yearly publication is always eagerly expected by psychologists, for it gives an accurate account of the research made in the various fields of psychology during the year. Reviews of books and of special articles are listed according to their subject; and the principal points in them are clearly explained. A series of specialized contributions add to the interest of this survey. In this issue might be mentioned those of Geblewicz and Shen (Rôle du temps dans la perception de la profondeur), of H. Piéron (Types d'intelligence), and of Fauville, Dewyn and Ellis (Aptitudes motrices et aptitudes perceptives).

T. G.

Urmass und Schöpfung

Neuentdeckte Gesetzlichkeiten. Von Ernst P. v. Schoen-Wildenegg. Pp. viii+235. (Berlin: G. Schoenfeld's Verlagsbuchhandlung, 1938.)

THE author investigates the origin of our system of numbers on the basis of biological facts. He attempts to prove the dominating existence of the geometrical progression in living beings as well as in celestial phenomena. Investigating and confirming some well-known facts, such as the distribution of the planets, he derives a number of empirical relations between the bodies of the solar system. Apart from this section of the book, which bears quite a personal note, the book as a whole is quite stimulating to read for all those interested in the physical and biological foundation of our past and present concept of measurement and number.

Animal and Bird Painting

The Outlook and Technique of the Artist. By Charles Simpson. Pp. viii+136+68 plates. (London: B. T. Batsford, Ltd., 1939.) 10*s.* 6*d.* net.

AN eminently readable book. The domain of animal painting has been little invaded by the 'wild men' of modern art, who would possibly be annoyed by the author's insistence on sincere observation, not only of animal structure and movement, but also of the landscape environment. Different classes of animals are treated in some detail, with short accounts of their origin and varieties. The student of animal painting will find help in the author's references to the particular snags and difficulties in the matter, and in his very practical advice on the method of catching and memorizing a special aspect of a moving subject. Considerable attention is given to the correct sequence of movements in walking and running animals. The influence of light in eliminating detail must not prevent close representation of essential form and solidity. Many paintings of animals should be called studies merely, in that the extreme details of anatomy are allowed to obscure the values in the picture as a whole.

The book is well and copiously illustrated by black-and-white reproductions of the works of old and modern masters of animal painting.

Physics

Physics for Technical Students

Sound, Electricity and Magnetism, Light. By Prof. W. B. Anderson. Third edition. Pp. x+361–796. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 15*s.*

THE stumbling block for many advanced technical students is inadequacy of training in fundamental physics. Physics is undoubtedly a subject in which, to the physicist, there can be no compromise; for the man who is to become one of a number of kinds of engineer and not a physicist, there is much to be gained by selecting those aspects of physics which are likely to be of greater use to him than other aspects. What these aspects are experience must tell; technology is daily becoming more scientific and an adequate syllabus must be continuously brought up to date.

The present text-book is along the right lines, but may not be entirely suitable for English engineering students. One thing that might have been done to improve its detail would have been the collaboration of a scientifically trained engineer, who would have introduced a greater conformity with the language of technology, so that the ideas may be more easily grasped by a technical student. Nevertheless, the author's work is very suggestive in forming fundamental treatments of physical phenomena for students specializing in applied science rather than in science itself.

L. E. C. H.

Motion Picture Sound Engineering

A Series of Lectures presented to the Classes enrolled in the Courses in Sound Engineering given by the Research Council of the Academy of Motion Picture Arts and Sciences, Hollywood, California. Pp. xviii + 547. (London: Chapman and Hall, Ltd., 1938.) 30*s.* net.

THIS text is the successor to "Recording Sound for Motion Pictures", compiled by some twenty authors and edited by Lester Cowan. In the distant days of 1931, the pioneer technicians of a new industry, that of adding sound to scene, had a great deal of what was new to say; their effort in print was by no means perfect, but it gave the impression of vitality and freshness. In the present publication we do not get a complete view either of the industry or of studio technique. The latter has changed extensively in the last decade, but we cannot judge what in the older book is now obsolete and what is now of primary importance. That is not to say that the first 175 pages are not valuable. They deal lucidly with technical solutions of many difficult practical problems which confront the recording engineer.

In a highly competitive industry, research has in recent years been on a co-operative basis, directed by the Research Council of the Academy of Motion Picture Arts and Sciences, which, through committees of experts, has sorted out the problems and used the best resources of the industry; the description of the results obtained gives an air of finality to the attainable criteria prevailing at the present time and that there is not much more to be done until there is another upheaval in the industry, such as the adoption of stereophony.

From the general acoustic point of view, great importance must be attached to the specification and realization of a standard of radiated sound reproduction, against which commercial systems can be compared and assessed in respect to their defects. The radiating system comprises two parts, one a cellular horn covering the range 300 c.p.s., to 10,000 c.p.s., driven by a phase-adjusted duralumin diaphragm, the other a set of large cone diaphragms operating through a horn terminated with a large baffle. The response results in a fluctuation within two decibels over the range 50 to 8,000 c.p.s., over a horizontal angle of nearly 110 degrees and a vertical angle of 60 degrees, with a maximum electro-acoustic efficiency approaching 50 per cent. The amplitude distortion and flutter specified in the reproducing machine and radiator set new standards for sound reproduction. The new types of push-pull recording on film, the control of the noise-level, microphones, and the new types of photo-electric cell which are required to reproduce the push-pull sound-tracks are very well treated. Film processing is rather less well done than before.

The remaining three hundred pages do not carry the subject much further, because attention is diverted to details of electrical circuits, such as transformers and filters and elementary circuit theory, which appear to have been included solely because they happened to fall into a series of lectures to film technicians as a part of their education. The only part which is not done better elsewhere by specialists is the section on properly designed equalizers; the dividing networks are new, and have been forced into reproducing circuits by the necessity of operating loudspeaking receivers in series or parallel without overloading them with currents of frequencies for which they are not intended to have appreciable response. One concludes that there is good material in the present text, but it has been made expensive by the inclusion of much extraneous elementary matter.

L. E. C. HUGHES.

Textbook of Heat

By Dr. R. Wallace Stewart and Dr. John Satterly. Revised by C. T. Archer. Second edition. Pp. vii + 410. (London: University Tutorial Press, Ltd., 1939.) 7*s.* 6*d.*

THIS is a book on the theory of heat written for students of the standard of the intermediate university examinations. It appears to fulfil its function admirably, and should afford an excellent introduction to the more advanced works on thermodynamics. There is no great originality of treatment, but all the usual branches of heat are dealt with in an adequate manner. The type used is clear, and the text is well illustrated by more than two hundred bold diagrams. The large selection of questions taken from recent examination papers of the University of London should prove useful to students.

Ions, Electrons and Ionizing Radiations

By Prof. J. A. Crowther. Seventh edition. Pp. xii + 348 + 7 plates. (London: Edward Arnold and Co., 1938.) 12*s.* 6*d.* net.

THE seventh edition of this well-known book is to be welcomed, for in it the author has been enabled to give an account of some of the more recent developments of the rapidly changing subject of atomic physics. Experiments on the structure and disintegration of the nucleus are described, including those made by means of the cyclotron, and there is also a discussion of the production of the artificial radio-elements such as radio-sodium and radio-phosphorus. The section on cosmic radiation has also been rewritten and enlarged. Prof. Crowther possesses the gift of lucid explanation, and it suffices to say that the additions now made reach the same high standard as the remainder of the work.

30: Mars on September 23. Mars, Jupiter and Saturn are the triad of evening stars. Mars, post-opposition, decreases from mag. − 1·8 to mag. − 1·1. Jupiter is in opposition on September 27 and reaches its greatest brightness (mag. − 2·5). Close groupings of Jupiter's four inner satellites are seen at 0h. 15m. on September 5 (satellite II in eclipse), 6, 13, 23, and 30. The ring system of Saturn has now reached its most open phase for this year. The variable star, Algol, is well placed for observation all night. The Pleiades rise in he late evenings "like a swarm of fireflies tangled n a silver braid". The chief interest, however, on clear moonless nights in autumn is the region of the Milky Way. Apart from its remarkable structure—star clouds, dark rifts and "coal sacks", and gaseous nebulæ, the galactic plane is also the preferential region for classes of stars of peculiar interest, novæ Cepheid variables and O-type stars. In the direction of the rich fields of Sagittarius lies the centre of our stellar system more than 30,000 light years away and obscured from sight by absorbing tracts of cosmic dust and of gas. Tracing a path slightly inclined to he Milky Way is a belt of bright stars that includes he brightest stars in Orion, Taurus, Cassiopeia, Cygnus and Lyra. These stars and others of the brighter *B*-type and *A*-type are representatives of a relatively small local cluster that is some 2,000 light years in diameter and contains the solar system. The average star density of the Milky Way fields is about 40,000 stars per square degree; towards the poles of the galaxy the density falls to about 1,200 stars. The 100-inch telescope at the Mount Wilson Observatory has recorded with exposures of 200 minutes on fields at the north galactic pole as many recognizable nebulæ per unit area of the sky as stars! These emote stellar systems are exemplified by the great Andromeda Nebula visible to the unaided eye as a hazy patch near the star ν Andromedæ.

Announcements

AT the first meeting of the Council of the newly formed Gas Research Board of the gas industry, it was announced that the first president of the Board would be Sir David Milne-Watson. The appointment f the secretary of the Institution of Gas Engineers s the first secretary of the Board was confirmed.

THE Médical Research Council has appointed Dr. Donald Hunter, physician to the London Hospital, and Mr. Harold E. Clay, national secretary of the Passenger Services Group, Transport and General Workers' Union, to be members of the Industrial Health Research Board, in succession to Prof. J. A. Dixon and Mr. R. Coppock.

THE College of Physicians of Philadelphia has warded the Alvarenga Prize to Dr. Harry Goldblatt, rofessor of experimental pathology and associate irector of the Institute of Pathology, Western Reserve University, Cleveland, Ohio, for his outstanding contributions to the pathogenesis of hypertension.

A REPRESENTATIVE body of members of the Institution of Civil Engineers is sailing from Liverpool on August 26 to participate, at the invitation of the American Society of Civil Engineers, in a British-American Engineering Congress opening in New York on September 4, and to visit the World's Fair and various places of engineering interest. The party numbers about a hundred, coming not only from Great Britain but also from India, Australia, South Africa, Nigeria, Iran and Palestine, under the leadership of Mr. W. J. E. Binnie, president of the Institution. It is thirty-five years ago since an official visit to America was made by members of the Institution.

THE fifty-second annual conference of the Sanitary Inspectors' Association will be held at Bournemouth on September 4–9 under the presidency of Mr. J. C. Dawes. Further information can be obtained from the secretary, 18 Grosvenor Place, London, S.W.1.

THE American Association of Biophysics and Cosmobiology is organizing an international congress of biophysics, biocosmics and biocracy to be held in New York on September 11–17 with Prof. D. Arsonval, Branly, Langevin and Tchijeskvy as honorary presidents. Further information can be obtained from the general secretary, 39 rue Scheffer, Paris 16^{e}.

THE seventh Congress of the French Society of Phoniatrics will be held on October 17 at the Paris Faculty of Medicine when Dr. Pichon and Mme. Borel-Maisonny will read a paper on aphasia and psychogenic disorders of speech. Further information can be obtained from the general secretary, Dr. Tarneaud, 27 avenue de la Grande-armée, Paris 16^{e}.

A EUROPEAN Conference on Rural Life will be held under the auspices of the League of Nations in Geneva during October 16–31. The Conference will be devoted to the well-being and solidarity of European rural life. Preliminary information, national monographs and technical documentation are being published in this connexion by Messrs. Allen and Unwin, 40 Museum Street, London, W.C.1. Further information can be obtained from the Secretary, League of Nations, 16 Northumberland Avenue, London, W.C.2.

A QUARTERLY review of philosophical books and periodicals in the form of brief excerpts and synopses will make its appearance in the early part of October of this year under the title *Philosophic Abstracts*. The intention is not only to present English-speaking philosophy departments with a bibliography of essential philosophical literature, but also to give them an opportunity of keeping abreast with the principal philosophical theories as presented by their respective authors. The editorial offices are at 884 Riverside Drive, New York, N.Y.

DR. HERBERT H. BROWN, one of the signatories of the letter entitled "Sponge Mortality in the Bahamas" which appeared in NATURE of May 13, p. 807, has written pointing out that his name is incorrectly printed as "Hubert H. Brown" at the end of the letter.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 384.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Role of Dietary Choline in Neurohumour Production

THE lipotropic action of choline[1] and the role of choline in the formation of acetylcholine have not hitherto been studied in the same experimental animals. It seems reasonable to suppose, however, that, in addition to the production of the familiar fatty liver, lack of dietary choline might result in deficient formation of the neurohumour, acetylcholine. The findings in preliminary experiments[2] suggested that this is indeed the case.

The present experiments were designed to test the hypothesis that a diet poor in choline results in a low level of vagus activity and that this in turn is due to deficient formation of acetylcholine at the nerve endings. Rats were used as experimental animals, and were kept on the various diets for at least nine weeks. Vagus activity was evaluated by observing the slowing of the heart brought about by electrical stimulation (twelve impulses per second at maximal strength) of the distal cut end of the left vagus nerve. The resting heart-rate in rats (170–250 gm.) under urethane anæsthesia on a normal diet is from 300 to 500 beats per minute. The heart rate of animals on a low-choline diet or of those receiving the same ration with added choline fell within these limits. In one series of animals vagus stimulation reduced the heart-rate to approximately 30 per cent of the normal value in rats on a normal diet, to 45 per cent in rats on a low-choline-plus-choline diet and to 75 per cent in the animals on a low-choline diet. In other series many of the rats on the low-choline diet showed a normal vagus effect but others, as seen consistently in the small series cited above, showed very little change in heart rate on vagus stimulation. The most suggestive finding of this investigation is that, in animals on a low-choline diet showing little effect of vagus stimulation, the intravenous administration of choline (0·5 c.c. of 2 per cent choline chloride) increased this effect. This phenomenon was never seen in rats on a normal or low-choline-plus-choline diet.

We conclude that deficient vagus function may be linked with a low intake of dietary choline and this may, in part at least, be rectified by injected choline. It is therefore reasonable to suggest that choline deficiency may result in deficient formation of acetylcholine at the nerve endings. This and other possibilities are to be tested further in subsequent experiments in which it is hoped that dietary conditions producing an even more drastic deficiency of choline may be utilized.

D. Y. SOLANDT.
C. H. BEST.

Departments of Physiology and
Physiological Hygiene,
University, Toronto.
July 29.

---

[1] Best, C. H., and Ridout, J. H., *Ann. Rev. Biochem.*, 8, 349 (1939).

[2] Solandt, D. Y., *Canad. Chem. and Process Indus.*, 23, 230 (1939).

Effect of Lipoid Solvents on Vaccinia Virus

THE elementary bodies of the dermal strain o vaccinia virus can be obtained readily from the skir of the infected rabbit's back in suspensions showin a high degree of physical and immunological homogeneity; the virus contains protein, carbohydrat and ether-soluble lipoid material[1]. We find that after drying and extraction with benzene or ether the dry density is increased from 1·26 to 1·31 and i is possible to redisperse the virus residue by mechanica grinding in buffer solution. The appearance by darkground examination and the sedimentation constan of the resuspended virus particles are unchanged, anc the boundary inhomogeneity is slightly reduced. Th infectivity of the virus is unaltered by this treatmen and it is therefore probable that the lipoid materia extracted with ether (consisting largely of cholestero and acetone-soluble fat) is derived from the host anc adsorbed on the virus.

The ether-extracted virus still contains 9 per cen of lipoid material, containing some 2 per cent phosphorus, which can be extracted only with alcohol o alcohol-ether mixtures. The virus residue after treatment with alcohol has almost entirely lost its infectivity, but it is impossible to say whether this i due to the removal of the lipoid material or to th concomitant effect of alcohol on the virus protein The virus residue now has a density of 1·36 and suspensions give completely inhomogeneous boundarie in the centrifuge. It contains 15·5 per cent nitroge and 0·7 per cent phosphorus. Colorimetric carbohydrate estimations (total carbohydrate[2], orcinol-HC pentose test and Feulgen reaction) indicate th presence of approximately 3 per cent thymonuclei acid and 4 per cent carbohydrate; tests for glucosamine after acid-hydrolysis were positive.

Washing the virus repeatedly with water or dilut buffer, which is known to result in the liberation o specifically precipitable protein[3], was found to remov nitrogen, phosphorus and carbohydrate but no nuclei acid. If the ether-extracted virus is treated with 1 pe cent sodium carbonate at 20°, practically all th nucleic acid and 40 per cent of the carbohydrate pas into solution in 1–2 hours. This effect is followed by gradual disintegration of the residue into particle of widely different sizes, some only slightly smalle than the original.

Though in its chemical and immunological complexity vaccinia virus approaches more nearly to th bacteria than to the plant viruses, there appears t us to be little evidence that the substance of the viru is held within a cell membrane. The evidence whic has been given[4] of osmotic swelling (derived indirectl from measurements of sedimentation rates in medi of different density) is open to serious objections and such swelling can be observed in protein gel There is no evidence of selective ion permeabilit nd the resistance of the virus particle to attempts t mechanical disruption, to drying and to the action f ether militates against the idea of a fluid cytoplasm onstrained within a membrane. The piecemeal disntegration of the virus particle in sodium carbonate olution suggests to us that the virus has a gel-like bility to preserve its form, in which the nucleic acid nd perhaps also the bound lipoid present play an ssential part. The analogy with a protein gel is ot altogether satisfactory however since, although here is evidence[5] that much water is associated with he virus, the mechanical properties and the intense ight scattering suggest that this water belongs mainly o an ion atmosphere and not to the central particle.

This work has been carried out in collaboration vith Dr. C. R. Amies and Dr. G. H. Eagles; a full eport will be made later.

A. S. McFarlane.
M. G. Macfarlane.

Lister Institute,
London, S.W.1.
July 26.

Hughes, T. P., Parker, R. F., and Rivers, T. M., *J. Exp. Med.*, 62, 349 (1935).
Pirie, N. W., *Brit. J. Exp. Path.*, 17, 269 (1936).
Craigie, J., and Wishart, F. O., *J. Exp. Med.*, 64, 803 (1936)
Smadel, J. E., Pickels, E. G., and Shedlovski, T., *J. Exp. Med.*, 68, 607 (1938).
McFarlane, A. S., *Proc. Roy. Soc.*, B, 126, 301 (1938).

Effect of Ultrasonic Vibration on Vaccinia Virus

Earlier experiments by Hopwood and Gordon[1] howed that calf lymph vaccine virus retained its nfectivity after subjection to ultrasonic vibrations c. 500 kilocycles/sec.) and even appeared to have an ncreased infective titre. The increase was attributed o disengagement of virus from particles of inert naterial in the crude lymph. Rivers *et al.*[2] found hat sonic vibrations of considerably lower frequency 8,900 per second) applied for 15 minutes to purified uspensions of vaccinial elementary bodies resulted n a detectable reduction in their infectivity, and oted that adventitious substances, particularly proein, protected the virus from inactivation.

Using washed vaccinial elementary bodies of a abbit dermal strain, in every way comparable to ivers' preparations, we have dried the virus from he frozen state, extracted the 'adventitious' lipoid[3] ith benzene, and redispersed the elementary bodies ompletely with ultrasonic vibration, without loss of nfectivity.

The washed, dried and benzene-extracted virus as irradiated at 550 kilocycles/sec. in a thin-walled lass tube containing dilute phosphate buffer. Three uccessive exposures lasting 1¼ minutes were given, nd, by cooling the tube in ice between the exposures, he temperature was kept below 20° C. throughout. he milky suspension was centrifuged for 15 minutes t 3,000 rev. per minute, whereby about a third of he virus was deposited. The deposit was again radiated and centrifuged; after two or three epetitions of this treatment, more than 95 per cent f the original dry virus was found to have been ispersed. Intracutaneous inoculations in the rabbit howed no significant difference between the titres f the original undried virus and that of the virus ried, benzene-extracted, and resuspended, either by ltrasonic vibration or by grinding[3]. The microscopic ppearance of stained specimens, and of unstained specimens by dark-ground illumination, the sedimentation rate, and boundary homogeneity, were also unaffected by the ultrasonic treatment.

F. L. Hopwood.
M. H. Salaman.

St. Bartholomew's Hospital,
London, E.C.4.

A. S. McFarlane.

Lister Institute,
London, S.W.1.
July 29.

---

[1] Hopwood, F. L., *J. Sci. Inst.*, 6, No. 2, 30 (1929).
[2] Rivers, T. M., Smadel, T. F., and Chambers, L. A., *J. Exp. Med.* 65, 67 (1937).
[3] McFarlane, A. S., and Macfarlane, M.G., see preceding letter.

A Benzpyrene Tumour Strain in Hamsters with Tendency to Metastasis Formation

Experiments on the hamster with carcinogenic substances have so far been described only in a short communication by Gye and Foulds[1]. Our experiments were made with the view of demonstrating whether the tumours caused in the hamster by carcinogenic substances show any peculiarities with regard to formation and course. 40 hamsters (*Cricetus auratus*) were given subcutaneous injections of 0·25 c.c. of a 1 per cent solution of benzpyrene Meurice. 93 per cent of the animals developed tumours after a latent period of three months on the average. Histologically they were polymorph cell sarcomata.

Whereas we never observed metastases in rats with primary or transplanted benzpyrene tumours, we found these in a hamster tumour strain which we have been passaging since February 1938. The special features of this metastasis formation are: (1) the extraordinarily large number of animals which developed metastases; (2) the preference of metastases for lymph glands; (3) their spread through the greater part of the body. Of 54 hamsters sectioned, 39 (72 per cent) showed metastases. All the animals had metastases in the lymph glands. One animal had in addition a metastasis in one kidney. The process involved the axillary, groin and mediastinal glands and a chain of glands in front of the lumbar spine down to the pelvis. Mostly several glands are affected, but in many cases all the glands in the above-mentioned regions are involved. The axillary region and mediastinum showed the largest tumours. We are here, therefore, dealing with a dissemination resembling a systemic disease.

Splenectomy or complete irradiation of the whole body with X-rays does not noticeably increase the percentage of animals with metastases. In some cases it is possible to transmit tumours by the subcutaneous injection of blood from hamsters with metastases.

The spread of the tumours in our hamsters resembles the changes in the lymph glands of tumour-bearing mice described by Parsons[2]. This worker assumes that because transmission is effected through filtered cell-free material, dissemination is caused by a filterable agent. We have not yet completed transmission experiments with filtrates. But we have deprived gland material of cells capable of multiplication by means of X-rays by the method employed by Doljanski and Halberstaedter[3] in Rous sarcoma. Attempts at transmission with such material have so far been negative.

While it is not usual to find metastases in rats with primary benzpyrene tumours, Oberling and M. and P. Guérin[4] have succeeded in obtaining them by injecting very large quantities of benzpyrene. Injection of 75 mgm. of benzpyrene will cause metastases in 50 per cent of rats. Oberling and Guérin consider that this is due either to the fact that large doses of benzpyrene lower the resistance of the organs, or that the tumour cells produced by large doses are more aggressive and proliferative.

In our cases, the animals showing metastases did not come into contact with benzpyrene. It must be assumed that both the tendency to metastasis formation and the organ affinity in our tumour strain is based upon a peculiar property of the tumour cells themselves.

L. Halberstaedter.

Department of Radiobiology,
Cancer Laboratories,
The Hebrew University,
Jerusalem.
June 30.

[1] *Amer. J. Canc.*, 35, 106 (1939).
[2] *J. Path. Bact.*, 47, 501 (1938)
[3] Nature, 143, 228 (1939).
[4] *Bull. Assoc. franç. Etude Canc*, 28, 198 (1939).

Lethal Action of Alpha-Rays on Sea-Urchin Eggs

When unfertilized eggs of sea-urchin, *Pseudocentrotus depressus* (A. Agassiz), are inseminated immediately after the irradiation with gamma- or beta-rays of radium, the time of their first cleavage is prolonged roughly in proportion to doses[1]. This phenomenon has the same tendency to that already reported by Henshaw[2] and others, who used roentgen rays and ultra-violet light. Recently, we have studied the effect of alpha-ray irradiation and obtained quite different results.

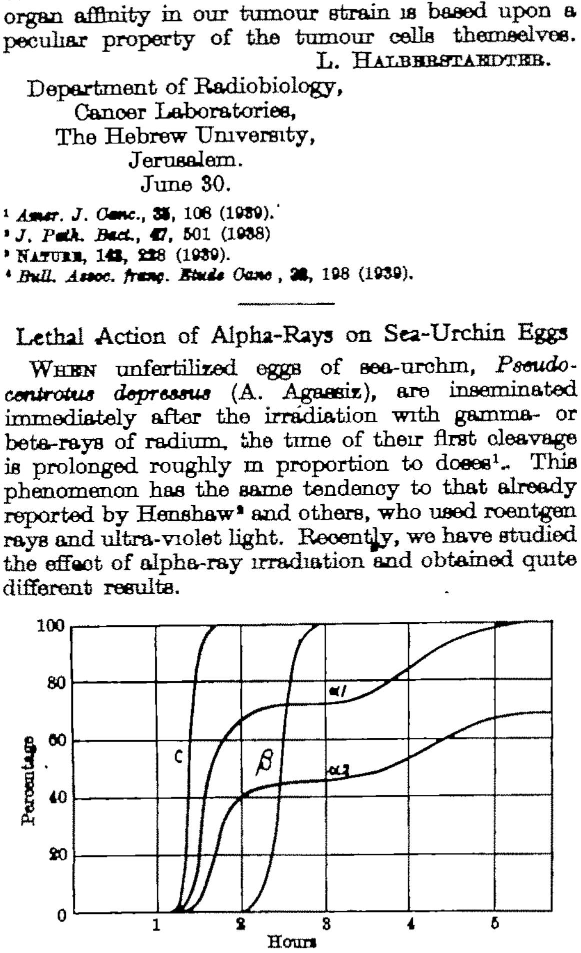


Fig. 1.

Curves showing the percentage increase of eggs in two-cell stage after insemination.

c: control; β: irradiated with beta-rays (30,000 r in one hour); a_1 and a_2 irradiated with alpha-rays (48 mc.-sec. in 10 seconds and 145 mc.-sec. in 1 minute).

The following experiment was made on the eggs of sea-urchin, *Strongylocentrotus purcherrimus* (A. Agassiz). Eggs were carefully placed in a single layer in a small dish, 7 mm. in diameter with a thin bottom of collodion film, less than 1 μ in thickness. Unde the dish a piece of glass with radium C′ was placed a the distance of 5 mm. As the range of alpha-ray of radium C′ in water is 60 μ, taking into considera tion the absorption of the air and the specific gravit of eggs, the alpha-rays are estimated to penetrat into the eggs as far as 51 μ. The diameter of the egg is about 90 μ. In every experiment the intensity o radium C′ activity was measured by electromete and the dose is expressed by millicurie-second, con sidering the decay of radium C′.

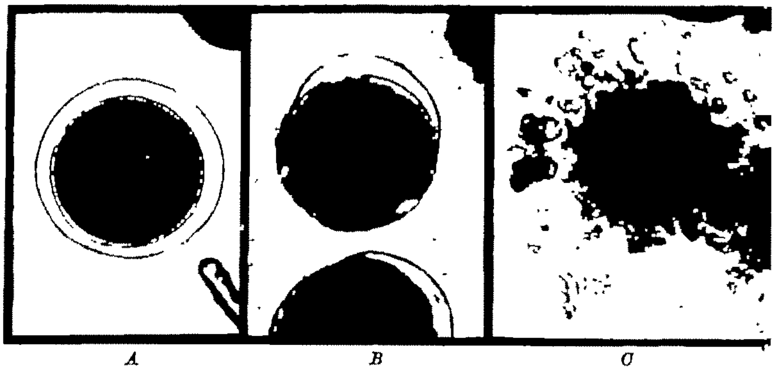


Fig 2.

Microscopic appearance of non-irradiated (A) and irradiated eggs in early (B) and complete (C) disintegration.

Fig. 1 indicates the increase of the percentage o eggs in two-cell stage produced by first cleavage wit the lapse of time after insemination. Curve C show control, curve β a case of beta-ray irradiation, an curve α_1 and α_2 two cases of alpha-ray irradiatio The eggs irradiated by beta-rays (curve β) take som time to begin cleavage and their cleavage goes o slowly, but the tendency resembles control. Smal doses of alpha-rays produce no effect on the cleavag time. Even after larger doses of alpha-rays (curve α_1 the beginning time of the cleavage is almost the sam as in control. (A very little prolongation shown i considered as the effects of beta-rays accompanied b alpha-rays.) Moreover, in this case the cleavag proceeds very fast at the beginning, but seems t stop when a certain percentage of cleavage is reache while after several hours it goes on very slowly agai Thus in the case of alpha-ray irradiation, some egg take the ordinary course of cleavage, while in othe the cleavage is delayed. With the increasing dose of alpha-rays, fewer cases of the ordinary cleavag are observed (curve α_2), and some eggs stop cleavag absolutely. Even the eggs producing fertilizatio membrane by insemination with normal sperm sto cleavage, and from about one hour after the irradia tion they gradually disintegrate, as is shown in Fig. This disintegration phenomenon can be seen in th same way in unfertilized eggs. This is death cause directly by alpha-rays.

We are indebted to Prof. M. Nagayo, Dr. B Yamakawa and Dr. W. Nakahara for their kin advice and encouragement.

Mituo Miwa.
Hisao Yamashita.
Kazuo Mori.

Radiological and Pathological
Divisions of the Japanese Foundation
for Cancer Research, Tokyo.
May 24.

[1] Miwa, Yamashita and Mori, *Gann*, 33, 1 (1939).
[2] Henshaw, P S, *Amer. J. Roent.*, 27, 890 (1932).

Amino-Acids and Rooting of Cuttings

THE work of Went and co-workers and that of Zimmerman and his associates has amply demonstrated the value of the so-called 'root-forming' hormones. Went, Bonner and Warner[1] have shown that in certain cases vitamin B_1 treatment of hormone-treated cuttings has resulted in a great increase in the rapidity of rooting and in the number of roots produced. I have confirmed this finding in the case of one species, namely, *Camellia*, used by these workers, but it is apparent that the treatment with vitamin B_1 (aneurin) must be given at the appropriate time after hormone treatment. This period after hormone treatment is difficult to determine. In some instances response has been rapid and at other times no response to vitamin B_1 has been obtained, but the same cuttings may respond to later treatment.

White[2] has shown that certain amino-acids are essential for the growth of excised tomato roots. The amino-acids found necessary were: glutamic acid, lysine, histidine, phenylalanine, leucine, isoleucine, valine, serine and proline. Went and co-workers, referring to "essential amino-acids" in the paper[1] referred to above, predicted that "cuttings may be found in which root development is limited by these substances".

In the course of my experiments, a mixture of the above-mentioned amino-acids was used to treat cuttings which had just been treated with α-naphthalene acetic acid at a concentration of 1 part in 20,000 of water. The cuttings used were *Rhododendron Maddeni* var. *Jenkinsii*. Two concentrations of the amino-acid mixture were used. Solution I was made up to contain approximately the concentration of each amino-acid that was found by White to be the optimum for root growth. Solution II was ten times the concentration of solution I.

Treatment 1. Cuttings after α-naphthalene acetic acid treatment were kept with about ¾ in. in solution I in a heated frame at 22° C. for eight days (the amino-acid solution was changed twice during treatment).

Treatment 2. Cuttings soaked for twenty-four hours in solution II.

Treatment 3. Cuttings soaked in water for eight days.

Treatment 4. Cuttings soaked in water for twenty-four hours.

After treatment the cuttings were planted in sand.

After four weeks the cuttings from treatment 1 showed marked swelling of the base of each cutting accompanied by the splitting of the epidermis. There were no signs of callus formation. Cuttings from treatment 2 showed similar enlargement of the base but this was not quite so marked, while those from treatments 3 and 4 showed definite callus formation but no swelling of the base.

After six weeks all cuttings from treatment 1 (10 cuttings in all) were rooted. Six cuttings from treatment 2 were rooted—after seven weeks all were rooted. No roots were on cuttings from treatments 3 and 4, even after seven weeks, though callus formation was marked.

The results indicate that one (or more) of the amino-acids used has had a marked effect on the production of roots. This observation substantiates the prediction of Went *et al.* that rooting of some cuttings may be limited by lack of amino-acids.

Experiments to indicate which of the individual amino-acids was responsible for the observed effect are under way.

B. W. DOAK.

Plant Chemistry Laboratory,
Department of Scientific and
Industrial Research,
Palmerston North,
New Zealand.
June 19.

[1] Went, F. W., Bonner James and Warner, G. C, *Science*, 87, No. 2251 (1938).

[2] White, P. R., *Plant Physiology*, 12 (1937).

Hydrolysis of Starch Films by Polarized Infra-Red Radiation

IT was shown in 1924 that, in the presence of small quantities of diastase at room temperature, plane-polarized daylight has a selective effect in accelerating the hydrolysis of starch grains[1].

In the case of the temporary starch in the living leaf very marked evidence of hydrolysis was observed on irradiation with daylight polarized by a Nicol prism, a well-defined image of the prism aperture being obtained, when the irradiated leaf was treated with iodine solution[2].

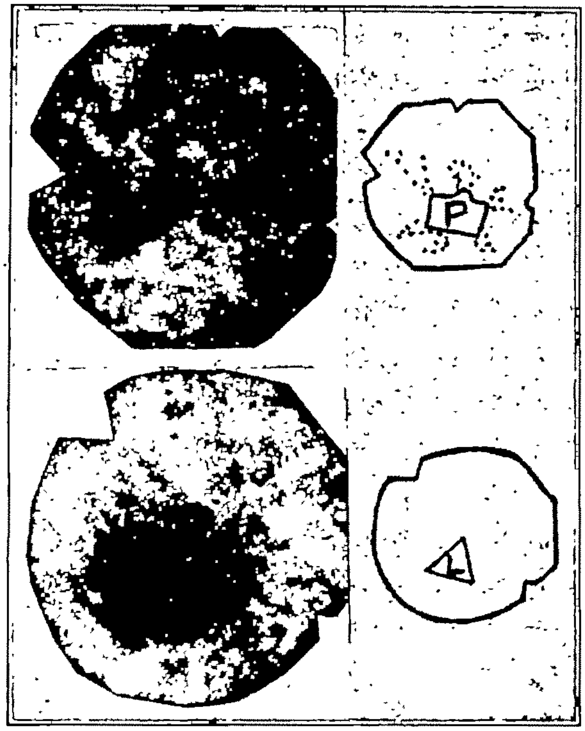
It was also shown that, when the stomata in the living leaf are irradiated with plane-polarized daylight, the rate of hydrolysis of the starch in the guard-cells is sufficient to burst them[3].

Furthermore, films of starch solution on glass and on filter paper were irradiated with plane-polarized light and convincing evidence of hydrolysis was obtained. The starch films on glass after irradiation deposited crystals on drying. The starch films on filter paper were treated with iodine solution after irradiation and the resulting blue colour was much less pronounced in those portions of the film which had been exposed to the polarized radiation.

In 1936 Prof. Baly directed my attention to the fact that carbohydrates do not selectively absorb rays in the visible and near ultra-violet regions of the spectrum, but selectively absorb rays in the wavelength region 1·5 μ–6 μ, and he suggested the use of polarized infra-red radiation.

The radiation from a roll of fine platinum gauze heated in a Bunsen burner was reflected upwards, (*a*) by a sheet of ferrotype at the polarizing angle, and (*b*) from a polished metal surface which had been lightly greased in order to reduce the intensity. These two reflected beams, one plane-polarized and the other non-polarized, irradiated moist starch films on filter paper in petri dishes. In each case a diaphragm with an aperture cut in it was interposed, the shapes of the two apertures being purposely different, as shown by the accompanying line diagrams.

After being irradiated for 2–3 hours, the starch films were allowed to dry in a dark room and then treated with iodine solution and *thoroughly* washed (to remove dextrins). As may be seen from the photograph (top) the effect of the polarized radiation is shown by a lighter coloured area which corresponds in shape to the aperture *A* in the diaphragm. The definition of this lighter area is somewhat marred by the diffusion of the products of hydrolysis into the non-irradiated area. It may be noted that this diffusion does not take place in the living leaf, owing to the starch grains being enclosed in cells, and



Starch films after staining with iodine (left). *P* shows diminution of starch, the dotted lines indicating streams of hydrolysed products. *L* shows condensation.

consequently the image of the aperture of the Nicol prism was much more clearly defined as stated above.

In the control shown in the lower photograph the reverse effect was observed with non-polarized infra-red radiation, the irradiated area giving a darker colour on treatment with iodine solution.

This result would seem to give definite evidence that starch is hydrolysed by polarized infra-red radiation.

I have to express my thanks to Prof. Baly and also to Mr. Riddell, director of the Folkestone Technical Institute, for the excellent facilities which enabled the observations with infra-red radiation to be made.

Elizabeth Sidney Semmens.

University of London Club,
Gower Street, W.C.1.
June 19.

---

[1] Baly and Semmens, *Proc. Roy. Soc.*, B, 97, 250.

[2] Semmens, *Bot. Gaz.*, 412 (Dec. 1930).

[3] Semmens, Nature, 134, 818 (1934)

Reciprocal Hetero-Transplantation of Limb Primordia between Duck, Turkey, Guinea and Chick Embryos

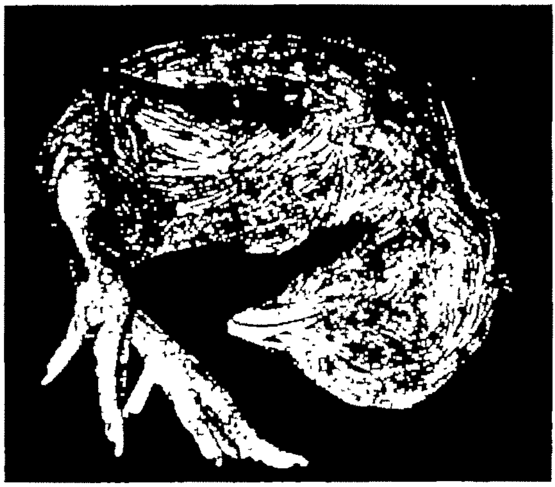
Successful transplantation of a chick limb bud to a turkey host was demonstrated by Eastlick[1] in 1939. Since that time, a number of grafts have been made by transplanting wing or hind limb primordia to the intra-embryonic cœlom or lateral body wall of a variety of hosts. Normal shaped limbs have been secured in reciprocal grafts made between chicken and turkey, duck and chicken, guinea and chicken, and turkey and guinea embryos.

That the limb primordia are self-differentiating is shown by the fact that many of the buds placed within the intra-embryonic cœlom develop although attached to the host mesenteries by only an artery and vein. In such cases the skeletal elements are well formed, but the muscles appear to undergo fatty degeneration. Other grafts attached to the flank of the host become innervated and seem to possess normal musculature.

While numerous examples of the above-mentioned types of grafts have been obtained, the majority of the hosts died before the time of hatching. This appears to be due to the fact that the grafts attached to the flank usually crowd the host within the shell and hence weaken it, while those grafts made into the cœlom seem to interfere with the retraction of the yolk sac. In five cases, to date, hatching has occurred and the birds have survived. One chick, killed 24 hours after hatching, was found to have a duck leg within its cœlom. A second chick with a duck leg attached to its flank still survives. The additional leg has a webbed foot and is in good proportion, with the exception of a missing toe. The leg seems to be innervated but cannot be flexed. This leg has increased in size since the time of hatching.

Three chicks have hatched with guinea legs attached to their flanks. All four of the above-mentioned chicks are being kept alive for further study. A number of turkey hosts bearing chicken legs and chicken hosts bearing guinea limbs have broken the shell but were too weak to survive.

Dorris[2] first reported that the melanophores of the fowl are derived from the neural crest. Eastlick[3] substantiated this observation by grafting limb bud of Barred Rock embryos to White Leghorn hosts. Those limb primordia, which included neural crest cells, developed pigmented down, while those from which the neural crest cells were excluded bore non-coloured plumage. Similar results have been secured in this study, since non-coloured plumage developed on limbs secured from mallard ducks, Bronze turkeys and Pearl guineas in those cases in which neural crest cells were not included with the transplant.



80-hr.-36-somite Bronze turkey limb bud transplanted to intra-embryonic coelom of 60-hr. 33-somite White Leghorn host. Host autopsied at 19 days. Transplant attached by narrow strand to mesenteries.

When neural crest cells were included with the limb primordia of Bronze turkey and mallard duck embryos and the transplants made to the flanks of White Leghorn chickens, it was found that the lateral body walls of the hosts became pigmented by the migration of donor melanophores. Such evidence of migration has not been observed when guinea limb buds containing neural crest cells were transplanted to White Leghorn embryos.

HERBERT L. EASTLICK.

University of Missouri,
Columbia, Mo.
July 7.

---

[1] *Anat. Rec.*, 73, 17 (1939).

Proc. Soc. Exp. Biol. and Med., 34, 448 (1936).

Genetics, 24, 98 (1939).

Fire-Fly 'Spinthariscope'

IT must be well known that the lantern of a firefly, teased by being held with the fingers, emits rregular flashes from minute point-sources in the antern which follow the normal flash, the light of which fills the entire lantern. I am wondering, however, if the very astonishing spectacle presented by a fly which has been bitten by a spider has been described. Within a few minutes after a few 'nips' have been made by the spider, if the fly is removed from the web, the lantern will be observed to glow with a faint green light which shows the same shimmering' quality as the radium paint on the dial of a watch. Examination with an ordinary hand magnifying glass, of moderate power, shows the antern filled with bright points of light, which at irst sight appear to be in rapid vibratory motion, and at the end of half an hour we have a seething cauldron of hundreds of bright points, dancing and flashing, and giving an almost perfect picture of a creen of zinc sulphide under a terrific bombardment of 'alpha' particles (spinthariscope). The phenomenon persists with undiminished intensity for forty-eight hours but finally dies out, the fly apparently having eturned to normal. The spinthariscope effect is frequently accompanied by an occasional normal flash, which ceases if the fly is decapitated, though he other effect continues. The normal flash of the antern is obviously due to the simultaneous excitaion of all the luminous centres by nerve impulses from the brain, but the scintillations persist even fter the lantern has been severed from the body. Both types of illumination cease if the fly is placed n a narrow glass tube through which a stream of carbon dioxide is flowing. I have produced the pinthariscope effect by innoculations with 1 : 1000 solution of snake venom, but in this case the fly id not recover.

Under a microscope, with a low-power objective, the individual flashes of green light are seen against black background and the strong vibratory movement seen with a hand magnifier appears to be due chiefly to the quenching of a flash at one point ccompanied by the successive flash of a luminous entre in its immediate vicinity. My impression is, owever, that I have seen single flashes quiver, hough in this case it may be merely the spreading of the chemical reaction which produces the light, rom one part of a cell to another. The phenomenon, een with the microscope, is really an amazing sight.

The spiders were, in most cases, small ones found n window webs, with bodies not much larger than grape-seed, and they usually make their first bites on the leg joints of the fly. The sparkling green flashes appeared first along the upper edge of one or both of the two lanterns, sometimes on one side only. The phenomenon then spread rapidly throughout the entire volume of the lantern. It seems possible that some information about the nervous system of the fly might be gained by recording the position of points innoculated by the spider and the point, or points, in the lantern at which the scintillations first appear, but the problem is one for a biologist rather than a physicist.

R. W. WOOD.

East Hampton,
Long Island,
New York.
July 22.

Role of Phosphate in Pyruvic Acid Dehydrogenation

DURING earlier work[1] on the problem of pyruvic acid dehydrogenation with *Bacterium acidificans longissimum* (Delbrückii), it was found that in the absence of inorganic phosphate no reaction took place, and at low concentrations of phosphate the rate of dehydrogenation was proportional to concentration. This indicated that inorganic phosphate must in one way or another participate in the reaction. Such a view was further strengthened when it was found that pyruvic acid dehydrogenation was able to promote adenylic acid phosphorylation[2]. The supplying of active phosphate by a dehydrogenation reaction had only been observed with the phosphoglyceric aldehyde dehydrogenation[3,4]. Recently Negelein and Brömel[5] were able to isolate as the primary product of this dehydrogenation a labile di-phosphoglyceric acid which they assumed to be either a 1-3-phospho- or a pyrophospho-compound, probably the former. The remarkable finding of Negelein and Brömel induced me to see whether during dehydrogenation of pyruvic acid to acetic acid an intermediary phosphate compound occurred.

Acetylphosphate was prepared from trisilver phosphate and acetylchloride according to the method of Kämmerer and Carius[6]. For the present no serious attempt has been made to isolate the assumed intermediate mono-acetylphosphate, but a solution containing a mixture of the mono-, di-, and tri-acetylphosphates, in addition to acetate, chloride, and some inorganic phosphate, was used for experiments with dry preparations of *Bacterium Delbrückii*. The average stability of the bound phosphate in the solution corresponded roughly to that of creatine phosphate. The content of bound phosphate was estimated by the early method of Eggleton for creatine phosphate.

In the following experiment the colorimetric method of Lohmann and Jendrassik was used, where acetylphosphate, like creatine phosphate, finally appears as inorganic phosphorus. 44 mgm. dry bacteria were used per vessel, in a total volume of 1·25 ml. containing 0·04 *M* fluoride. The suspension was shaken at 37·5° for sixty minutes in nitrogen :

	0·75 mgm. acetyl-P 4·0 mgm. adenylic acid	0·75 mgm. acetyl-P 0 1 mgm. adenylic acid	0·75 mgm. acetyl-P
Mgm. inorganic and acetyl-P	1·12	1·39	1·37
Mgm. pyrophosphate-P	0·35	0·09	0·10

The experiment shows that after incubation with adenylic acid about 30 per cent of the phosphate of the added acetyl-phosphorus appears in the pyrophosphate fraction, corresponding to a phosphorylation of about 25 per cent of the added adenylic acid.

From the results of this and similar experiments and the earlier work mentioned above, it is concluded that the dehydrogenation of pyruvic acid proceeds according to the following formulation:

$$\text{pyruvate} + \text{phosphate} - 2\text{H} \rightarrow \textit{acetylphosphate} + \text{CO}_2$$

$$\underset{\text{(or adenylic acid)}}{\textit{acetylphosphate} + \text{H}_2\text{O}} \rightarrow \underset{\text{(or adenosinepolyphosphate)}}{\text{acetic acid} + \text{phosphate}}$$

In investigations of pyruvic acid metabolism it has long been puzzling that, although the oxidative breakdown of pyruvic acid has been found to go through a stage corresponding to acetic acid, added acetic acid is inactive in systems oxidizing pyruvic acid completely. The intermediate formation of acetylphosphate provides a reasonable explanation for the 'active' acetate, and for various acetylation processes connected with the oxidative breakdown of pyruvic acid and carbohydrate, for example, acetylation of amino-acids[7] and of choline[8].

Further details will appear in vol. 7 of the Cold Spring Harbor Symposium on Quantitative Biology. Acknowledgment is made of a grant from the Ella Sachs Plotz Foundation.

FRITZ LIPMANN.

Department of Biochemistry,
Cornell University Medical College,
New York City,
and
Biological Institute
of the Carlsberg Foundation,
Copenhagen.
July 21.

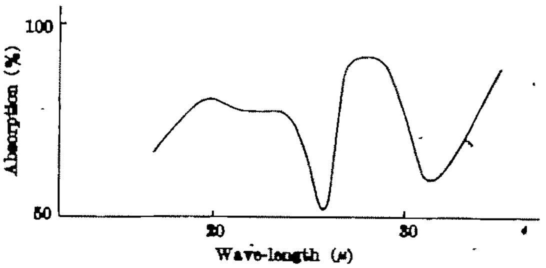
---

[1] Lipmann, *Enzymologia*, 4, 65 (1937).
[2] Lipmann, NATURE, 143, 281 (1939).
[3] Meyerhof, Ohlmeyer, and Mohle, *Biochem. Z.*, 297, 90 (1938).
[4] Needham and Lu, *Biochem. J.*, 32, 2040 (1938).
[5] Negelein and Bromel, *Biochem. Z.*, 301, 135 (1939).
[6] Kämmerer and Carius, *Ann.*, 131, 165 (1864).
[7] du Vigneaud and Irish, *J. Biol. Chem.*, 122, 349 (1937-38).
[8] Mann, Tennenbaum and Quastel, *Biochem. J.*, 32, 243 (1938).

Structure of the Tetrachlorethylene Molecule

THE suggestion has been made by one of us that the vibration spectrum of tetrachlorethylene cannot be interpreted properly by a potential function involving only four or even seven force constants[1]. By considering the physical meaning of the 'cross-terms', a potential function was chosen the expression for which contained thirteen force constants, the values of which were determined from experimental data. The prediction was made that two fundamental frequencies, of symmetries A_1 and A_2 respectively, occur in the far infra-red, at 400 cm.$^{-1}$ and 346 cm.$^{-1}$.

Measurements have been made with the 'residual ray' apparatus, and with a grating spectrometer, described elsewhere[2]. The accompanying curve (obtained by the second method) shows the absorption in the region 30 μ, due to tetrachlorethylene dissolved in paraffin.



The frequencies of the two absorption bands are 387 cm.$^{-1}$ and 332 cm.$^{-1}$, in good agreement with the theoretical values. The slight differences may be due to the neglect of the anharmonicity and to the fact that the computed values refer to the gaseous and not to the dissolved state, as in our experiments.

From the above results, it is now clear that the frequencies in the spectrum of tetrachlorethylene cannot be correlated by means of a simple potential function as suggested before by one of us[3], and by Linnett and Thompson[4]. For example, a valency force field should give 604 cm.$^{-1}$ instead of 387 cm.$^{-1}$ for A_1.

On the other hand, it is still difficult to determine exactly the value of the C—C force constant because the interaction terms are insensitive to its variation. However, it may be substantially less than $8{\cdot}5 \times 10^5$ dynes/cm. as in ethylene; and the suggested structure arising from resonance between the C—C bonds is not to be excluded since the interaction terms of the form $f_C\ \Delta_{C-C}\ \Delta_{C-Cl}$ and $\gamma_C\ \Delta_{C-C}\ \Delta_{Cl-C-Cl}$ are very important ($\sim 1{\cdot}70 \times 10^6$ dynes/cm.).

Complete details will be published shortly elsewhere.

One of us (J. D.) wishes to express his thanks to Prof. C. Manneback for helpful correspondence during the preparation of the note on which the present one is based.

JULES DUCHESNE.

Mathematics Department,
Imperial College of Science and Technology,
London.

MAURICE PARODI.

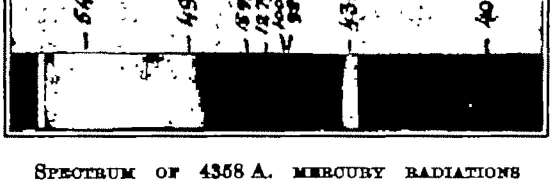
Laboratory of Physical Researches,
Sorbonne, Paris.

---

[1] Duchesne, J., NATURE, 142, 256 (1938).
[2] Parodi, M., Thesis (Hermann, Paris, 1938). Barchewitz, P., and Parodi, M., *J. Phys.*, 10, 143 (1939).
[3] Duchesne, J., NATURE, 139, 288, 634 (1937).
[4] Linnett, J. W., and Thompson, H. W., *J. Chem. Soc.*, 285, 1293 (1937)

Structure of *p*-Diphenylbenzene and its Raman Spectrum

THERE have been very few structure determinations of aromatic compounds which contain three benzene rings. The structure of *p*-diphenylbenzene of the diphenylbenzene family has been studied by L. W. Pickett[1] by the method of trial and error and Fourier analysis, and this tends to show that the molecule of this compound is planar in form. In the present investigation our object is to attack the problem from a study of the Raman spectra of such compounds.



SPECTRUM OF 4358 A. MERCURY RADIATIONS SCATTERED BY SOLID *p*-DIPHENYLBENZENE.

In a previous note[1], one of us and S. Abdul Aziz have submitted the results of our investigation on the meta- and the ortho-compounds of this family. We have now also succeeded for the first time in obtaining the Raman spectra of *p*-diphenylbenzene in the solid state, and in spite of the very strong fluorescence shown on the plates, as the photograph reproduced here will show, the substance has yielded 24 new lines not recorded before. The frequencies obtained are at 3041(3), 2824(0), 2205(½), 2140(½), 2095(3), 2029(3), 1760(1), 1673(0), 1605 (10), 1592(10), 1549(3), 1503(1), 1372(0), 1274(10), 1219(6), 1148(0), 1039(1), 1008(4), 981(4), 811(0), 773(5), 598(½), 85(5), and 42(5) cm.$^{-1}$ respectively. (Intensities are given in brackets.)

p-Diphenylbenzene has three benzene rings joined in the *para* position, and the central ring with each of the end ones may be considered to constitute a diphenyl molecule. Diphenyl[2], which consists of two benzene nuclei joined end on by a C–C bond in the *para* direction, has been shown to be planar, and all the important frequencies found in diphenyl by one of us[3] and also by Wood[4] and others[5] are observed also in *p*-diphenylbenzene. These diphenyl frequencies are at 1610(10), 1590(8), 1544? (Wood), 1283(10), 1032(3), 1003(10), 980(1) and 779 cm.$^{-1}$ respectively. A comparative study of the spectra observed in these two compounds lends support to the view that the molecule of *p*-diphenylbenzene is planar in form.

Further investigation is proceeding and details will be published elsewhere.

S. K. MUKERJI.
LAKSHMAN SINGH.

Physics Department,
Agra College, Agra.
July 7.

[1] *Proc. Roy. Soc.*, A, 142, 333 (1933); NATURE, 131, 513 (1933).

[2] Mukerji, NATURE, 142, 477 (1938).

[3] *Ind. J. Phys.*, 7, 43 (1932); also Mukerji and Aziz, *Ind. J. Phys.* 12, Pt. IV (Aug. 1938).

[4] Wood, *Phys. Rev.*, 36, 1431 (1930); 38, 2168 (1931).

[5] Dadieu and Kohlrausch, *Sitzber. Akad. Wiss. Wien*, Abt. IIa, 138, 799 (1929); Donzelot and Chaix, *C.R.*, 201, 501 (1935).

Dunstan's Law

DUNSTAN'S law[1] for viscosity is given by

$$\log \eta = aM + b,$$

where η is viscosity of liquid at a definite temperature, say 20° C.; M is the molecular weight of the liquid; a is a general constant; and b is a specific constant characteristic for any one homologous series.

I have derived this law from theoretical considerations; but the important point is that this derivation also defines the limitations of the law in more rigorous manner. Andrade's equation is now universally accepted:

$$\eta = Ae^{B/T},$$

where A and B are constants and T is absolute temperature of measurements. A recent rendering of this equation is:

$$\eta = Ae^{\frac{Ml}{nRT}};$$

where l is the latent heat of vaporization, and n is a characteristic constant between 2·5 and 4·0 approximately, for ordinary liquids.

Similarly, vapour pressure is given by

$$P = Ae^{-Ml/RT}$$

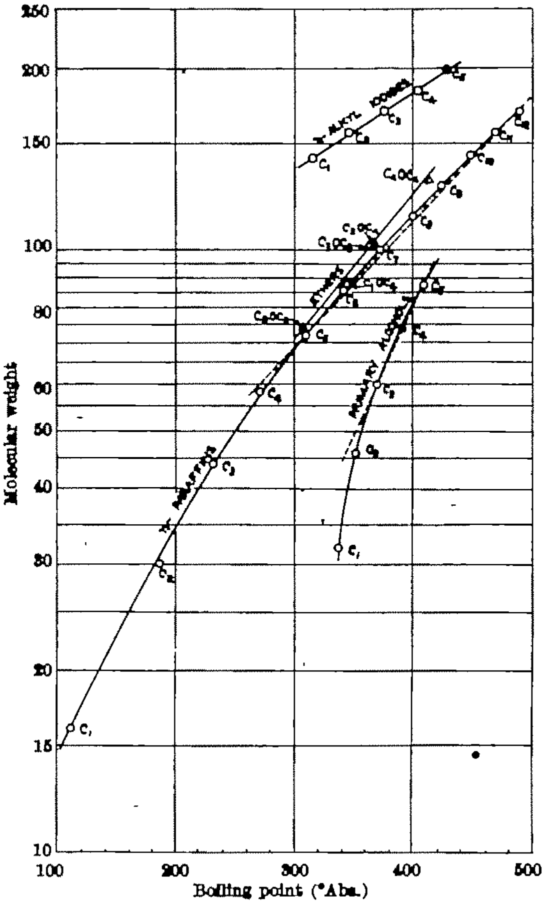
and the Clausius–Clapyron rendering of this formula is

$$\log\left(\frac{P_1}{760}\right) = -\frac{Ml}{2\cdot 3\,R}\left[\frac{1}{T_1} - \frac{1}{T_B}\right];$$

where the suffix B denotes boiling point.

$$\text{Thus}\quad \log\left(\frac{P_1}{760}\right) = -\frac{Ml}{2\cdot 3RT_B}\left(\frac{T_B}{T_1} - 1\right) = -K\left(\frac{T_B}{T_1} - 1\right),$$

since $\frac{Ml}{T_B}$ = constant from Trouton's rule.



It follows then that

$$\log \frac{\eta_1}{\eta_B} = K'\left(\frac{T_B}{T_1} - 1\right).$$

This last formula means that if $\log \eta$ is plotted against values of T_B/T for an homologous series like the normal paraffins, only one line is obtained. Such a graph was published in the literature recently[2].

Hence

$$\log \eta = K'T_B + K''$$

for an homologous series if a standard temperature, say 20° C., is chosen for T_1.

The accompanying graph shows that $\log M$ plotted against T_B for normal paraffins yields a curve: but if the portion appropriate to the liquids n–C_6H_{14} up to n–$C_{12}H_{26}$ be taken, a straight line would roughly pass through it. Thus, with approximation and limiting the carbon atoms to those mentioned,

$$T_B = A \log M + B.$$

$$\text{Hence}\ \log \eta = A'\log M + B',$$

which is Dunstan's law in a more exact form.

It is clear, then, that this law is limited by the following considerations:

(1) It can only apply to those homologous series which yield a solitary curve for log η *vs* T_B/T for all their members. Since first members in homologous series generally do not lie on these curves—for reasons which will be detailed in a later publication—it will not apply to first members of homologous series.

(2) The law can only apply to those homologous series which will yield approximately straight lines for log M *vs* T_B. Again, it is seen that first members will be excepted.

(3) When the effects of a certain radicle, say CH_2, are studied in different series, say alkyl iodides, *n*-paraffins and alcohols, the increment in log η due to CH_2 will be the same only for those series which have parallel straight lines for log M *vs.* T_B. Thus the iodides have been found to possess smaller values for the increment in log η due to CH_2 than the *n*-paraffins, whilst the alcohols possess greater values, and the ethers have identical values.

(4) The law is approximate only, even for *n*-paraffins.

A. H. NISSAN.

Dept. of Oil Engineering and Refining,
The University, Birmingham, 15.
June 27.

---

[1] Hatschek, E., "The Viscosity of Liquids", 108 (1928).

[2] Nissan, A. H., and Clark, L. V. W., NATURE, 143, 722 (1939).

Points from Foregoing Letters

D. Y. Solandt and C. H. Best, from experiments made with rats, conclude that deficient vagus function may be associated with a diet poor in choline and that this may, in part at least, be rectified by injected choline. Thus, it is suggested that choline deficiency may result in deficient formation of acetylcholine at the nerve endings.

A. S. McFarlane and M. G. Macfarlane report the presence in vaccinia virus of two types of lipoid, and of nucleic acid. The behaviour of the virus to mechanical treatment, to lipoid solvents, and to the action of sodium carbonate suggests that forces are present which are able to preserve the form of the particles in the absence of any demonstrable cell membrane.

F. L. Hopwood, M. H. Salaman and A. S. McFarlane find that dried vaccinial elementary bodies which have been extracted with benzene may be completely redispersed by means of ultrasonic vibrations. The virus particles so obtained have lost none of their original infectivity.

L. Halberstaedter finds that the hamster reacts to the subcutaneous injection of benzpyrene by tumour formation like the rat and mouse. Apart from a shorter incubation period, there are no peculiar features in the formation of the primary tumours. Passaging of a benzpyrene tumour in hamsters resulted in a remarkably high percentage of animals developing metastases, which were always localized in the lymph glands. This property is regarded as a peculiarity of this strain.

Unfertilized eggs of a sea-urchin have been inseminated immediately after irradiation with alpha-rays from radium C′ by M. Miwa, H. Yamashita and K. Mori. They find that the start of cleavage is delayed in some eggs, and with increasing doses of irradiation the number of eggs showing normal cleavage decreases; in some eggs cleavage stops altogether and disintegration occurs.

B. W. Doak finds that treatment of rhododendron cuttings which had already received a root-forming hormone with a mixture of certain amino-acids promotes root formation, thus substantiating a prediction by Went *et al.* that rooting of some cuttings is limited by lack of amino-acids.

Elizabeth S. Semmens states that the selective effect of polarized radiation in the hydrolysis of starch, both in the starch grain *in vitro* and in the living plant, is confirmed by a similar action on films of boiled starch, thus showing the effect to be a physico-chemical one. That the result is mainly due to the infra-red portion of the spectrum is demonstrated by the use of heated platinum gauze as a source.

H. L. Eastlick reports that reciprocal transplants of limb primordia have been made between 2½ and 3½ day duck and chicken, turkey and chicken, guinea and chicken, and turkey and guinea embryos. The transplants grew attached to the body wall or to the coelom of the hosts and the limbs thus obtained are normal in appearance. The flank grafts seem to be innervated. Several chicks bearing duck and guinea limbs have hatched and in at least one instance the additional leg is increasing in size.

R. W. Wood states that the scintillations given out by the 'lantern' of a fire-fly bitten by a spider when observed under low magnification have a similar appearance to a zinc sulphide screen under alpha particle bombardment. Study of the origins o scintillations in relation to the position of the bite might give information about the nervous system o the fly.

F. Lipmann puts forward a scheme for the de hydrogenation of pyruvic acid by *Bacterium Delbrücki* which involves the formation of acetylphosphate a an intermediate stage.

The absorption curve in the region 30 μ for tetra chlorethylene dissolved in paraffin is submitted b J. Duchesne and M. Parodi. The frequencies of the two absorption bands observed are in agreement with the predictions of a theoretical discussion of th vibration spectrum of this substance.

S. K. Mukerji and L. Singh have investigated the Raman spectrum of solid *p*-diphenylbenzene, an deduce that the molecule is planar.

Dunstan's law for the relationship of viscosity with the molecular weight of members of an homo logous series is derived by applying Trouton's rule to the Clausius-Clapyron and Andrade equations The limitations of the law become apparent from this derivation and it is shown by A. H. Nissan tha the equation log. $\eta = K'T_B + K''$ is the fundamenta one giving rise to Dunstan's log $\eta = aM + b$ onl in certain cases.

RESEARCH ITEMS

New South African Stone Age Cultures

DR. E. G. N. VAN HOEPEN in his presidential address to Section E of the South African Association for the Advancement of Science on July 5, 1938 *Argeologiese Navorsing Nas. Mus.*; 9, 10, 1939), in discussing certain aspects of South African archæology, adduced argument for the conclusion that there had been in the Stone Age in South Africa, as in Europe, two civilizations, existing side by side simultaneously, of which one was characterized by implements made on cores ('Fauresmith', Vaal, Stellenbosch), and one by implements made of flakes (Koning, including three industries, Wilton, Smithfield, Koning; Mossel Bay; and Pniel). Further research and exploration have since brought to light new cultures, confirming and extending the application of this view. A number of cleavers from Wellington made from river boulders, one side showing the original surface, are of more primitive form than the Vaal cleavers, and though Pniel in shape and technique, represent an earlier flake industry, which it is proposed to call the Wellington industry, to distinguish it from the Pniel industry, in conjunction with which t constitutes the Pniel culture. It is contemporary with Stellenbosch. A second new culture comes from the Brakfontein farm, and is a congeries of lakes and implements which cannot be placed in any of the known industries. The flakes are large, a breadth of twelve inches being not uncommon. More often the implements are broader than they are long. Flakes have been made into implements by secondary rimming of the edge opposite the bulb of percussion. They resemble flaying knives from the Koning industry, but are larger and cruder. Probably Koning is derived from them. Two other localities are known but not yet worked. The Brakfontein culture, as it is proposed to call it, may have been contemporary with earlier Mossel Bay, to which belong a number of long flakes recently found at Swartfontein with 175 hand-axes of the Vaal and Stellenbosch cultures. The Swartfontein flakes are distinct from the Mazelspoort, and it is proposed to differentiate the two as the Swartfontein and Mazelspoort industries, constituting together the Mossel Bay culture.

Chromosomes of the Pig

F. A. E. Crew and P. C. Koller (*Proc. Roy. Soc. Edin.*, 59, 163–175; 1939) show that the chromosome complement of the pig is $2n = 38$, with a range n chromosome size of $7 \cdot 5\,\mu$–$1 \cdot 5\,\mu$. There is little, f any, terminalization between mid-diplotene and metaphase, and the chiasma frequency in some hromosomes appears to be proportional to the ngth of the chromosome. The five larger bivalents xhibit localization of chiasmata; consequently, ecombination of genes on these chromosomes is xpected to be peculiar and limited. The Y, with sub-terminal centromere, pairs with one arm of he medianly attached X, while the other arm of he X chromosome appears to be the differential egment. Pre-reduction is obligatory in the XY bivalent. Evidence of at least one inversion is iven.

Chromosome Rearrangements in Drosophila

B. P. KAUFMANN (*J. Hered.*, 30, 171–190; 1939) irradiated Drosophila males and studied the salivary gland chromosomes of the progeny. Deficiencies, duplications, translocations, transpositions (intrachromosomal translocations) and multiple exchanges involving up to eight breaks were found. The author points out that chromatid and chromosome breaks caused by X-rays do not provide unequivocal evidence for the time of chromosome splitting.

Temperature Rhythm in an Ant-hill

THE temperature changes within the mound of a widely distributed species of Japanese ant, *Formica truncorum truncorum* var. *yessensis*, have been investigated by Mutsuo Katô (*Sci. Rep. Tôhoku Imp. Univ.*, 4 Ser., 14, 53; 1939). The diurnal temperature rhythm in the interior of the mound was remarkably different from that of the air temperature, for at a depth of 20 cm. or more below the surface it was almost constant, ranging only from 26·1° to 28·8° C. Even at a depth of 10 cm. the temperature was fairly constant (24·6°–30·9° C.), but at lesser depths the influence of the rhythm of solar radiant energy became more and more apparent as the surface was approached. The mounds are composed of masses of withered grass, bits of leaf-stalks and twigs loosely piled on bases of living trees or stumps; they are thus partially insulated by the content of air interlaced in the material of the mound. Nevertheless artificial mounds showed, at corresponding depths, greater temperature fluctuations than the ant-hills, and this was due to temperature regulation within the latter. The main source of heat is undoubtedly the sun, and although during periods of activity the ants may add a little to the sum total, further regulation of the internal temperature is brought about by the opening and closing of the entrances to the mound. When the day is declining many ants carry material which is used in blocking the passages made for exit during the day-time, and thus the loss of heat which would take place during the night is reduced.

Market Economics of the Apple

AN interesting study of the complex relations between quality and price of McIntosh apples sold in the New York City markets has been made by John R. Raeburn (*Cornell Univ. Agr. Exp. Sta. Mem.* No. 220. Ithaca, U.S.A., March 1939). The average diameter, the amount of red-coloured skin, the practice of 'facing' or having the top layer of apples superior to the general sample, and serious and not-serious defects produced by insect attack, by fungal parasites or by bruising, all affect the price received. Their effects are interrelated, and a method of surface correlation involving the presentation of data in three dimensions has been used to reveal the joint effects of two variables upon the dependent variable, price. One important result of the study concerns the economic effects of high-quality grading. Separation of the highest quality fruit does not produce the greatest financial return; the utilitarian needs of the ultimate consumer provide a surer basis for grading. Prices recorded in the present investigation indicate the gastronomic, rather than the æsthetic, value of the fruit. Serious and not-serious defects affect prices jointly, for the influence of one type depends upon the proportion of the other. This finding vindicates the numerous recent studies of pests or parasites which have little effect upon their hosts. They predispose the market against even slight occurrences of more serious defects. The paper under review gives many other detailed correlations, several of which are crystallized into definite recommendations for the farmer or the market organizer.

Observation of Growing Roots

OBSERVATION trenches for the examination of roots in the field are described by W. S. Rogers (*J. Pom.*, 17, 99; 1939) in an account of four years' work on the growth of apple roots at East Malling. The trenches, which were 4 ft. 6 in. deep and 2 ft. 6 in. from the tree trunks, were provided with plate-glass windows held against the soil profile. They were enclosed to form wooden cabins and protected from light. 14 year-old Lane's Prince Albert apple trees were observed over four years and the time and rate of root growth, suberization and formation of laterals recorded. During active growth, the rate of root elongation approximated 3 mm. per day, while suberization occurred when the roots were a week to a month old. Small roots died and disappeared after suberization. Larger ones persisted, often with rapid secondary thickening, and produced laterals. Root growth was closely correlated with soil temperature, very little growth occurring in winter at soil temperatures from 35° F. to 45° F. Active growth began at about 45° F. and increased up to 69° F. (at 8 in. deep). It began before the leaves unfolded, and continued after shoot growth ceased. A fall in soil moisture checked root growth though the moisture content was still well above the wilting range. In spring, most root growth occurred in the warmer surface layers of soil and in winter in the lower layers. The greatest concentration of roots occurred at a depth between 5 and 30 inches. A comparison of trees on stocks I, IX and XVI showed that the amounts of root corresponded with the relative vigour of the stocks, but the mean growth-rate per root was similar for all stocks. It appeared that physiological differences between the rootstocks were relatively small.

Apparent Shape of Protein Molecules

IT has been recognized for some time that protein molecules are probably not spherical and the term dissymmetry constant was introduced by Svedberg for the ratio f/f_0, where f and f_0 are the measured molar frictional coefficient (derived from sedimentation and diffusion experiments) and the theoretical value for a spherical molecule of the same molecular weight, respectively. H. Neurath, (*J. Amer. Chem. Soc.*, 61, 1841) has applied Perrin's diffusion equation to the problem, this equation involving the long and short axes of a prolate ellipsoid of revolution. The results are subject to large limits of error but they show that, with a few exceptions, protein molecules are not spherical, and most exhibit high molecular dissymmetry. Proteins which belong to different groups as regards their molecular weight become members of the same group if arranged according to their molecular dimensions. Thus, cytochrome C, gliadin and erythrocruorin, with molecular weights of 15,600, 26,000 and 31,400, have a common short diameter of about 18 A. Comparison of the dimensions of proteins with those of their respective dissociation and aggregation products indicates that cleavage occurs only in directions parallel to either the major or minor molecular axis.

Diffusion Velocity and Molecular Weight

CONSIDERABLE interest has recently been shown in the use of diffusion velocity in determining molecular weights, calculations having usually been made by the Stokes-Einstein diffusion equation $D = (RT/N) . 1/(6\pi\eta r)$. L. Friedman and P. G Carpenter (*J. Amer. Chem. Soc.*, 61, 1745; 1939) point out that the diffusion coefficient to be used in this equation should be that at infinite dilution and by plotting diffusion coefficients against the square root of the concentration and extrapolating the straight line to zero concentration for some sugars and salicin, they find reasonable values of the molecular weights. An experimental study of the diffusion velocity of glucose by this method gave the correct molecular weight. It is pointed out that the relationship holds for a substance of molecular weight as low as 180, whereas most investigators have felt that the Stokes-Einstein relation could not be applied to substances of such low molecular weight.

Detection of Carbon Disulphide Vapour

LEAFLET No. 6 of the series by the Department of Scientific and Industrial Research on methods for the detection of toxic gases in industry deals with carbon disulphide vapour (H.M. Stationery Office 3*d*. net). It is stated that the permissible concentration of carbon disulphide vapour in the atmosphere of work-rooms should be kept well below one part in 30,000 of air and preferably below one part in 100,000 The method of detection of the vapour depends on its interaction with diphenylamine and copper acetate to produce a coloured compound, copper diethyldithiocarbamate, and full instructions for carrying out the tests are contained in the leaflet which is bound in strong paper covers.

Impurities in Brass

FOR the last seven or eight years, on the recommendation of the American Society for Testing Materials, the Non-Ferrous Ingot Metal Institute ha supported a research on the effects of impurities and heat treatment on the physical properties of bras which has been carried out by H. B. Gardner and C. M. Saeger at the National Bureau of Standards Two papers on the effects of pouring temperatur and of sulphur and iron impurities have already been published, and in the June issue of the *Journal o Research* of the Bureau a third on the effects o aluminium and of antimony appears. Cast red bras of composition 85 per cent copper, 5 per cent each tin, zinc and lead was remelted and up to 0·10 pe cent aluminium or 0·23 per cent antimony added and specimen bars cast at temperatures from 1230° to 1065° C. in chilled or unchilled or sand moulds The running properties were observed and tests o density, hardness, tensile strength, porosity unde hydraulic pressure and electrical conductivity wer made. Pouring temperature had little effect, but aluminium, while improving the running properties lowered the ductility, hardness, tensile strength and electrical conductivity and raised the porosity of th brass. Antimony increased slightly the running and decreased slightly the conductivity, but its oth effects were insignificant.

THE DUNDEE MEETING OF THE BRITISH ASSOCIATION

GENERAL ARRANGEMENTS

PREPARATIONS for the Dundee Meeting of the British Association, which will open on August 30, are in their final stage. There are indications that fear for the international situation is keeping a few visiting members away, but powerful efforts are being made in Dundee to secure the support of a strong body of local members such as is always anticipated at a Scottish meeting.

The main outlines of the programme have been announced long ago, and the activities of the sections are given under their own headings, but there are certain new features to be mentioned here. The evening lecture on "Science and Social Pioneering", which Dr. Isaiah Bowman, president of Johns Hopkins University, will deliver, will be the first of a new series furnishing outward evidence of the intimate relations between the British and American Associations, which were so happily strengthened during the meeting at Cambridge last year. This series will be known as the British and American Association Lectures, a title which, if something cumbrous, has at least the merit of self-explanation. A British lecturer will be heard at an American Association meeting next year, and so thereafter, in alternate years at future meetings of the two Associations, this invaluable contact is intended to be maintained.

The new Division for the Social and International Relations of Science, created by the General Committee of the Association last year, seems already to have established itself firmly. In case it should be feared that its potential field is beyond the scope of the Association's work, it may be said at once that there is no evidence of this: the outlook of the Association (taken as a whole) is wide, and its mechanism elastic, and the new Division is in direct line of descent from the intentions of those who founded the Association more than a century ago. It will be evident from the transactions of the Division at Dundee that through it the Association is establishing contacts with other organizations which otherwise might have been neglected. The Division will hold three sessions, at which there are to be discussed an interim report on an inquiry into the organization of research in Britain, in which the Division is associated with P E P (Political and Economic Planning); population problems; international intellectual co-operation, introduced by Prof. Gilbert Murray; and nutrition, introduced by Sir John Orr. The Division has also arranged the Sunday evening lecture requested by the local executive in Dundee, which will be given by Sir Richard Gregory as chairman, on "Contacts of Religion and Science"; the public as well as members of the Association being admitted.

A third unusual feature in the programme of the meeting, though not without precedent, is found in the two special sessions dealing with jute, the material (it need scarcely be said) of one of Dundee's staple industries. Every scientific aspect of this material and the industry associated with it will be dealt with by experts, and the Textile Institute will collaborate in publishing the results.

The familiar programme and daily time-table will appear in a new guise. Its pages are increased to correspond in width (though not in depth) with those of the forthcoming quarterly form in which the annual report will be published in future. Moreover, the *Journal* of sectional transactions, containing abstracts of papers, will appear within the same covers and not as a separate publication, an arrangement, carried out not without heart-searching on the part of the administration, which should make for the general convenience. The new quarterly, of which the first number will appear at the end of October, will bear the title of *The Advancement of Science*, a name hitherto attached to the collection of presidential addresses which has appeared for some years at the time of the meeting. This collection will now be discontinued, but in its place separates of the various addresses will be on sale at the meeting.

Entertainments detailed in the programme, while nowise overwhelming it, fully exemplify Scottish hospitality, notably the generous number of garden parties to be given by private hosts. The Corporation and the University College both entertain, as is customary, as also do the Dundee Harbour Trustees with a river trip. The Eastern Club, the University College Students' Union, the Dundee Rotary Club, the Dundee Medical Club and the Forfarshire Medical Association, the Overseas League, and, it scarcely need be added, several famous golf clubs, including the Royal and Ancient of St. Andrews, all offer hospitality in various forms. Finally, masonic members of the Association will find very special interest in a meeting arranged for them by the Dundee St. Mary Lodge, to exemplify a working of the Scottish Constitution.

The reports of the Council, the Down House Committee, and the Division for the Social and International Relations of Science, which will be presented to the General Committee, cover a range of incidental interests from the safeguarding of native tribes in Australia to that of the green belt around London, and from the possibility of a future annual meeting in Brighton to that of scientific delegations to the West Indies and Southern Rhodesia. It is no matter for wonder that the general treasurer in a recent appeal, and again in his forthcoming report, has asked for extended support for the Association by way of membership "from all those who appreciate the benefits that science confers and wish to aid the Association in discharging its function of the advancement of science".

SECTIONAL PROGRAMMES

SECTION A (MATHEMATICAL AND PHYSICAL SCIENCES)

SECTION A (Mathematical and Physical Sciences) has for many years had two sub-sections, one for mathematics and the other for cosmic physics, and each of them this year has some interesting discussions to offer. On the Saturday, there will be a discussion on "The Teaching of Mechanics", opened by Prof. E. A. Milne and continued by speakers representing Scottish and English schools and universities. Although the meeting is not a joint one, it is hoped that the choice of day will permit some members of Section L to attend and to take part in the open discussion. In cosmic physics, a discussion on solar-terrestrial relationships, to be opened by Prof. E. V. Appleton, promises much of interest, as also does one on the surface temperatures of stars.

It is not to be thought that the only matters of interest are those pertaining to the special interests of the subsections (though these are not so specialized as to be unintelligible to the ordinary member), for the main section shows a judicious blend of 'new' and 'classical' (or 'applied') physics, which should interest many. Starting on Thursday with electron optics and the presidential address by Mr. R. S. Whipple on "Instruments in Science and Industry", the former of which is 'electronic physics' but of wide everyday application, the section proceeds on Friday to artificial radioactivity, and on Monday to the theoretical but applied subject of "High-Speed Flight", and thence on Tuesday to high temperature physics, the programme of which is largely devoted to papers from the National Physical Laboratory and from laboratories of the steel-making industry. In the course of this session, a coloured film will be shown to illustrate some of the physical problems of modern steel making.

Section B (Chemistry)

THE proceedings of Section B will begin with the presidential address by Prof. E. K. Rideal on "Film Reactions as a New Approach to Biology", and the rest of the day will be devoted to a joint discussion with Section I on "Tissue Respiration", to be opened by Prof. R. A. Peters. Dr. Malcolm Dixon will deal with catalysis in tissue respiration (catatorulin) and Dr. H. Theorell (Stockholm) with the flavoproteins. After an account of cytochrome and similar compounds by Prof. D. Keilin, Dr. F. Dickens will consider the interpretation of intermediary metabolism from measurement of tissue respiration, and Dr. J. H. Quastel that of narcosis. Dr. S. Ochoa will deal with carbon dioxide evolution and cocarboxylase. Prof. H. S. Raper will discuss the control of tissue respiration, and other aspects of the subject will be presented in discussion by Dr. D. E. Green, Sir F. Gowland Hopkins, Dr. H. A. Krebs, Dr. T. Mann and Dr. E. P. Poulton.

A discussion on "Light Alloys" will be opened by Dr. C. H. Desch, who will speak of their growing importance and will refer in particular to their mechanical strength and to their resistance to corrosion. Dr. A. G. C. Gwyer will discuss the constitution of aluminium alloys and Mr. W. C. Devereux will describe the controls of production of light alloys, including spectrographic analysis and the X-ray control of their thermal and mechanical treatment. Their industrial uses will be dealt with by Prof. A. von Zeerleder. An exhibition illustrating the uses of light metals and alloys, with a research section, will be open throughout the meeting.

Progress in physical chemistry is largely dependent on the development of new technique. Not only does such technique help to solve specific problems unassailable by the older methods, but it also opens up entirely new lines of investigation. This topic will form the subject of a discussion in which new methods and their bearing on problems connected with the mechanism of chemical reactions will be described. Radioactive and non-radioactive indicators ('labelled atoms') will be dealt with by Prof. S. Sugden and Prof. W. F. K. Wynne-Jones respectively. Dr. M. Ritchie will discuss reactions of free atoms; Prof. T. Alty accommodation coefficients, and Dr. H. W. Melville will describe recent technique in photochemistry.

At the last Dundee meeting of the British Association in 1912 Prof. A. McKenzie opened a discussion on the migration of groups and dealt especially with the Walden rearrangement. During the quarter of a century which has elapsed, the Dundee school under his leadership has greatly advanced our knowledge in this field. On the present occasion, Prof. McKenzie and Dr. R. Roger will open a discussion on intramolecular change involving the migration of groups, and will give an account of their work on deamination and dehydration involving semi-pinacolinic rearrangements in which optically active alcohols and glycols have been used. Contributions will also be made by Prof. M. Tiffeneau (Paris), Dr. S. F. Birch, who will deal with the catalytic isomerization of paraffins, Dr. A. K. Mills and Dr. T. S. Stevens.

A special feature of the meeting will be a two-day discussion on jute, the principal industry of Dundee, including chemical and physical as well as economic aspects of the subject. In this connexion a comprehensive exhibition will be open throughout the meeting. Two popular lectures will be given. Dr. D. A. Spencer will deal with colour photography and Dr. H. W. Melville will give an experimental lecture on the methods of producing light.

By kind invitation of the University Court, a visit will be made to the University of St. Andrews, and visits to jute-spinning mills and Messrs. Moncrieff's glass works at Perth are being arranged. The usual sectional dinner will be held. The following chemists have accepted the Council's invitation to attend as foreign guests of the Association: Dr. H. Theorell (Stockholm), Prof. Marc Tiffeneau (Paris) and Prof. A. von Zeerleder (Zurich).

Section C (Geology)

THE programme of Section C (Geology) will, for the most part, be devoted to Scottish geology. Prof. H. H. Read has taken as the title of his presidential address "Metamorphism and Igneous Action". He has spent much time in the study of this subject in the Highlands and elsewhere, and this summary of his views will be awaited with interest.

Discussions are to be held on the raised beaches of the Forth and Tay and on the boundary between the Carboniferous and the Old Red Sandstone. These are matters of considerable importance to geologists working in Scotland, and the contributors are largely drawn from the Scottish branch of the Geological Survey.

A number of short individual papers will be presented. These will include: Prof. Innes on the geology of the Dundee district; Dr. J. Pringle on the discovery of Cambrian fossils in the Highland Border Series, an important advance in the study of these rather problematical rocks; Dr. M. Macgregor on the buried channel of the Forth, with Dr. Pringle on the Carboniferous rocks of Bridge of Awe and with Prof. J. Ritchie on remains of reindeer from the glacial deposits of Glasgow; Dr. T. S. Westoll on the fish fauna of the 'Caledonian' Old Red Sandstone; Prof. W. T. Gordon on a new type of seed from the Carboniferous rocks of Tantallon; Dr. E. Dix on the Coal Measures of Warwickshire and with Mr. W. D. Ware, on those of Pembrokeshire;

Dr. A. Lamont on antidunes in geology; Mr. E. H. Davison on the solubility of rocks and Mr. F. W. Anderson on algal limestones in east Fife and on ostracod zones in the Wealden and Purbeck Beds.

SECTION D (ZOOLOGY)

PROF. J. RITCHIE'S presidential address to Section D is entitled "Perspectives in Evolution".

Two discussions have been arranged by the Section. The first of these will cover various aspects of parthenogenesis. Prof. A. Vandel, the distinguished French authority on this subject, will open the discussion, Prof. Peacock will give a review of recent researches in experimental parthenogenesis, and Dr. Sanderson and Miss Malcolm (two workers from Prof. Peacock's laboratory) will contribute papers on the cytological aspects of parthenogenesis in snails and sawflies.

The second discussion will deal with the biology of salmon and trout, and, in the six papers arranged under this heading, a résumé of our present knowledge of the migratory habits, homing instinct, food and sexual phases of these fishes will be given. Mr. Menzies, of the Scotch Fishery Board, will open the session, and other speakers include Prof. Orton, Mr. R. M. Neill and Mr. MacFarlane. Mr. D. F. Leney will contribute an account of modern hatchery methods for salmon and trout.

Dr. Fraser Darling will give a semi-popular lecture on the grey seal in which will be included a summary of his recent researches on the behaviour and habits of the colony of seals on North Rona. Prof. Brambell and Mr. H. A. Cole will describe a new ciliary organ found in enteropneusts which suggests affinities with the hypophysis of higher vertebrates and adds further evidence for the chordate affinities of the Hemichorda. Dr. Worthington will outline the developments in research on fresh waters which have been inaugurated at the Freshwater Biological Station at Wray Castle.

There is to be an exhibition of biological films produced by the Strand Film Zoological Production, Ltd., Gaumont British Instructional Films, Ltd., and Associated British Film Distribution, Ltd. Sectional excursions have been arranged to Glen Doll, the Field Station of the Department of Natural History at University College, Dundee, to the Perth Museum, and to the Silver Fox Farm of Mr. J. B. A. Mackenzie at Balbeggie.

SECTION E (GEOGRAPHY)

SECTION E (Geography) at Dundee will this year depart from precedent in that it will not open its meetings with the presidential address. Instead he first morning will be given to certain urban studies of Scotland and to a joint discussion with many other sections on the proposed National Atlas. This latter proposal came before the Section at Cambridge and received general support. Since then a representative committee has been at work on the scheme, and its report will form the basis of the discussion. In the afternoon there will be two papers dealing with recent developments in the Ordnance urvey.

On Friday Mr. A. Stevens will deliver his presidential ddress, there will be one paper by Mr. Linton suggesting a new idea in the evolution of some of the Scottish rivers, and the local secretary, Dr. J. F. Scott, will give a preliminary account of the sectional excursions.

The excursions begin on Friday afternoon with a visit to the city of Dundee and to the Hillbank Linen Works. On the following day the Section will make a circular tour of the Fife peninsula, and on Sunday a visit will be made to part of the Highlands. Another excursion, on Tuesday, will give opportunity to study the agricultural geography of the Carse of Gowrie.

On Monday all papers deal with topics or regions which are outside Great Britain. Prof. T. M. Knox will raise some important points concerning the future of the palm oil industry in West Africa. Dr. N. Friberg, a foreign guest of the Association, will describe highway developments in Sweden. The Spanish zone in Morocco, the great basin of North America, and current movements of population in Eire are the subjects of the remaining papers.

On Tuesday, apart from one paper on the geography of Cheshire at the time of the Domesday Survey, the general topics are more closely related to Dundee or its neighbourhood. Thus one paper deals with population changes in the Lower Tay valley since 1755, and another discusses the geographical background of Scottish sea-borne trade in the eighteenth century. Dr. Snodgrass, whose studies of the agricultural geography of Scotland are well-known, will make comparisons of population density and agricultural type in Britain and the Continent.

The meetings of the Section will end on Wednesday morning with two papers on subjects of physical geography, in one of which Mr. W. V. Lewis will further develop his views on plucking as a factor in glacial valley erosion.

The programme of the Section covers a wide field, and apart from its general interest affords many indications of the way in which geography plays a part in current problems. It is hoped that this side of the Section's activities will make an appeal to those members of the Association who will be naturally interested in the new Division for Social and International Relations of Science.

SECTION F (ECONOMICS)

BY the nature of its subject, the work of Section F (Economics) is essentially concerned with public welfare. It is current events which largely decide the aspects to be discussed. Last year unemployment and the trade cycle occupied the first place. For the Dundee meeting, a number of the papers concern urgent Scottish problems. There are to be papers on housing in Scotland, on the finance of Scottish Local Government, on the finance of new enterprises in Scotland, and on the economy of the crofting districts. Lord Douglas Hamilton will open a special afternoon session on the problem of the distressed areas, and the various measures taken to assist them.

Although the name of Dundee has always been associated with the jute industry, it has been the home of some financial activities of more than local importance. There will be a paper on the Dundee Investment Trusts. Three problems of 'planning' will come up for discussion—the localization of industry, the economics of urban decentralization, and the consequences of the legislation concerning the coal-mining industry. In contrast to these detailed topics, a whole morning will be given up to the discussion of the theory and problems of socialism, in its national and international aspects. It is perhaps a significant sign of the times that the Presidential address by Prof. H. O. Meredith will be on Rates and Taxes.

SECTION G (ENGINEERING)

THE presidential address to the Engineering Section will be delivered by Mr. H. E. Wimperis, who was for many years director of scientific research at the Air Ministry, and has recently been in Australia and New Zealand to advise those Governments upon the establishment of aeronautical research organizations. The subject of his address will be the "Future of Flying". Another item of great aeronautical interest will be a paper to be read by Major R. H. Mayo describing his composite aircraft which is under trial by the Air Ministry and Imperial Airways. The paper will be followed by a discussion which will be opened by a representative of Messrs. Shorts, who have built the trans-Atlantic flying boats, and a representative of Sir Alan Cobham, who has developed a system of flight refuelling.

The Section has during several years given careful consideration to the training of engineers, particularly in university courses. The matter was dealt with last year by Prof. R. V. Southwell in his presidential address and afterwards a questionnaire was circulated to a large number of practising engineers and firms who employ university graduates. A very large number of answers have been received, and these will be shortly reviewed by Prof. Willis Jackson who has been mainly responsible for the work.

An important paper will be read by Prof. R. G. H. Clements on the design of roads. There will be a number of other papers, and the Section will repeat its experiment of last year by including five short papers by junior engineers, each of whom will be allowed thirty minutes for his paper and the discussion which will follow it.

SECTION H (ANTHROPOLOGY)

ACCORDING to custom, the programme has been arranged so that the various branches of the study of man are fairly represented. The section has this year restricted the number of papers to be read, in order that there may be adequate time for discussion. Prof. W. E. Le Gros Clark will give the presidential address (Friday) on "The Scope and Limitations of Physical Anthropology". The Monday morning is devoted to a joint discussion with Section I (Physiology) on "Nutrition and Physique", which should appeal to a wide public. In the afternoon of the same day important communications will be read on "The Affinities of the South African Pleistocene Anthropoids" (Dr. R. Broom) and on "Recent Discoveries bearing on Human History in South Africa" (Prof. Raymond Dart). Dr. Broom has sent a collection of casts which will be exhibited at the meetings. Two papers of philosophical interest will occupy the latter part of the afternoon: "The Evolution of the Human Brain" (Dr. S. Zuckerman) and "Mental Evolution of the Primates" (Dr. R. H. Thouless).

In the periods given to archæology there will be papers on a recent discovery of cult objects at Grimes Graves (Mr. A. L. Armstrong), an Irish hill-site of the Megalithic Period (Dr. E. E. Evans), the types and chronology of beakers in Spain (Dr. Bosch Gimpera), connexions between the Lake District and Ireland in the Bronze Age (Miss C. Fell), and on the prehistory of Uganda (Prof. C. van Riet Low and Mr. E. J. Wayland). Having special reference to Scotland there will be two papers: "Prospects of the Advancement of Knowledge in Early Scottish History" (Dr. A. O. Anderson), and "Some Recent Work of the Royal Commission on Ancient Monuments (Scotland)" (Mr. Angus Graham).

General ethnology is represented by communications dealing with a wooden tea-pot from Tibet (Mr. R. Kerr), racial crossing and cultural efflorescence (Prof. J. Murphy), the crane dance (Prof. P. E. Newberry), sign language and the education of dea mutes (Sir Richard Paget), spiritual journeys o the seer (Mrs. N. K. Chadwick), change of persona name among the Biblical Hebrews (Prof. A. M Honeyman), primitive cults in the religion of the Old Testament (Prof. E. O. James), the wares of a Moroccan native doctor (Mr. W. Fogg). A joint discussion with Section L (Education) on anthropology in education has also been arranged.

In the section dealing with the ethnology of the British Isles there are papers on ballads and tune which travel (Prof. W. J. Entwhistle), the folklor of death cairns (Miss Maire McNeill), the folklor associated with fishing in the north-east of Scotlan (Mrs. M. McCleod Banks), the human interest of a highland folk-collection (Miss I. F. Grant), and with a survey of some Scottish folklore and its origin (Rev. Canon J. A. McCulloch). Mrs. Catrion MacKintosh will discuss Hebridean folk-songs, an will sing some of the songs to the accompaniment o the old harp.

SECTION I (PHYSIOLOGY)

ALTHOUGH the Physiological and Biochemica Societies each meets nine times every year yet Section I (Physiology) of the British Associatio offers certain facilities to physiologists and to biochemists rarely provided by their own societie These facilities are prearranged discussions o various topics, contact and joint discussion wit members of other sections and the opportunity t give publicity to authoritative views on scientifi matters of public interest. This is well exemplifie by the programme of Section I for the Dundee meeting.

On the Thursday morning, Sections B and I wil both hear Prof. E. K. Rideal give his presidentia address to Section B on the importance of surfac film phenomena in biology. Thereafter, there wil be a joint discussion with Section B for the rest o the day on "Tissue Respiration". The subject wil be introduced by Prof. R. A. Peters, who convene the discussion. Nine papers will be given. A featur will be the allocation of time for informal discussio of the subject by recognized authorities who hav promised to attend.

On Friday morning, Section I will discuss "Th Problem of Pain". Very appropriately they wi visit St. Andrews for this purpose, where the memor of Sir James Mackenzie, in his day the outstandin authority on the subject, is still fresh in the min of local workers. In the afternoon there will be visit to the Mackenzie Institute for Clinical Researc and to places of scientific and historical interest the neighbourhood.

On Monday morning there will be a discussion o "Nutrition and Physique" with Section H (Anthr pology). Here it is to be expected that the vexe question of "Nature versus Nurture" will recei much attention.

On the Tuesday morning Prof. D. Burns w deliver his presidential address to Section I. H subject is "The Assessment of Physical Fitness His communication will be followed by a discussi n the same topic which will extend into the afteroon.

Both the discussions on the Monday and the Tuesay deal with matters of great importance at the resent time. Their scientific interest is equalled nly by their practical significance for human welfare. t is to be hoped that many members of the Associaon, not primarily physiologists, will take the opportunity to be present at these two discussions.

SECTION J (PSYCHOLOGY)

THE presidential address by Mr. R. J. Bartlett is on measurement in psychology.

Two discussions have been arranged. One is on aining the mind. Starting with the old problem f formal training, possible ways of giving a broad nd general discipline will be debated. The other discussion has to do with the use of films in propaganda, ntertainment films and public taste, their influence n the child, and so on.

The remaining papers cover most of the fields of sychology. Of broad interest are papers on methodology in psychological medicine, the ego in his world, e primitive nature of poetic genius, and the sychology of frustration. Industrial problems dealt ith are the selection of skilled engineering workers, e sorting process in laundries, the analysis of skill y motion study, and the everyday work of a vocaonal adviser; while under mental testing and general xperimental psychology come papers on the psychological respectability of physical activity, common nse in music testing, the relations between characteristic interests of schoolboys, the predicting of sychological aptitude in students, experiments on e ultra-perceptive faculty, measures of reliability in oup intelligence tests and recent experiments in ocial psychology.

SECTION K (BOTANY) AND DEPARTMENT K* (FORESTRY)

THE president of Section K (Botany), Prof. D. Thoday, will deal in his presidential address with e "Interpretation of Plant Structure". Captain eorge I. Campbell, the chairman of K*, will speak n "Forestry in Scotland".

The semi-popular lecture, to be given by Sir Frank tockdale, will deal with "The Application of conomic Botany in the Tropics". Department K* as organized a special meeting on the larch, and a int meeting of Section K and Department K* will e concerned with local races of trees, seed proenance, and allied topics. The last Tuesday afteroon of the meeting will be given up to the demonration of exhibits, and the proceedings on that fternoon will finish with the showing of a film, Coloured Impressions of Tweeddale and the Borders" y Miss I. M. Hayward.

In addition to these special items, Section K and epartment K* will have before them a comprehensive programme ranging over many aspects of otany and forestry, including a number of communications from Scottish workers. The serious bours of the meeting rooms will be varied by cursions to places of interest to botanists and resters, the chief excursions taking place during e week-end.

SECTION L (EDUCATIONAL SCIENCE)

FOLLOWING customary practice in recent years the papers to be read before Section L (Educational Science) are grouped around one main theme with two subsidiary themes. The main subject at the Dundee Meetings will be "Education in and for Industry" which will be discussed on the mornings of Thursday, Friday and Monday. Papers will also be read on Monday on recent educational research in Scotland, while on Tuesday there will be a symposium on the Spens Report.

The President of the Section for 1939 is Dr. A. P. M. Fleming, director of research and training to Metropolitan Vickers Co., and it is fitting in view of the paramount importance that his firm attaches to research and training that his presidential address on Thursday will be on the subject of education for industry. Following the address, papers on aspects of the same theme will be read by Mr. Lester Smith, Dr. Fisher and Mr. Mouat Jones, who will respectively analyse the part played by local education authorities, public schools and universities in educating those who enter industry at various age-ranges and in various capacities. On Friday, papers will be read on education in industry by Mr. Longmuir of Messrs. Mavor and Coulson, and Mr. Darbyshire of the L.M.S., who will describe schemes of training carried out by industrial firms. The contribution made by technical colleges will be discussed by Mr. C. F. Richardson and Principal Smail of the Heriot-Watt College. Post-advanced courses at the universities will be described by Dr. Willis Jackson.

At Monday's meetings papers will be read on aspects of industrial education by Mr. Herbert and Dr. Radley who are the chief research officials at the L.M.S. and the G.P.O. respectively. Educational research in Scotland will be discussed by Prof. McClelland and Mr. Hepburn on the same day. Papers on the Spens Report will be read on Tuesday morning by Miss L. Grier, Mr. Henshall, and Mr. J. B. Frizell.

During the meetings the reports of two research committees will be presented (*a*) on the organization of educational research (Friday), (*b*) on the informative content of education (Monday). Visits will be paid on Monday to Perth Academy and on Tuesday to the Dundee Child Guidance Clinic.

SECTION M (AGRICULTURE)

THE whole of the programme of Section M (Agriculture) has been designed to be of immediate practical interest to the farmer, and in all of the discussions which have been arranged, a balance has been kept between recent scientific work and its application in practice. Sir Thomas Middleton will open the proceedings on Thursday with his address entitled "Practice with Science" which will be the keynote for all that follows. Other papers on that morning are "The Breeding and Feeding of Beef Cattle" by Mr. Howie, "Sprouted Fodder in Cattle Feeding" by Principal Paterson, and "Pre-digestion of Coarse Fodders" by Mr. Godden.

Friday morning will be devoted to a discussion on agricultural education to be opened by Mr. MacGregor, who will give an account of some Fife experiments in agricultural education. Mr. Wannop will deal with the organization and working of young farmers' clubs, and Prof. Comber will speak on advisory work in relation to agricultural education and research.

A subject of immediate practical application, namely, grass conservation, will be discussed on Monday morning. This will be opened by Mr. Martin Jones, who will deal with "The Place of Grassland in Modern Food Production". He will be followed by Dr. Watson, Mr. Roberts and Prof. Kerr, who will speak respectively on the scientific, economic and engineering aspects of grass conservation.

A subject suited to the locality is that of seed potato growing. A discussion on this will be opened by Mr. Wedderspoon, who will speak as a growe Virus diseases and seed potatoes will be considere by Dr. Cockerham, and Dr. McIntosh will de with the importance of variety in potato produ tion.

An innovation this year is the display of a seri of agricultural films by Mr. More and Dr. Gordon the Department of Agriculture of the University Edinburgh. These will be shown on the Monda afternoon.

THE INSTITUTE OF MEDICAL AND VETERINARY SCIENCE, ADELAIDE

Opening of New Laboratories

By Sir Charles Martin, C.M.G., F.R.S.

The new Institute of Medical and Veterinary Science was officially opened on May 24 by Sir George Murray, Lieutenant-Governor of South Australia and Chancellor of the University of Adelaide. It represents in part an extension and modification of the pre-existing facilities for the study of pathology, bacteriology and biochemistry at the Adelaide Hospital, which is the School of Medicine of the University; in part, it is a new development:

(1) To carry out, with more adequate accommodation, equipment and staff than heretofore, the routine investigations in the subjects mentioned above for the Adelaide Hospital, Stock and Brands Department, country hospitals and private practitioners.

(2) To engage in research into the causation, diagnosis and cure of disease in man and animals.

(3) By bringing into a building devoted to these purposes the University teaching departments of pathology, bacteriology and applied physiology, as well as a properly equipped clinical lecture theatre previously wanting in Adelaide, to attempt to inculcate in the medical students that appreciation of the significance of laboratory medicine to which at present comparatively little attention is paid, and thus to render their later outlook more truly scientific.

The Institute will work in the closest collaboration with the Adelaide Hospital on one hand and with the University on the other, and adds greatly to the amenities of the Adelaide Medical School.

The Institute is the result of a joint effort on the part of the University and members of the staff of the Hospital to bring together in closer association the Department of Pathology of the University and the pathological services of the Hospital. As the two institutions adjoin there were no topographical reasons why this should not be brought about. The Institute is located in the grounds of the Hospital. It faces Frome Avenue, on the opposite side of which is the University campus. It extends backwards amidst the hospital buildings, which are arranged on the pavilion system. It is, therefore, suitably placed for service to the Hospital and readily accessible to patients. It is also close to the other scientific institutes of the University and to the University library. The style is Georgian, with a pleasing simple frontage, and it has been judiciously planned so as to permit of future extension.

In 1936 the authorities were fortunate in securin Dr. E. Weston Hurst for its first director. Shortl afterwards, the University appointed Dr. Hurst t a research professorship which whilst it gives hi the status of a senior officer in the Universit makes no demands upon the director for teachi duties.

Building was not commenced until 1937, so th the details of planning and equipment were able t be made under his supervision, and it is clear fro the description of the arrangement of the Institut that they have been admirably conceived an carried out. Facilities for research have had du consideration.

The Institute has two stories with a half-basemen It contains some twenty laboratories, a library, tw classrooms, a lecture theatre, a complete operatin suite for animals, common rooms for staff an students, offices for the director, and an abunda supply of general service rooms (hot room, cold roo photographic suite, etc.), plenty of store rooms an a workshop.

On the first floor is a museum, 80 ft. × 40 ft., house the collection of specimens of morbid anatom hitherto inadequately accommodated at the Un versity. Perhaps the most notable feature of th Institute is its fine animal house. This is situate 100 yards from the main building. Especial care h evidently been devoted to its construction and equi ment for the breeding of experimental animals an the convenience and accuracy of experimental wor Expense has not been spared for this essential pa of an institute for research in pathology, and it co one tenth as much as the main building.

The total cost has been £53,000. £15,000 w contributed by three notable benefactions, £10,0 by the commissioners of charitable funds and th rest by the Government of South Australia.

The Institute is governed by a council of s representing the Adelaide Hospital, the Universi and the veterinary interests of the State.

The Adelaide Hospital being a Government instit tion, the surrender of a measure of its sovereign and some of its territory required a special Act Parliament. By this Act, the Government undertak to contribute £10,000 a year towards the maintenan of the Institute, the remainder being derived fro the University Chest and by the allocation of certa ust funds at the disposal of the University. As is sual, the provision of a sufficient revenue is left to ick. If the amount of research is to be enough to istify the accommodation, much more than is at resent forthcoming will be required to provide modest alaries for the upkeep of research workers. There is o lack of suitable graduates in Australia who are nxious to devote themselves to investigation if they an see a reasonable prospect of a living wage. At resent they come to Great Britain with Rhodes and eit and other research studentships and when rained remain, as there are not openings for them in heir mother country. This drainage is not too good or Australia.

Both University and Hospital are to be congratulated on having secured convenient modern ccommodation and equipment for teaching and esearch in pathology and for the better treatment f patients and investigation of their diseases. They re still more to be congratulated on having surmounted the difficulties always attending combined action by the two corporate bodies under separate governance.

Close association of pathology with clinical medicine is desirable. A pathological institute can function apart from a hospital, but its scope is restricted, and researches tend to become remote from the immediate problems of human medicine and the workers lack the stimulus to effort which is afforded by contact with the sick.

An unusual feature in the new Institute at Adelaide is the inclusion of the study of animal pathology as one of its main objects. For some years investigations of diseases of farm animals have been carried on at the pathological laboratory at the Adelaide Hospital, the Government providing a veterinary officer and technical staff for the purpose. The continuation of this association of the study of human and animal diseases will be both convenient and advantageous, for pathology has no specific boundaries, and have not most of the recent discoveries in human pathology been, perforce, achieved by experimenting with animals ?

SYNTHETIC SOUND

N *Philips Technical Review* of June, which is edited by the Research Laboratory of Philips Glow Lamp Factory, Eindhoven, Holland, there is an interesting paper on "Synthetic Sound" by J. F. Schouten. A sound of prescribed character of periodic vibrations, in other words, a sound consisting of harmonic omponents of prescribed amplitude and phase, is btained synthetically. This method permits a closer study of a number of problems which are onnected with the nature of the perception of sound. The principle used is to make a beam of light vary as a function of the time in the desired wave form. The beam is incident on a photo-electric cell and ctuates a loud-speaker. A paper stencil is made nd is uniformly illuminated by a point source of ght from a tungsten arc lamp placed at a considerable distance away. Behind the stencil there is a rotating aluminium disk in which nine slits have been made, each with a width of 1 mm. and at istances of 40° from each other. Behind the disk, which is driven by a motor, is a lens which focuses the light source upon the photo-electric cell. The only light which can fall upon the photo-electric cell is that which has passed through the part of the stencil cut away and one of the slits. When the disk is turning, the amount of light transmitted at each moment is proportional to the height of the part cut away at the point behind which there is a slit at that moment.

The centre of the wave form is situated on the extension of the axle of the motor. With the arrangement used negative values of the light transmissibility annot be produced, and so a constant quantity equal to the largest negative value occurring is added to all the ordinates of the wave form to be reproduced. The frequency was determined by regulating the number of revolutions per minute of the motor. If the desired form is given as the sum of a number of sine-shaped components, the components can be added and the resultant wave form cut out. It is easy to cut out the forms separately one above the other.

An attractive property of this apparatus is that it makes it possible to study directly the influence exerted on sound perception by changes in the wave form. For example, when several components have been cut out one above the other, any one of these components can be made to disappear, simply by screening this part of the stencil from the light.

According to a law of acoustics which was formulated by Ohm, a definite pure tone will be observed in a synthetic sound, when a component of the frequency in question occurs in the Fourier analysis of the wave form. According to a rule enunciated by Helmholtz, the sound perception will further depend entirely on the relative intensity with which the different components occur and will be independent of the relative phase of these components.

The author accounts for these facts in a simple way, which seems to be permissible anatomically, that there are in the ear a large number of resonators tuned for different frequencies. This mechanism explains in the first place the fact that the ear carries out, as it were, a Fourier analysis of the sound while it furthermore makes it possible to suppose that the stimuli which are sent from each resonator to the brain depend exclusively upon the intensity, and not upon the phase of the component in question. The author shows how to test this rule by his apparatus.

Four wave forms were built up of very different shape but all having the same harmonics from 1 to 20. It was found that these four totally different wave forms were quite indistinguishable as to their sound impression. It is also stated that non-linear distortion occurs in the ear. This is manifested by the fact that when a pure tone of sufficient intensity is heard, higher harmonics are formed in the ear; when two tones of different frequency are heard at the same time, new tones are formed with frequencies which are linear combinations of the two tones heard (combination tones). The most obvious combination tone is the difference tone and this is the one that was first discovered.

FORTHCOMING EVENTS

British Association for the Advancement of Science (Dundee Meeting).

Wednesday, August 30

At 8.30 p.m.—Sir Albert Seward, F.R.S.: "The Western Isles through the Mists of Ages" (Presidential Address).

Thursday, August 31

At 10 a.m.—Prof. E. K. Rideal, F.R.S.: "Film Reactions as a New Approach to Biology" (Presidential Address: Section B).

Prof. J. Ritchie: "Perspectives in Evolution" (Presidential Address: Section D).

H. E. Wimperis: "The Future of Flying" (Presidential Address: Section G).

A. Mackay, Dr. W. B. Inglis, A. Cavalcanti, Oliver Bell, R. Ford, W. Farr: Session on Films (Section J).

Dr. A. P. M. Fleming: "Education for Industry" (Presidential Address: Section L).

Sir Thomas Middleton: "Practice with Science: the Farmer's Position and the Scientific Worker's Programme" (Presidential Address: Section M).

At 10.30 a.m.—Dr. S. E. Wilson, Dr. M. L. Anderson, J. A. B. Macdonald, J. M. Murray, F. Story: "Larches" (Discussion: Section K*).

At 11 a.m.—W. O. Lester Smith, Dr. K. Fisher, B. Mouat Jones, Dr. J. A. Bowie: "Education as a Preparation for Industry" (Discussion: Section L).

At 11.30 a.m.—R. S. Whipple: "Instruments in Science and Industry" (Presidential Address: Section A).

Prof. R. A. Peters, F.R.S., Dr. M. Dixon, Dr. H. Theorell, Dr. D. E. Green, Sir F. Gowland Hopkins: "Tissue Respiration" (Discussion: Sections B and I).

Prof. E. G. R. Taylor: "The Proposed National Atlas" (Joint Discussion: Sections C, D, E, F, H, K, M).

At 2 p.m.—W. R. Day: "Larches" (Discussion continued: Section K*).

At 2.15 p.m.—Prof. D. Keilin, F.R.S., Dr. F. Dickens, Dr. H. A. Krebs, Dr. T. Mann, Dr. J. H. Quastel, Dr. S. Ochoa, Prof. H. S. Raper, F.R.S., Dr. E. P. Poulton: "Tissue Respiration" (Joint Discussion, continued: Sections B and I).

Prof. A. Vandel, Dr. A. P. Sanderson, Miss M. C. Malcolm, Prof. A. D. Peacock: "Aspects of Parthenogenesis" (Discussion: Section D).

At 2.30 p.m.—(*a*) Dr. J. S. Huxley: Interim report on inquiry into organisation of research in Britain; (*b*) A. M. Carr-Saunders: "Population Problems" (Division for Social and International Relations of Science).

Friday, September 1

At 10 a.m.—Dr. J. Lawrence, Dr. W. B. Lewis, Dr. L. H. Gray and Dr. J. Read: "Artificial Radioactivity and its Applications" (Discussion: Section A).

Dr. H. W. Melville, Prof. S. Sugden, F.R.S., Prof. W. F. K. Wynne-Jones, Dr. M. Ritchie, Prof. T. Alty: "New Technique in Physical Chemistry" (Discussion: Section B).

W. J. M. Menzies, P. R. C. Macfarlane, Dr. K. Carpenter, R. M. Neill, Prof. J. H. Orton and J. W. Jones, D. F. Leney: "The Habits of Salmon and Trout" (Discussion: Section D).

Prof. W. E. Le Gros Clark, F.R.S.: "The Scope and Limitations of Physical Anthropology" (Presidential Address: Section H).

R. J. Bartlett: "Measurement in Psychology" (Presidential Address: Section J).

Prof. D. Thoday: "Interpretation of Plant Structure" (Presidential Address: Section K).

J. B. Longmuir, G. L. Darbyshire, F. T. Chapma Principal J. Cameron Smail, Prof. W. Jackson, C. Oakley: "Education in Industry" (Discussion: Section L).

G. MacGregor, A. R. Wannop and Prof. N. M. Comber "Agricultural Education" (Section M).

S. G. Barker, W. G. Macmillan, H. L. Parsons, D. Carte H. A. Elkin, Col. J. C. Brockbank, H. C. Bryson, D. Oury: Special Session on Jute.

At 10.40 a.m.—Prof. D. Waterston, Prof. J. Morley, Pro B. A. McSwiney and Dr. B. M. Unkauf, Prof. J. Moir, Prof. E. D. Adrian, F.R.S., T. F. Todd: "Th Problem of Pain" (Discussion: Section I).

At 11 a.m.—A. Stevens: Presidential Address (Sectio E).

At 11.15 a.m.—Dr. J. B. Simpson, Dr. E. M. Anderso Dr. M. Macgregor, Dr. R. Campbell, C. F. Davidso F. W. Anderson: "The Raised Beaches of the Fort and Tay" (Discussion: Section C).

At 2.15 p.m.—Exhibition of Biological Films in th 'Cinerama' Picture House (Section D).

Conference of Delegates of Corresponding Societie Prof. H. L. Hawkins, F.R.S.: President.

At 5 p.m.—Sir Frank Stockdale: "The Application Economic Botany in the Tropics".

Saturday, September 2

At 10 a.m.—Prof. E. A. Milne, F.R.S., Dr. G. P. Tarran K. Snell, Prof. R. Peierls: "The Teaching of Mec anics" (Discussion: Section A*).

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned:

Inspector for Livestock Duties (unestablished)—The Secretar Establishment Branch, Department of Agriculture for Scotland, St. Andrew Square, Edinburgh 2 (September 2).

Instructor in Electrical Engineering and an Instructor Mechanical Engineering at the Constantine Technical Colleg Middlesbrough—The Director of Education, Education Offic Woodlands Road, Middlesbrough (September 4).

A Scientific Officer (Engineer) at the Road Research Laborator Harmondsworth—The Establishment Officer, Department of Scie tific and Industrial Research, 16 Old Queen Street, S.W.1 (quoti J.39/10) (September 5).

Assistant Drainage Engineers (temporary) in connexion wi Land Drainage schemes—The Secretary, Ministry of Agriculture a Fisheries, 10 Whitehall Place, S.W.1 (September 8).

Scientific Officers (Ref. No. B.3430) in the Air Ministry Scie tific Research Pool, and Assistants Grade II (Ref. No. B.3440)—T Chief Superintendent, Royal Aircraft Establishment, South Far borough, Hants (September 8).

A Research Physicist for the Department of Glass Technology The Registrar, University, Sheffield (September 9).

A Statistical Officer at the General Register Office—The Regi trar-General, Somerset House, W.C.2 (September 25).

Meteorological Officer Cadets in the Department of Indust and Commerce—The Secretary, Civil Service Commission, 45 Upp O'Connell Street, Dublin (September 28).

Professional Officer (Field Husbandry) in the Department Agriculture and Forestry of the Union of South Africa—The Secreta Office of the High Commissioner for the Union of South Africa, Sou Africa House, Trafalgar Square, W.C.2 (September 30).

Lecturer in Agricultural Chemistry in the University Sydney—The Secretary, Universities Bureau of the British Emp 88a Gower Street, W.C.1 (October 15).

A Cotton Botanist—The Secretary, Indian Central Cotton Co mittee, Vulcan House, Nicol Road, Fort, Bombay (October 20).

Civilian Education Officers, Grade III, in the R.A.F. Education Service—The Under-Secretary of State, Air Ministry (S.2.I.) (R.M.P. Adastral House, Kingsway, W.C.2.

Assistants (Grade III) in Research Departments—The Establis ment Officer, Department of Scientific and Industrial Research, Old Queen Street, S.W.1 (quoting A/139).

Assistant Advisory Officer to the Board of Greenkeep Research—The Director, St. Ives Research Station, Bingley, Yorks.

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, SEPTEMBER 2, 1939 No. 3644

A PALÆOBOTANICAL RETROSPECT

IT is one of the privileges of the study of science to-day that it gives to the student a perspective and a sense of proportion that has a wonderfully steadying effect in these anxious days, and thanks to the happy decision of Sir Albert Seward to leave technicalities aside in his presidential address to the British Association, which is printed in the Supplement to this issue of NATURE, his listeners and his readers have had their thoughts tuned to a sense of distance and of time which permits a saner contemplation of the present temporary European turmoil.

No subject could be more appropriate for contemplation by a Scottish audience, or indeed by any British audience, at this holiday season, than a retrospective survey of one of the most popular holiday retreats, the Western Isles of Scotland; but the simple language in which problems of the widest import and of the most intriguing nature are expounded, makes the address at the same time a fascinating example of the scientific method in operation—as Sir Albert expresses it "of how a student asks questions of Nature and does his best to interpret the answers". For a few magic minutes it must have been a great joy to his listeners to yield themselves completely to the direction of so competent and persuasive a guide, and with him to take an excursion "into a world that knew not man", for the Western Isles are contemplated when they were part of a great continent, the Thulean continent or province, at a time some sixty million years ago, and human beings have not appeared upon the scene until all but one fiftieth of this period has transpired.

If thus vast tracts of time are passed in review and at the same time problems raised which demand a mental grasp of distances that cover a large part of the northern hemisphere, the picture is built up by a creative imagination working with the most scrupulous regard for detail, and probably no feature of the address would more impress the newcomer to such problems than the suggestive use that is made of careful, detailed observations upon fossil plant material, the debris perhaps of a forest floor, preserved through the ages by the processes of sedimentation or the fortuitous action of volcanic agencies. The detailed sculpturing of a pollen grain needs microscopic examination with careful optical control, but through it may be built up a 'spectrum' of pollen dispersion in peat or coal which is as revealing to the botanist as is the spectrum of a star to the astronomer. Careful methods of clearing may render details visible in a fossil cuticle which permit the recognition of a microscopic leaf parasite and thus some suggestion as to the moisture of the climate in which this leaf-born cuticle had flourished. The student of the living plant must admit that if he had studied details of form and venation of leaves with the thoroughness of his palæobotanical colleague, very often his claims as to the affinities of living plants would be more securely founded.

Sir Albert's reconstruction of the Thulean forest is based in part upon the earlier collections from the plant-containing beds of the islands of the Inner Hebrides, and particularly the layers near the base of the basaltic lavas on Ardtum Head, near the south-western corner of Mull, but it is based mainly upon recent and as yet unpublished data obtained by Sir Albert himself, in association with Mr. W. N. Edwards, keeper of geology in the British Museum, and Dr. J. B. Simpson of the

Geological Survey; they are, then, the result of a felicitous partnership of botanists and geologists and illumine the field of study of both sciences.

The conifers of this corner of the globe in these far-off days were certainly more varied and diverse than the Forestry Commission would venture to utilize in trying once more to reclothe their rocky flanks and mist-swept valleys with forest. *Sequoia sempervirens* they might plant, and also Abies, but Cryptomeria and Cephalotaxus are surprising genera to find in a Hebridean flora; they are confined to-day to the Far East, as is also that other remarkable gymnosperm, *Ginkgo biloba*, the maidenhair tree, a doubtful native now of any country but still much valued in cultivation in China and Japan.

Indeed one striking result of this survey is the remarkable preponderance in the probable generic sources of fossil pollen, and in the debris of woody gymnosperms and angiosperms, of generic names which now are associated with the flora of the Far East. Many a keen gardener in Sir Albert's audience—and in a Scottish audience there would be many—must have been intrigued to realize that, in introducing to the garden such plants as Cercidiphyllum for its beautiful autumnal foliage, or such a flowering shrub as an Abelia, he was re-introducing to a Hebridean environment a genus which flourished in the Thulean forest sixty million years ago; the wheel has come full circle.

It is evident that the former existence of this vast continent, reaching into the Arctic Circle and linking North America through Greenland with Europe and even the Far East, has considerable significance in relation to problems of plant distribution of the present day—a point that is made clear by Sir Albert's suggestive discussion of selected genera of flowering plants. This naturally leads to a reference to hypotheses of drifting continents, discussed by Prof. W. W. Watts at the Norwich meeting of the Association. Sir Albert recognizes that geophysical methods of precision have as yet failed to furnish evidence of any sliding of the earth's crust, but he points out that "geologists and palæontologists contribute facts that are incontrovertible however much they seem to be in opposition to the views of students whose primary interest is in geophysical problems".

On such vexed questions of evolution as the origin of the flower and the angiosperm carpel, this Hebridean flora of sixty million years ago is silent. So comparatively recent a time is this in terms of evolutionary processes, that the forest has already taken on the general aspects of a modern sub-tropical forest with seed plants dominant.

Sir Albert discussed in this connexion the fascinating problems raised by Prof. T. M. Harris's observations upon forest beds at Scoresby Sound in Eastern Greenland, which suggest that a luxuriant and uniform vegetation once occupied an area stretching from central Germany to southern Sweden and a thousand miles farther north, beyond latitude 70° N. In those days arctic voyagers, had there been any, might have felled tall trees for their masts within the Arctic Circle, and the fossil records from both arctic and antarctic regions are a constant reminder that the problems of climate of past time raise questions of far-reaching implication.

In fact the address showed how the palæobotanical approach stimulates interest, gives significance to the minutest detail and adds depth and width to our contemplation of everyday phenomena. Inevitably, therefore, the thought arises, as it emerged at the end of the address, why is this enrichment of everyday experience usually denied to us during school years. But a plea for the introduction of geology to a curriculum which is already so overloaded that even biology still often demands a place in vain is scarcely likely to receive more than a sympathetic hearing.

Perhaps the solution is along the lines followed now in an increasing number of schools, where up to the School Certificate stage the formal divisions of science are no longer recognized and general science is studied; when the material for exercises in scientific method can thus be selected in accordance with their claim upon experience, the soil will certainly win its way into the class-room and thus, for certain schools, where perhaps some member of the staff has made contact with geology in his years at the university, the rocks and their story and that of the agencies at work moulding the earth on which we live will be permitted to weave their own spells upon the unspoilt imaginations of the coming generation, which may thus become alive to the possibilities of interest which the subject holds. It will then perhaps add still more, for a coming generation, to the foundation of a serenity of outlook and saneness of poise, conspicuous in this year's president, which if more widely spread among us, would to-day have its definite value in preserving the community from the onslaught of the 'war of nerves' now so loudly proclaimed as in full spate.

THE FUTURE OF MANKIND

The Fate of Homo Sapiens
An Unemotional Statement of the Things that are Happening to him Now, and of the Immediate Possibilities Confronting Him. By H. G. Wells. Pp. vi+330. (London: Martin Secker and Warburg, Ltd., 1939.) 7*s*. 6*d*. net.

NO one having reached maturity in the reign of Queen Victoria and having survived into our present epoch can be expected to feel altogether at home. In those days, distant not so much in time as in atmosphere, although everyone believed in inevitable progress, "there was a widespread feeling that nothing more of primary importance was ever likely to happen". It was precisely because of this static condition of things that the public so eagerly took to Mr. Wells's futuristic romances.

But all that has changed; the dominant question is: What is likely to happen? And the answers given to it are disturbing. Mr. Wells's answer is no exception:

> "There is no reason whatever to believe that the order of nature has any greater bias in favour of man than it had in favour of the ichthyosaur. . . . I perceive that now the universe is bored with him, is turning a hard face to him, and I see him being carried less and less intelligently and more and more rapidly . . . along the stream of fate to degradation, suffering and death."

Mr. Wells does not consider that this fate is as yet absolutely inevitable, though to escape it there will have to be something in the nature of a wholesale conversion of the species to more rational habits of thinking and behaving; and he does not appear to believe that this is very likely to happen.

The gravest menace to humanity at present springs, as everyone recognizes, from war. The Marxists regard war as a natural symptom of an economic system in decay; but Mr. Wells repudiates Marxism. For him, war has been from primitive times a natural form of social blood-letting, caused by a surplus of young men. In the pre-scientific epoch only relatively puny means of destruction were available. But the inventive urge of the species has altered the situation for the worse. Instead of being "part of the accepted human rhythm", war has become "a galloping consumption of the human species".

Thus a situation has developed which threatens the human race with decline and ultimate extinction. The question is: Are human powers of self-adaptation sufficient to enable the species to adjust itself to this new situation? The trouble is that speed seems to be called for; there is no time for the older and slower methods of adaptation. Of course, man's possession of a unique brain gives him an advantage; and the readjustment will have to be a *mental* one. This mental readjustment, says Mr. Wells, must involve three main essentials: (1) the idea and tradition of war must be eliminated; (2) "The vast and violent wastage of natural resources in the hunt for private profit, that went on in the nineteenth century, must be arrested and reversed by the establishment of a collective economy for the whole world"; (3) the resultant world organization must be "of an active, progressive, imaginatively exciting nature", so that the surplus energy of youth may be absorbed by it and not allowed to run to destructive waste in war.

These three principles, peace, collectivism, and incessant new enterprise, are interdependent and inseparable. In Mr. Wells's view, the League Covenant failed because it completely disregarded these principles. It overlooked the problem of the restless young men; and it gave no attention to "the absolute necessity of reconstructing economic life upon a collectivist basis throughout the world".

In order to bring about the mental adjustment involving acceptance of his three principles, Mr. Wells calls for "such a *kultur-kampf* as the world has never seen before". Nothing less than the entire reconditioning of our mental life is required. What our generation needs is the kind of enlightenment that the French encyclopædists provided in the eighteenth century. It was the ideas of Diderot and his associates that "materialised in the American and French revolutions and in a great heartening of the creative spirit of man". Is it possible for this achievement to repeat itself on a larger scale to-day?

Mr. Wells does not believe that our present educational institutions are likely to effect the change. The common schools "are essentially conservative institutions, adapting the common man to the social order in which he finds himself", and they fail to provide "the scientific vision of life in the universe". Thus the existing educational organization "needs to be recast quite as much and even more than the political framework".

It will be plain that what is here advocated is nothing less than a complete change of mentality, a redirection of public interest. The question is whether a new programme of intellectual education, even of the most enlightened kind, would suffice to achieve the change. The real trouble is that the educated, even those with an education in natural science, can be enlightened intellectually, without being in the least enlightened emotionally. What is needed is a transvaluation of values, and this is not to be achieved easily. Mr. Herbert Read has suggested that we should "try the experiment of educating the instincts instead of suppressing them". Many educationists (who as a class are very much more progressive and alive to realities than Mr. Wells would seem to be aware) are trying to work along these lines, but it is work that will not be done in a day. Meanwhile, as Mr. Wells says, the need is urgent.

This is a timely and sincere book and written without fear of giving offence. J. C. H.

TRADITIONS AND FUTURE OF BRITISH DEMOCRACY

The Anglo-Saxon Tradition
By George Catlin. Pp. xii+286. (London: Kegan Paul and Co., Ltd., 1939.) 10*s*. 6*d*. net.

THE Anglo-Saxon tradition has "impregnated the political institutions of the Anglo-Saxon world on both sides of the Atlantic and has provided patterns to all Europe and to the lands that look to Europe". Prof. Catlin seeks, in this book, to re-clarify the political and moral content of that tradition and to derive from it guidance as to the course which should now be taken by the Anglo-Saxon peoples. This tradition is contrasted with the conception of man's purpose in the world that arises from Fascist and Communist ideology.

Whatever may be the truth for German and Russian minds in these concepts, they are not for British. The fulfilment of life in the Anglo-Saxon meaning is in the preservation of our own cultural traditions, while we carry out the changes in economic and social organization that are necessary so that this tradition may flower and bear fruit for all the citizens instead of, as now, mainly for a favoured few. Prof. Catlin urges upon us that if we are to serve our mission in the world we must develop a new vigour of thought and action inspired by humanist philosophy. Only by moving forward with courage and wisdom in the light of our own cultural history will we be saved from drifting unwittingly into errors which will make us appendages to one or other of the totalitarian camps.

The Anglo-Saxon populations of the British Empire should be bound closer together in economic and political co-operation. They have an immense opportunity and responsibility to develop the vast area of the Colonial Empire "until the time comes to transfer it, as a substantial basis of wealth and power and a *peculium* to the direct rule of Geneva or a World State which requires such sovereign possession to give it dignity". They should take the first step towards a new federalism in the world by establishing now a community of interest in all fields with the United States of America.

Perhaps the most striking thing about the book is that, while it is written by a member of the Labour Party, it expresses a view with regard to the mode of economic, social and political evolution which will be acceptable to all Conservatives of progressive mind. The pressure of crises, economic and political, in the modern world, is producing such new formulations of policy as to make the party alignments preposterous There are many things which Prof. Catlin says that I do not agree with. Curiously enough, the main theme of my criticism would be that he is too hard upon the Soviet Union. I should have interpreted its experiment as having a far greater content of social value and of progress than this book gives it credit for. On the other hand, I should have been less tolerant of the German Nazis than, in some passages, he appears to be. There are differences of emphasis but they are of a kind which show how completely obsolete is the old party conflict.

The main contentions of the book are stimulating; they form a valuable contribution to a current of opinion which has been growing in strength in recent times. The issues dealt with are of vital importance to ourselves and to the world. Those who appreciate that we are not going to find our way out of the present impasse without some hard thinking would do well to read this book with care.

H. MACMILLAN.

MAGNETISM: OLD PROBLEMS AND NEW METHODS

(1) Ferromagnetism
The Development of a General Equation to Magnetism. By Dr. J. R. Ashworth. Pp. xiii+97. (London: Taylor and Francis, Ltd., 1938.) 7*s*. 6*d*. net.

(2) Modern Magnetism
By Prof. L. F. Bates. Pp. ix+340. (Cambridge: At the University Press, 1939.) 16*s*. net.

ALTHOUGH the books of Dr. Ashworth and Prof. Bates both deal with aspects of magnetism, their difference in character and purpose is such as to illustrate very forcibly the limitations of any formal system of book classification by title or subject.

(1) Dr. Ashworth has performed a useful service in collecting together, in abbreviated form, his own contributions to magnetism It is more than forty years since he published his first paper on the subject; but most of the twenty-two papers listed have appeared since 1912. The experimental work described includes extensive investigations on the temperature and field dependence of the magnetization of iron, nickel and cobalt, with particular reference to anhysteretic properties, studies of the temperature coefficient of magnets, and measurements of specific heat. In the attempt to develop a general equation covering ferromagnetic behaviour, to which much attention is devoted, use is made of an equation having formal analogies with the van der Waals equation of state for fluids. In this ferromagnetic equation of state, field and intensity of magnetization correspond to pressure and density, and the reciprocal of the paramagnetic Curie constant to the gas constant in the fluid equation. Critical constants are evaluated for the different ferromagnetic materials, and empirical relations between these constants are obtained.

In seeking to correlate a wide range of facts in this particular way, Dr. Ashworth has pursued a very independent course. Many of the relations are striking, but as the task of tracing their significance in the light of the interpretation of ferromagnetism which is now generally adopted is not undertaken, most readers will be left in a state of doubt as to what has, in fact, been achieved. The answer would appear to be that there is a considerable amount of purely empirical correlation covering a limited range of ferromagnetic phenomena, which may be useful for empirical purposes, but that, without much further consideration and development, the fundamental significance of the relations obtained remains obscure. In spite of this drawback in the treatment of one of the main themes, the book is well worth examination by those concerned with magnetism, just because of its almost complete independence of approach to the problem of ferromagnetism. Moreover, some of the experimental investigations are along lines which for some time have been rather neglected, but are now again becoming of central interest.

(2) Prof. Bates, who collaborated in some of the earliest successful investigations on the gyromagnetic effect, and whose subsequent researches have been mainly concerned with magnetism, has written a general survey of recent work. He has been impressed by the difficulty found by students in acquiring a satisfactory knowledge of magnetism, and he believes this to be largely due to the subject having been treated far too much from a strict theoretical point of view. He has, accordingly, given prominence to the description of fundamental experiments. The theoretical side is not excluded—indeed, the first chapter gives a very comprehensive account of the classical and quantum theoretical background—but usually questions of theoretical interpretation are considered only briefly in connexion with experimental work to which they are relevant.

There are good accounts of methods for the production and measurement of fields, and for examining the magnetic properties of isotropic substances and crystals. The details given of the more widely applicable methods, and the practical comments, will provide a most useful guide to those embarking on similar work. Adequate footnote references will facilitate the task of finding fuller information. There are shorter descriptions of more specialized apparatus.

Some of the most outstanding examples of recent experimental technique are admirably presented in chapters on atomic and nuclear moments, and on the gyromagnetic effect. The last part of the book deals mainly with ferromagnetism. Methods for the measurement of saturation magnetization and the determination of the Curie point are described, the general theory is outlined, and there are accounts of the magnetic properties of metals and alloys. The various magneto-thermal effects are fully considered. Finally, a résumé is given of work on magnetostriction and the Barkhausen effect.

Inevitably, in a book of this kind, there is some overlapping with other books dealing generally with magnetism, but the author has chosen his main topics so as to include a considerable amount of material "which a student cannot readily find elsewhere". Though the book, if considered alone, might seem to give a rather ill-balanced survey of the field of magnetism, when considered in relation to other books, it is just this lack of balance which makes it a most useful addition to the literature of the subject. The author's own work has been very varied, and in writing of experimental technique, he includes information of a kind which could only have been gained from practical experience. The book will be particularly valuable to those carrying out experimental work on magnetism. The clear presentation will appeal to the student, and the account of much recent work will be appreciated by physicists and others who wish to keep up to date with the subject.

In one of these two books the author, who has zealously followed up an individual line of inquiry, presents his findings almost unconcerned with their relations to the wider scheme. In the other, the author surveys a wide range of work with a keen appreciation, and with a sense of the interlocking character of scientific investigations. The books present, on one hand, a particular approach to an old problem, and on the other, a broad survey of the new methods for attacking this problem and others related to it. E. C. S.

THE LIVING PLANT

Botany of the Living Plant
By Prof. F. O. Bower. Third edition. With the Assistance of Prof. J. M. F. Drummond and Dr. George Bond. Pp. xii + 700. (London: Macmillan and Co., Ltd., 1939.) 25s. net.

PROF. BOWER'S text-book is so well known for its many excellent qualities that it needs no introduction to British students and teachers. It is evident, however, that during the sixteen years which have elapsed since the second edition was published, many fresh discoveries have been made which it is desirable to include in an up-to-date text-book. In preparing this new edition Prof. Bower has been assisted by Prof. J. M. F. Drummond and Dr. G. Bond.

No change has been made in the general arrangement of the book, which was fully described in NATURE at the time when the first and second editions appeared (NATURE, 104, 274; 1919: 112, 51; 1923); but the sections dealing with certain aspects of plant physiology, cytology and genetics have been largely rewritten or amplified. In particular the chapter on the living cell has been considerably modified, and there is new information on the internal regulation of growth by plant hormones, and also on the influence of the length of day on the flowering of plants.

The sections dealing with mycorrhiza and the fixation of nitrogen by the bacteria present in the root nodules of leguminous plants have also been considerably modified. Recent advances in cytology are well summarized, although necessarily in a somewhat condensed form, and the relationships of cytology to genetics and between genetics and evolution are discussed. There is also a short article on vitamins. On the morphological side the most interesting innovations include a section dealing with the Psilophytales, a more complete treatment of the Equisetales, and a new discussion of the origin and significance of alternation of generations.

The author has also included a chapter on the relation of size and form in plants. In this he cites and discusses examples which support his working hypothesis that "Elaboration of form as the size of the individual increases is a means of maintaining the surface-volume ratio, which would otherwise tend to fall to a point of physiological inefficiency". Prof. Bower admits quite candidly that his views on this subject are not yet fully proved, but he asks meanwhile that his readers shall maintain that "wholesome frame of mind styled by Huxley as 'suspended judgment' until by extended observation this theory of Size and Form shall have been either disproved, or raised to a level of reasonable probability, with Galileo's Principle of Similarity as its foundation". He makes the interesting speculation that the primary form of a plant may be initiated by a hormone "under control of the apical cone".

As one would expect, the book is characterized by a welcome simplicity of expression throughout, and no intelligent student can complain of inability to understand its contents. Opinions differ from time to time concerning what should or should not be included in a text-book of botany, and in these days of specialization it may be felt by some whose botanical interests are somewhat circumscribed, that their own particular subjects have not received adequate attention. But it is difficult to see how a more balanced and broad-minded introduction to general botany could have been written. It is much to be hoped that it will be even more generally used than the two earlier editions.

C. R. METCALFE.

ELECTRON OPTICS

(1) Electron Optics

Theoretical and Practical. By L. M. Myers. Pp. xviii+618+68 plates. (London: Chapman and Hall, Ltd., 1939.) 42*s*. net.

(2) Theory and Applications of Electron Tubes

By Prof. H. J. Reich. Pp. xviii+670. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 30*s*.

(3) Fundamental Electronics and Vacuum Tubes

By Prof. A. L. Albert. (Engineering Science Series.) Pp. ix+422. (New York: The Macmillan Company, 1938.) 20*s*. net.

(4) Electron Optics

By the Research Staff of Electric and Musical Industries, Ltd. Compiled and written by Otto Klemperer. (Cambridge Physical Tracts.) Pp. x+107. (Cambridge: At the University Press, 1939.) 6*s*. net.

(1) MR. MYERS is to be complimented on producing the first book on the subject to be published in Great Britain, and a truly comprehensive and readable book. He has spared no pains in bringing the matter up to date, and his exhaustive survey of the whole field includes some eight hundred references.

Roughly, the first half of the book is mathematical, and gives the fundamental electron-optical laws and a detailed examination of electric fields which brings in the electron trajectory. This eads up logically to the treatment of various types of electron lenses and their aberrations. The mathematical derivations are supplemented by experimental details which bring out the important applications, but more stress could profitably be aid on the physical interpretation of the formulæ deduced.

The second half of the book is mainly descriptive. t deals with the electron multiplier, electron microscope, and some of the latest developments. The immediate application of electron-optical principles in the discussions of these various devices makes stimulating reading, since the uthor has participated in some of the researches which are described.

On the whole, the book is well balanced. Apart from a number of simple misprints, the illustrations are excellent, particularly those showing ravitational models of the electric field. Aspects f the subject which would enhance the value of the book are (1) a discussion of deflection distortion nd design of deflecting systems, and (2) graphical ray tracing involving a discussion of lens design. The section on the space-charge effect is not clear, and needs further amplifying. A most useful addition would have been a discussion of ion focusing and its application to atomic disintegration research.

(2) It will always remain a matter for argument as to what ought to be included in a book of such wide scope as Prof. Reich's, if the subject is to be adequately treated. The author has made a wise choice of subject-matter. He brings to the student of radio-engineering and the future television engineer just those fundamentals necessary for an intelligent appreciation of this wide field. After two preliminary chapters on the physics of their internal action, the behaviour of vacuum tubes and an analysis of circuit conditions are discussed in eleven chapters.

The introduction of the series expansion for the alternating plate current as well as the numerous applications of graphical analysis should prove most helpful to the student. Glow and arc phenomena are discussed at greater length than is usual. This is all to the good, because of their expanding practical applications. The chapters on photo tubes and instruments dependent for their action on the use of vacuum tubes complete an excellent book. The author has brought all his experience as a teacher to bear in his lucid method of presentation. The large collection of references adds greatly to the value of the book for all engaged in research in these fields.

(3) Prof. A. L. Albert's book can worthily take its place among the excellent group of American works on vacuum tubes which have appeared in the last few years. The author has succeeded in his task of introducing to engineers the fundamental principles of electronics.

The first three chapters are devoted to an examination of sources and methods available for production of electron streams. Their utilization in diodes and multi-electrode valves is fully discussed in the next four chapters. After this, vacuum tube amplifiers, oscillators, and modulators are dealt with. Chapters on photo and cathode ray tubes complete the book.

The treatment is non-mathematical throughout, and the illustrations and numerical applications of formulæ aptly bring home the important points that require stressing. A more graphic and detailed account of the electric field as affecting electron motions would have added to the stimulating explanations given.

The book can be recommended to physicists as well as to engineers.

(4) Mr. Klemperer's monograph is an excellent introduction to the study of electron optics. While written mainly for graduate students, the development of the subject almost from first principles extends its usefulness. The cardinal points of electron lenses determine their behaviour and properties. These are deduced on the basis of field plots, and the parallel optical concepts are neatly worked into the scheme. Other important chapters deal with aberrations and magnetic lenses, and a final chapter is devoted to applications. The author has performed a difficult task very well indeed. His choice of subject-matter as well as his method of giving examples of immediate practical applications of theory should prove most stimulating to all his readers. L. JACOB.

PHARMACEUTICAL CHEMISTRY

(1) Bentley and Driver's Text-Book of Pharmaceutical Chemistry

Revised by Dr. John Edmund Driver. Third edition. Pp. ix + 624. (London: Oxford University Press, 1937.) 16*s*. net.

(2) Drugs and Galenicals: their Quantitative Analysis

By Dr. D. C. Garratt. Pp. xiv + 422. (London: Chapman and Hall, Ltd, 1937.) 25*s*. net.

(1) THE pharmaceutical student has, as a rule, only a short period of intensive and continuous study in which to acquire that somewhat heterogeneous collection of knowledge about the inorganic chemicals, synthetic organic substances and components of natural drugs, which constitutes the pharmaceutical chemistry of an examination syllabus. A large part of this knowledge is concerned with the standards of quality specified for the drugs of the British Pharmacopœia, and the methods by which deviations from these standards may be detected. It is reasonable, therefore, that the authors of this text-book should begin with a series of chapters dealing generally with methods for the characterization and analysis of substances used in medicine, and they have spared no pains to secure clarity and simplicity in their statement and explanation of the principles on which these methods are based.

This section is followed by one dealing with inorganic compounds, written so far as possible on the usual lines of a text-book on inorganic chemistry, but distinguished by the addition of that special information required for therapeutic purposes. Thus, the reader is not told how to prepare oxygen—he should already possess that information—but how it is manufactured, what impurities associated with different manufacturing processes may be present, and how he may ascertain whether these impurities are within the limits allowed by the Pharmacopœia.

More than half of the book is devoted to organic chemistry, dealt with on the usual systematic lines, but with each group of substances illustrated by its outstanding pharmaceutical examples.

By this method of treatment the authors have constructed, from what appears at first to be rather difficult material for systematic exposition, a coherent and well-balanced text-book, which contains much interesting information not usually found in books on chemistry written for students That the book is appreciated by its special clientele is clear from the fact that, since the first issue in 1925, it has been reprinted once, and is now in its third edition.

(2) The first reasonably efficient process for the estimation of morphine in opium was published over half a century ago. Since then there has been a steady output of papers on the same subject and recent activity indicates that even now the last word has not been said. Few other drugs have received so much analytical attention as opium but most of them have had a good deal said about them, possibly because the pharmaceutical analyst is an observant and uncompromising individualist who is happiest in using a method in the evolution of which he has himself played some part, or as Dr. Garratt puts it, "individual bias is often responsible for the fact that a method which is found unreliable by some analysts may, in other hands, give good results". Whatever may be the reason, the literature on drug analysis is enormous and Dr. Garratt has earned the thanks of his fellows by putting into this book the results of his critical survey of this mass of material, and giving them the benefit of his seventeen years' experience as drug analyst to the London County Council in trying, comparing and checking selected methods

The book being intended for professiona analysts, explanations of processes are not given and the familiar British Pharmacopœial methods are not quoted, unless comment has to be made or new applications suggested for them. A particularly useful feature of the book is the inclusion of methods for the analysis of mixtures and compounded drugs of various kinds, and the term drug is not interpreted too narrowly, insecticides such as derris and pyrethrum being also dealt with.

Great pains have been taken to secure accuracy and to achieve completely the objective indicated by the title of the book. Here and there small points can be found to cavil at, but there can be no doubt that the book will prove useful to all whose business it is to be engaged regularly, or occasionally, in the examination of drugs, simple or compounded.

T. A. HENRY.

THE EARTH'S CRUST: ITS FABRIC AND FOUNDATIONS

Architecture of the Earth
By Prof. Reginald Aldworth Daly. (Century Earth Science Series.) Pp. xiii+211+47 plates. (New York and London: D. Appleton-Century Co., Inc., 1938.) 12*s*. 6*d*. net.

IT is on record that Prof. Daly's students, in his practising days, used to chant "Every morning in the year, Daly has a new idea". But Prof. Daly's claims to the gratitude of his scientific brethren lie as much in his popularization of the results of geological research as in his many contributions to its progress. In this volume he takes as his text a happy adaptation by the late Prof. P. Termier, director of the Geological Survey of France, "The earth declares the glory of God", and succeeds in justifying it, telling his story in a manner that the intelligent layman can understand. In this matter of popular scientific writing, a trite remark from the author's preface is worth reproduction: such popularization of science requires "effort by the specialist to be an adequate reporter; effort by listener and reader to imagine".

The "Architecture of the Earth" represents the slightly expanded material of lectures on "The Crust of the Earth", given under the auspices of the Norman Wait Harris Foundation of the Northwestern University in May 1937. Special emphasis is placed on the discoveries and classifications made since the opening of the present century; in particular, new light is thrown on old problems as a result of the recent spectacular growth of the young science of geophysics. Four main problems are selected for study: mountain-building, the eruption of lava, the diversification of rocks once molten, and the stability of continents and island masses. Up-to-date results of the analysis of earthquake records and gravity measurements are utilized.

The author expounds in simple language the thesis he recently published in less accessible form —to the effect that the 'third' layer of the earth's crust consists of glassy basalt rather than ultrabasic rocks like dunite and pyroxenite, as the geophysicists are disposed to postulate Thus the earth-shells consist, from the surface downwards, of Sial (the sedimentary and granitic layer of which the continents are composed), with the 'intermediate' layer, the Sima of crystallized basalt underlying the continents and forming the floor of the oceans, otherwise termed the gabbroic layer, and the 'third' shell of vitreous basalt. Concerning the constitution of these layers as deduced from the behaviour of earthquake waves, Prof. Daly expresses himself as not convinced of the force of the argument that, since a fluid cannot transmit shake- (transverse) waves, and such waves are propagated to depths of 60 km. or more, a vitreous shell cannot exist there. He contends that it still remains to be demonstrated that shake-waves cannot be propagated in melted basalt exposed to a minimum pressure of 17,000 atmospheres. Recalling the fact that Gutenberg, from his earthquake studies, deduced the possibility of a vitreous layer at 60–70 km. depth, he refers to Ide's experiments on the passage of sound waves through Pyrex glass and Volarovitch's statement that, up to a temperature of 1100° C., molten basalt at only one atmosphere of pressure has effective rigidity and can transmit shake-waves. From recent laboratory work, the determination of the velocity of shake-waves suggests that the effect of high temperature somewhat offsets that of high pressure.

Prof. Daly further argues that dunite and pyroxenite (supposed to form the 'third' layer, because specimens of these rocks collected from the earth's surface most nearly satisfy the density and velocity requirements) are actually loose-textured and porous rocks which could not exist in that condition in the depths. He suggests interesting experimental work which would throw light on these and other problems, and looks hopefully in one chapter for a Croesus to supply the funds, and in another to a Maecenas to furnish the equipment. Whether his new views are accepted or not, they are characteristically stimulating, and his well-written and richly illustrated volume is worthy of attention from both specialists and laymen.

P. G. H. BOSWELL.

THE COLLAPSE OF CIVILIZATIONS

AT a time when Western civilization seems to be in danger of self-immolation, and in the East the greatest of Empires has yet to show whether it has lost that power of resilience, which has been its most striking characteristic in the history of a civilization extending over a period reckoned not in centuries, but in millennia, some of us may well turn to the past for a sign which will act as a guide to the underlying laws which govern the rise and decadence of peoples. It is this that justifies a reference, belated though it may seem, to a Friday Evening Discourse at the Royal Institution on "The Collapse of Ancient Civilizations", delivered by Mr. Stanley Casson, on February 24.

Mr. Casson, in surveying the rise and fall of peoples and cultures in antiquity, drew the interesting moral—much to the point in the present stress of rearmament—that whereas war-like aggression was a destructive force, hurrying more often than not to its own destruction, militarism, in the sense of preparedness for war, was an essential of survival. In truth, however, his argument developed a broader implication ; and it may not be without present advantage to see how, when observed through the eyes of an archæologist, the main trends of movement revealed by this department of research afford analogies which may aid in the attainment of a judicial and detached view in perspective when estimating present-day tendencies.

Now Mr. Casson points out that so far as our evidence goes, organized warfare begins with the emergence of man from the simple stage of the food gatherer into the neolithic phase of food-production by agriculture—the food gatherer, who lives from hand to mouth, raids the agriculturist in order to seize his surplus supplies of food. The agriculturist—short of becoming a serf, as might have been pointed out—survives only on condition that he organizes a successful system of defence. "So War, the scourge of mankind developed", while militarism, using the term in no derogatory sense, came into being "for the purpose of dealing with War—a part of civilization—its defensive aspect". In other words, "war is the biological process by which a less developed or successful people attempts to get something for nothing, by simple seizure, by violence and by assault", while "the immediate response of the civilized community to imminent warfare is defence, and defence implies what can be called Militarism".

Mr. Casson proceeds to develop his thesis by examining in broad outline the development of ancient civilizations, beginning, naturally, with that of the Sumerians in Mesopotamia. Thus the earliest written records of the Sumerians relate on one hand to the storage of surplus corn, on the other to wars and the treaties which concluded them. There is a further significance in the fact that this surplus of corn had given rise to a leisured class, the priests, who controlled it, and they also controlled education, another consequence of the existence of a surplus. Again, almost as soon as they had perfected the urban mode of life, which is their great cultural legacy to the world, they also perfected a defensive machine with which to protect it. They created an army to defend themselves against the less cultured peoples, possibly still food-gatherers of the mountains to the east, and devoted to it all their intellectual gifts. By the end of the fourth millennium, they possessed armaments which "anticipate by many centuries those of the Homeric and Classical Greeks". Walls and an organized army preserved civilization in its earliest stages ; and, Mr. Casson argues, so firmly did this militaristic defence establish it, that civilization in Mesopotamia survived in fact longer and with more persistence than in any other part of the globe.

This may seem a hard saying, in view of the duration attributed by tradition to the civilization of China, which goes back to a date little, if at all later, than that of Mesopotamia ; but Mr. Casson makes his meaning clear when he goes on to argue and to demonstrate that the civilization founded by the Sumerians not only contributed to the foundation of European civilization—he is evidently a diffusionist—but also endured in an unbroken stream, notwithstanding dynastic and racial changes, though subject to interruption by the Mongols, down to historical, or even, it might be said, to present-day times. In all this period, he points out, there has been no collapse of civilization, no real breakdown.

Turning to Egypt, there is here too an immensely ancient mode of life, largely conditioned by geographical and physical factors, which survived. While its history runs concurrently with Mesopotamian, neither Greece nor Rome were ever more than superficial controls on Egypt. Egyptian culture was too deep-seated, too well-protected to be displaced. Its protection was the desert, which flanked its valley, and the excellent organization of its armies. It survived the attacks of the sea-raiders of the thirteenth century B.C., the Libyans, the Bedouins, and the nomads, who came to raid it and seize its surplus wealth. "Egypt was throughout her history, as well organized against barbarian as was Sumer."

Mr. Casson is fully alive to the importance of the negative instances which lend their support to his theory. These he finds in Crete and the Hittites. Crete, he points out, is "the first complete collapse of a complete civilization". On the basis of a culture derived from the Middle East and to some degree influenced by Egypt, the Cretans forged a peculiar and unique civilization unlike any other before or since. Living on an island surrounded by a sea, difficult even for large ships to-day, they were isolated and free from attack. Therefore, unlike Sumerians and Egyptians, they had no standing army, no militaristic organization, other than for ceremonial, and no navy. Apparently they depended on the fact that the barbarous peoples of the mainlands would be unequipped to cross the dangerous seas to attack them; and so they built no walls. Unwisely, however, they conveyed to those barbarous peoples some knowledge of their wealth and culture; and it is therefore scarcely likely to be accidental that at the very time that Cnossos wanes, Mycenæ waxes. Though it cannot be proved as yet, it is a sufficiently satisfactory working hypothesis that when about 1400 B.C. the whole civilization of Crete crumbles and collapses, it may have been due to the barbarous Greek-speaking peoples of the mainland, the forerunners of the heroic period. It is instructive to note that the Myceneans adopted the externals of Cretan culture, rather than its intimate spirit. Mycenean culture is both cruder and more magnificent than Cretan.

An even more instructive point which Mr. Casson makes is that this great heroic age, of which Homer sang, did not endure. "Examine history," says Mr. Casson, "and you will always find that heroes have little lasting power or survival value. . . . The heroes of an heroic age are busily engaged in squandering the accumulated capital of their predecessors, and living on the carcase of a higher civilization than their own." The Homeric civilization in its brief duration and decadence finds a parallel in the heroic age of England after the departure of the Romans, and in Ireland, as well as in the exploits of the Crusaders in Byzantine history.

Again, of the Hittites, without following the details here, it may be said that the fall of the Hittite Empire—the empire of a people who left us no heritage of culture and had no survival value—is to be attributed to the fact that they allowed a people more barbarous than themselves to encroach on the south and west, and lived with a permanent open door at the back of their fortress. They ignored Europe and Europe destroyed them.

A pregnant contrast is afforded in the respective fates of Greece and Rome. Rome perished and Greece survived. For in the Byzantine Empire—Greek in spirit, in intelligence and in organization, in all three of which it was superior to Rome at any period—Greek culture persisted nearly a thousand years longer than the main structure of Roman culture. Roman culture, even if it left the indelible marks of its great civilization on some of the peoples of Europe, for their eternal advantage, passed away as a complex structure of civilization as certainly as did the Hittite.

The inferences which Mr. Casson draws provisionally at this point may be stated as follows:

(1) A civilization that lives in a world, where there are deeply marked divergences of culture and development, must be fully defended to survive. Its defence must take the form, as did the defence of Byzantium, of attack, if necessary, and of alertness always. As Mr. H. G. Wells has said, "An empire that awaits attack is doomed".

(2) Only where civilizations are of equal development and status can militarism be expunged from the list of essentials for survival. Nowhere in history have civilizations of equal status lived in proximity, unless we make the exception of Egypt and Babylonia.

(3) If the civilization you have created has not enough innate driving force and survival value of its own to transform barbaric peoples who intrude into it, and to assimilate them rapidly, then your civilization will break down by a process of steady barbarization. If you once admit the less civilized and their customs into your own highly developed structure, you will find them sapping its foundations, whittling it away, and leaving you nothing but a ruin.

In regard to this last, which to many will seem the most important in its application by analogy to modern conditions, Mr. Casson goes on to point out that while both the Mesopotamian peoples and the Egyptians admitted barbarians, it was the barbarians who vanished, and the same is true of Greece, but that though Rome admitted barbarians early, in course of time it was the Romans who were barbarized. Rome, he says, fell to an internal assault, which was an assault on the spirit as well as on the structure of Roman life, and the fabric fell an easy prey to the direct attack of still more barbarous barbarians. In support, Mr. Casson instances the evidence of recent archæological excavation in Britain, in which it has been shown how Roman villas were used as squatting places by the barbarous successors of the Romans on such sites. "You must deal with barbarians spiritually as well as physically," he says, "and convey to them that your civilization has qualities which they can envy and emulate, as well as wealth they can loot." Contrast the survival value of Greece. The Greeks absorbed foreign blood without losing their Greek character; and their invention, the *polis*, had not only a prodigious attraction as a mode of life to barbarians of all kinds, but also it carried Hellenism from Greece to the Indus. The Greeks saw that you must present to a people of a lower order of development something which will attract them to you, not with the desire to take your surplus wealth, but to emulate your mode of life.

"Such reflections," concludes Mr. Casson, "on the breaks and pauses in the course of civilization have some value for those who argue by analogy. . . . We should pocket our pride and glance at some of our past failures. For they are chastening to those who indulge in that greatest weakness of the civilized—complacency."

INSECTS IN THE UPPER AIR

BY DR. A. D. IMMS, F.R.S.

THE investigation of insects in the upper air has so far been conducted on a very limited scale. Probably the first attempt to collect insects from such an environment was that made by E. P. Felt, in the United States in 1926, who used a special kind of trap attached to the lower wings of an aeroplane. Since that year, several experimental attempts have been made to explore the insects and other arthropods of the upper air. Thus in 1931, 1932 and 1933 more extended flights by aeroplanes, with insect traps attached, were made in the United States.

The first European entomologist to attempt this line of investigation was L. Berland who, in 1934, used an aeroplane with specially devised nets attached to the wings and controlled from the cockpit. Many flights were made and all were in the vicinity of Paris. Very similar methods have also been used in Asia Minor and at Oran in Algeria. In 1937, J. A. Freeman made collections of insects in the upper air by using kites along the Great Lakes in Canada.

Between 1932 and 1935 Freeman, working in England in conjunction with A. C. Hardy, made a study of insect drift, using nets attached to 300 ft. masts of a wireless station. Specially constructed kites enabling samples to be obtained from given altitudes were also used. In 1938, A. C. Hardy and R. S. Milne published a detailed account of aerial tow-netting from kites with closeable nets attached.

The most extensive investigation of insects in the upper air is that described by P. A. Glick in Technical Bulletin No. 673 (May, 1939) of the U.S. Department of Agriculture. Under the title of "The Distribution of Insects, Spiders and Mites in the Air", a detailed account of the work, running to 150 pages, is given. The collecting was done during the five-year period 1926–1931, and special kinds of trap fitted to the wings of diverse types of aeroplane were employed. It appears that more than 1,300 flights were made at Tallulah (La.) and 44 flights in Mexico. More than 30,000 insects and spiders were taken at altitudes ranging from 20 ft. to 15,000 ft. and were most abundantly captured in the month of May. Eighteen orders of insects together with arachnids were represented. In the Tallulah collections there were more than 700 species belonging to more than 200 families. The order Diptera was the most abundant and was represented by nearly three times as many specimens as in any other order: Coleoptera followed next as regards numbers taken.

The highest altitude at which insects were captured was 14,000 feet and, as a general rule, their frequency of capture was in inverse ratio to the altitude. Among individual orders of insects, only 21 specimens of dragonflies were collected, and the author states that this is due to their rapid flight and their ability to avoid the oncoming aeroplane. He records having observed Odonata (probably *Anax junius*) keeping up with, and sometimes even flying ahead of, an aeroplane that was travelling at 90 miles or more per hour. Homoptera were captured at almost every altitude up to 14,000 feet. More than half of the Coleoptera taken belonged to the families Carabidæ, Staphylinidæ, Chrysomelidæ and Curculionidæ or, in other words, to the largest groups of these insects. Altogether 4,420 specimens belonging to 191 genera of Coleoptera were captured in the traps and the maximum elevation was 11,000 ft. Lepidoptera (32 species) were not captured higher than 5,000 ft. Hymenoptera, represented by nearly 250 genera, were obtained at nearly all elevations up to 14,000 ft. Their dominant representatives belonged to the Parasitica and the ants. Of the Diptera the most abundant families represented were the Chloropidæ with 2,227 specimens and the Chironomidæ with 701 examples. Culicidæ were represented by 111 specimens belonging to seven genera.

Among apterous forms, 1,461 spiders were captured, one example occurring at 15,000 ft. A single example of *Pulex irritans* at 200 ft. is recorded. Numerous Apterygota are mentioned, besides wingless Hymenoptera, etc., and larvæ.

Among the various factors governing the distribution of insects in the upper air the size, weight and buoyancy of individual forms are discussed together with the influence of temperature, dew-point, barometric pressure, wind direction and velocity, convection, light intensity, etc. Of these, and other factors, temperature is regarded as the most important agency regulating the numbers of insects to be found in the air at any given time.

With the great number of aeroplanes now in regular use in the world, numerous ways are offered for insects to find shelter in these vehicles and so become carried from one territory to another. New means for the dispersal of dangerous insect pests are thus afforded. Air currents are also believed to be an important accessory factor in the distribution of the destructive pink bollworm in the United States. During the five years of flying to collect insects, many kinds of these creatures were found either in the cockpit, fuselage or cabin of the planes used, but no special collections were made.

OBITUARIES

General the Hon. C. G. Bruce, C.B.

BRIGADIER-GENERAL THE HON. C. G. BRUCE died on July 12 at the age of seventy-three years.

Charles Granville Bruce, born in 1866, was a son of the first Lord Aberdare. Probably no man since the time of the Schlagintweits had a wider knowledge of the Himalaya than Bruce. No one ever had so intimate a knowledge of so many of its peoples. Bruce's climbing experience extended from the Safed Koh to Sikhim. He was with Conway in his notable expedition to the Karakorum, and with Mummery and Collie in the first attempt on Nanga Parbat. The snows of Khagan and Kulu were his happy hunting grounds. In 1907, the jubilee year of the Alpine Club, he nearly arranged the first exploration of Mount Everest; but at the last moment the plan was vetoed in London by John Morley, who feared Russian suspicion. Again in 1910 he got leave from the late Maharaja to explore Everest from the Nepalese side; but at the last moment this had to be given up for fear of arousing religious hostility.

By profession a soldier, Bruce was an acknowledged master in the difficult technique of fighting on the North-West Frontier. His influence with his own Gurkhas was remarkable, and his greatest contribution to mountaineering came through his wide knowledge of the tribes of the Himalaya. He was the first to use trained Gurkhas for serious mountain work. He started the Baltis of Kashmir and the Bhotias of Garhwal on the upward path, a lead which Kellas ably followed. But his great discovery was the value of the Sherpa, a Tibetan tribe long settled in Nepal. These, with their purer Tibetan cousins, have been the mainstay of every Himalayan expedition of recent years. The cause of his success was his sympathy with and knowledge of the languages and habits of these very varied peoples.

In 1923 Bruce was elected president of the Alpine Club. In 1915 he was awarded the Gill Memorial Prize and in 1925 the Founder's Medal of the Royal Geographical Society. But it was the adventure, not scientific interests, which absorbed him during his climbing holidays and longer expeditions. Of the latter, the Everest expedition of 1922 stands out. He made an ideal leader. Yet it is as a companion, the perfect one, that I most remember him, especially with Arnold Mumm and myself in Garhwal in 1907. He was the most invariably considerate, and pleasant, and uncomplaining companion it is possible to imagine. Not even the injured knee which deprived him of climbing Trisul with his devoted Subadar Kharbir Burathoki drew one word of disappointment or complaint from him. Bruce's name became a household word: but only his friends knew his real worth.

T. G. LONGSTAFF.

Prof. Archibald Young

PROF. ARCHIBALD YOUNG, who died in Glasgow on July 24 at the age of sixty-five years, had held the regius professorship of surgery in the University of Glasgow since 1924, when he succeeded Sir William Macewen. He had come under the influence of his predecessor, and this partly accounted for his leaning towards the surgery of the nervous system, to which he had regularly contributed since his service in the South African War. Moreover, this choice of speciality was natural in one whose clinical inclinations were coloured by the minutest examinations of clinical cases.

Prof. Young was at his best in dealing with conditions in which careful attention to the smallest details was essential for diagnosis and treatment, and to this characteristic may be attributed his success in dealing with fractures, with lesions of peripheral nerves, and with affections of the sympathetic nervous system. For many years his health was indifferent, and his work was carried on often in discomfort and not infrequently in pain; and it is a sad reflection that his last major contribution to surgical literature was a translation of Prof. Leriche's monograph on pain.

A man of the highest integrity and professional ideals, and of uncompromising opinions, Prof. Young instilled into all his students his example of steadfast devotion to duty. J. R. LEARMONTH.

WE regret to announce the following deaths:

Dr. W. C. Mansfield, geologist of the U.S. Geological Survey, on July 24, aged sixty-five years.

Dr. A. H. Trow, formerly principal of the University College of South Wales and Monmouthshire, professor of botany in the College during 1905–18, on August 26.

NEWS AND VIEWS

Science and the National Ideal

THE world stands on the brink of the abyss. Before these words appear in print, it may have taken the plunge; and ten million men will already have entered on the initial phase of a struggle, of which none can foresee the end, except it be in disaster. The efforts of those, who during the last twenty years have striven to reconstruct a civilization shaken to its foundations by the war of 1914–18, have been frustrated by the incompatibility of their aims with the exclusive methods of national regeneration. In all the antagonisms of recent years, the voice of science, except where throttled by the political partisan, has been steadfast in support of freedom of thought and toleration—to those of this way of thinking, essentials of social and intellectual advance, but now threatened root and branch by the aggressions of a totalitarian nationalism.

SIR ARTHUR KEITH (*Sunday Times*, August 27), while admitting the close kinship of exclusive nationalism with the tribalism of the barbaric Dark Ages, sees in its spirit the mechanism of progressive development, and contrasts it with a cosmopolitanism which is lacking in force and colour. But in this contrast is he not guilty of a false antithesis, to which he is led by a too crude and outmoded interpretation of the Darwinian's force of natural selection? In the history of civilization, the struggle for existence has been resolved from one of brute force into a struggle for survival among ideas. Too true that often advancement has come about, and the world being what it is, must still at times come about by the aid of the driving force of the national idea. But more and more the struggle loses the character of national rivalry and becomes one in which we move, slowly it may be, towards a world order, which is not merely an undifferentiated cosmopolitan universalism, but an order to which each group, be it people, nation, or empire, by the development of its traditional culture to its highest power, may contribute something towards the common good and advancement of mankind as a whole. This is the faith and the ideal of a nationalism to which science must cling fast at all costs.

Education to Meet the Challenge to Democracy

SOME two thousand representatives of parents and teachers in the United States recently met at Cincinnati to discuss "The Purposes of Education in American Democracy" under the four heads: self-realization, human relationships, economic efficiency and civic responsibility. The proceedings culminated with a remarkable address by the president of the University of Wisconsin. American education, he said, entrusted as it has been to local inspiration, leadership and control, with emphasis on individual rights and individual liberty and but little sense of national responsibility, has for generations taught values which no longer conduce to a proper understanding of a world infested everywhere by a highly organized and efficient system of vilification and ridicule of the whole theory and method of democracy. The dictators are cultivating a common interest and a new goal; telling the masses that to save one's life one must lose it in devotion to a common social ideal. How can this be countered in a society split into groups which are at war with each other on political, social and economic fronts? Only by engendering an overriding devotion to what it wholeheartedly believes to be a worthier common social ideal. "Only a dynamic democracy can cope with a fact-facing fascism." The need is urgent. Only a conscious educational programme can produce the requisite sense of common purpose and common sacrifice, active, steady and constant. It "calls first of all for an understanding of democracy as a way of life and a nourishing of the underlying values upon which society depends for its existence. . . . Education must face this issue or lose its liberty and its opportunity". The address is reported in the July issue of *School Life*, the official organ of the Office of Education.

Use and Misuse of Science

IN his presidential address "The Use and Misuse of Science" to the Royal Society of New South Wales, which has been reprinted in part from the *Journal and Proceedings* of the Society, Prof. J. C. Earl points out that control over Nature involves not merely the knowledge that in certain circumstances a known natural phenomenon will occur, but also the ability to arrange the stage so that the occurrence takes place when and where we will. Knowledge may be power, but it remains inactive until a conscious effort is made to use it. We can use the power we have constructively or destructively, and this responsibility cannot be regarded lightly. Our conduct must be determined by some motive and the moral issue cannot be evaded. Discussing the use of science, Prof. Earl termed research associated with the use rather than the extension of knowledge, secondary scientific research, in contrast to primary scientific research, which is concerned with the extension of knowledge as such. The latter he considered an essential duty of a university, the discharge of which would foster its other duty of maintaining cultural traditions. He urged that the tendency to foster secondary rather than primary research in the universities of Australia with the resources now available was dangerous and that the claims of the latter required more energetic support from within and without. In urging this larger and keener interest in fundamental work, Prof. Earl did not suggest, however, that secondary scientific work was less important, and he referred to the need for scientific work in Australia on Australian products.

Mental Disease and War

IN a recent essay (*Hibbert J.*, 37, 513; 1939) on mental disease as a factor in the causation of war, Dr. Olof Kinberg, professor of forensic psychiatry at the University of Stockholm, remarks that though it is growing increasingly clear that war as a means of solving social problems is utterly futile, for the remedy is worse than the disease, many large countries are seeking to imbue even their children with an admiration for war and to do all they can to represent it as the most glorious exposition of national greatness, while other countries are making every possible effort to avoid war, though they are compelled to build up enormous armaments. Prof. Kinberg discusses some of the psychological features of modern society which may help to explain this paradoxical state of affairs. He points out that in order to mould public opinion the ruler must transform private citizens into a psychological mass and keep them in that condition for a considerable time. The production of this mass is brought about by the Press and the radio being in the hands of the Government, the formation of a bulwark against criticism and the persecution and destruction of anyone who dares to entertain different opinions.

PROF. KINBERG directs attention to the likeness between the qualities of the national mass and the paranoid personality which is characterized by touchiness, egoism, quarrelsomeness, inability to judge its own affairs impartially and a conceit and arrogance which sometimes takes the form of megalomania. At the same time the mass adopts towards its leader, however shabby and obscure his past may be, an attitude of servile submission which contains a strong infusion of magic and mysticism. A continuous interaction takes place between the national mass, whose passions are kept at boiling point, and the leader, who has himself shown from the onset abnormal psychical features of a paranoid character. Such a state of affairs, according to Prof. Kinberg, has been exemplified from the French revolution down to the revolutions of the present day.

Eiderdown Industry and Protection of Eider-Ducks

THE numerous islands which border the north coast of the Gulf of St. Lawrence have long been a breeding ground of eiderducks. But it is only since 1933 that a supervised industry in the collecting and marketing of eiderdown has been established. During the past six years the export of cleaned eiderdown has increased five-fold, and the recognition of the value of the birds has led to active protection and encouragement of an increasing stock of nesting ducks. Where the eiderdown industry has been established severe penalties are enforced for their destruction or molestation. The collection of the down, it is reported by the Office of the High Commissioner for Canada, does not interfere with the regular hatching of the eggs, and as a result of this and of protection the colonies of eiders have been steadily increasing in numbers. For the purpose of eiderdown production, residents of the Gulf-shore area now lease from the Province of Quebec suitable coastal islands at a nominal rental for a period of five years, and each lessee is supplied with a permit under the Migratory Birds Convention Act authorizing him to collect, possess and sell eiderdown taken from the nests in his leased area. We trust that a close watch will be kept upon this new industry and that definite counts will be made by scientific observers at periodic intervals to test the effect of the trade upon the number of birds. The conditions of the leases granted to the down collectors are unknown to us, but it is hoped that some provision is made to check what might easily develop into ruthless destruction at the close of a period of lease, if the lessee suspected that renewal might not be granted.

Re-organization of the Cotton Industry

THE Cotton Industry (Reorganization) Act, which has since reached the Statute Book, is the subject of a further broadsheet issued by P E P (Political and Economic Planning). The Cotton Industry Board to be appointed by the Board of Trade will be representative of all sections of the industry in addition to having three independent whole-time members, including the chairman, with special knowledge of the industry. The Board will appoint, partly from among its own members, a special Export Development Committee, which will have the particular duty of making recommendations regarding the export trade. Cotton and rayon interests will be equally represented on the Committee and the other principal bodies in the industry will be the Cotton Industry Advisory Committee, charged with examination of the sectional schemes, and the Representative Advisory Council. Provision is also made for the establishment of a separate Rayon Industry Committee. Producers are compelled and merchants permitted to register with the Cotton Industry Board, but merchants will only be registered if they agree to abide by the contracts prescribed in sectional price schemes. Sectional schemes, which to become legally binding must be supported in a poll by the majority of the section concerned and approved by the Board, may relate to the elimination or reduction of redundant plant or to the fixing of prices. The broadsheet emphasizes the importance of marketing policy, the need for market research, the urgency of establishing central marketing arrangements, the necessity of a more enlightened labour policy than that which has short-sightedly sought exemptions from the Factories Act which reduced the juvenile working week from 48 to 44 hours, as well as the importance of implementing the permissive clause of the Act which allows the compensation of operatives displaced by redundancy schemes. Only long-term measures of this character can overcome the operatives' real and natural fear of technical change and eliminate the labour troubles which have contributed to the industry's difficulties.

Mr. W. Gavin, C.B.E.

IN further development of the organization which would be set up by the Government in the event of war to bring about an increase in food production in Great Britain, Mr. W. Gavin has been appointed agricultural adviser designate to the Minister of Agriculture and Fisheries. Mr. W. Gavin has already served in the Ministry of Agriculture, having been appointed in 1916 to act as assistant to the late Hon. E. G. Strutt, who was agricultural adviser throughout the war of 1914–18. Mr. Gavin afterwards became secretary and deputy director of the Army Cattle Committee, director of flax production and director of land reclamation. He is now the agricultural adviser to Imperial Chemical Industries, Ltd., a director of Strutt and Parker Farms, Ltd., a director of the Agricultural Mortgage Corporation, a member of council of the National Institute of Agricultural Botany, a trustee of the Lord Wandsworth Agricultural College, and an 'appointed' member of the executive of the Potato Marketing Board.

Bernhard Naunyn (1839–1925)

BERNHARD NAUNYN, an eminent German physician and experimental pathologist, was born on September 2, 1939, in Berlin, where he studied medicine under Lieberkühn, Reichert and Frerichs. He qualified in 1862, and after acting as clinical assistant to Frerichs for some years, became successively professor of medicine at Dorpat (1869–71), Bern (1871), Königsberg (1872–1888) and Strassburg (1888–1905). He was the author of two medical classics, the first on cholelithiasis (1892), which was translated into English by A. E. Garrod for the New Sydenham Society's publications (1896), and the second on diabetes mellitus (1898). He also wrote important articles on cerebral compression, the problem of fever, coagulation of the blood, gastric fermentation, cirrhosis of the liver, disorders of speech and syphilitic disease of the nervous system. Considerable historical interest is attached to his papers on "The Development of Internal Medicine in the Nineteenth Century", "The Berlin School 50 Years Ago" (1908); and his autobiography entitled "Erinnerungen, Gedanken und Meinungen". In 1872 he founded, in conjunction with Schmiedeberg, the *Archiv für experimentelle Pathologie und Pharmakologie*, and in 1896, with the surgeon Mickulicz, the *Mittheilungen aus den Grenzgebieten der Medizin und Chirurgie*. Naunyn had many pupils who attained distinction, such as Eichhorst, Minkowski, Schreiber, Stadelmann, Umber and Weintraud. He remained active in his retirement at Baden-Baden until shortly before his death, which took place on July 26, 1925.

Gift of Sutton Hoo Antiquities to the Nation

ALL anxiety, which has been not inconsiderable, as to the future of the antiquities from the Sutton Hoo Anglo-Saxon royal ship-burial has been allayed by the announcement made by the Trustees of the British Museum (Bloomsbury) that Mrs. E. M. Pretty, declared their owner by the verdict of the Coroner's inquest of August 14 (see NATURE of August 19, p. 318), has generously presented them to the Museum. The gift is subject to a condition that they shall be exhibited in due course on loan for a period in the Borough Museum of Ipswich. The gift comprises articles in gold, gems, and enamel, silver, bronze, iron, stone, wood, leather and textile fabrics—everything, in fact, which was found in the ship-burial on her estate at Sutton Hoo. Thus the relics from a find, which archæologically is the most important of its kind made in Great Britain, and the most valuable of its period made anywhere, not only become the property of the nation, but also will be preserved together as a whole. Had the collection been dispersed, as was feared possible, the discovery would have lost much of its unique value for cultural studies, and as tangible evidence for the whole complex of religious and social concepts, which inspired our Anglo-Saxon forbears in the seventh century of our era in their reactions to the demise of a chiefly head and representative of the community. Intrinsically valuable objects and jewels in gold, silver, and enamel, especially when found in such rich profusion, impress the popular imagination: they afford evidence of a highly developed æsthetic faculty and superb skill in technique; but it is the humbler objects with which they are associated, the personal and domestic articles of the less precious metals, the pottery, the wood, leather, stone and the textiles, which are the more eloquent for the student of the culture of the time. They are the raw material from which the archæologist interprets advance in civilization and the cultural history of the people as a whole.

EXCAVATIONS are still proceeding on the site in the hope of securing further evidence, which will throw light on certain points still obscure. It would appear to be beyond doubt from the completeness of the funeral furniture, the extensive equipment, domestic and personal, and the unexampled richness and excellence in workmanship of the jewellery and objects in precious metal, that this was the burial-place of a king or chiefly leader, which is to be assigned, on the evidence of the Merovingian coins, though themselves bearing no date, to about A.D. 640; but as yet no evidence of identification has been found. Such suggestions as have been made are purely speculative. It is further remarkable that no skeleton, or fragments thereof, or evidence of cremation, have been found. It has been suggested as possible that the burial mound may have been intended to confer the last rites on a leader whose body had been lost at sea. Should further relics accrue, presumably they will be added to the original gift, with a generosity worthy of the owner. The verdict of the Coroner's inquest, however, has given rise to some serious misgivings as to the possibilities to which a find of this value, and in such circumstances, is exposed. It has been suggested that drastic measures should be taken by legislation to ensure their reservation to the nation. It is probable that any such action would defeat its own end. The generous interpretation of compensation now accepted in application of the law of treasure trove, which ensures to the finder the full archæological value of a find, and the vigilance of the Office of Works, are adequate to meet ordinary contingencies, while any exceptional find, such as that at Sutton Hoo, is certain of the protection of a publicity which would be intolerant of anything in the nature of improper disposal.

A Museum of the Roman Wall: An Appeal

WHILE some, at least, of the advantages of an adequate display for relics from the Roman Wall must be obvious to every layman who gives the matter a thought, only an archæologist can appreciate to the full both the hindrances to Romano-British studies of the present arrangements, as well as the benefits which would follow from the appropriate grouping of the collections in premises dedicated to this sole purpose. Mr. Ian A. Richmond, lecturer in Romano-British archæology in the University of Durham, in a review in *The Times* of August 29 of the present position, touches upon both aspects of the matter in putting forward a plea for better accommodation for at least some of the collections under the custody of the University of Durham. At present the relics from the Wall are divided between three principal museums, the Blackgate at Newcastle-upon-Tyne, Tullie House at Carlisle, and Chesters on the Wall itself. These museums are both overcrowded and ill-adapted to the requirements of modern display. In particular, the Blackgate, the medieval gateway of the Castle, is the most urgent problem. Once a debtors' prison, it is dark and gloomy, yet it contains the collections of the Society of Antiquaries of Newcastle-upon-Tyne, which now have been in existence for more than a century and are the most important source of information on the Wall and its area.

So strongly did the needs of the situation and the claims of Hadrian's Wall as "one of the universally famous monuments of our island" appeal to the Standing Commission on Museums and Galleries that it was from this body that the suggestion came that the responsibility of a museum of the Roman Wall should devolve upon the University of Durham; and following upon an expression of willingness by the Council of the Society of Antiquaries to transfer the custody of its collections to the University, and an appeal to the public by Lord Eustace Percy, as representing the University, for funds to erect such a museum, the University Grants Commission has generously made an offer of £5,000 towards the cost of the building, provided the balance of £15,000 required is raised within two years. Mr. Richmond goes on to point to a number of directions in which study of Romano-British culture is hampered through lack of adequate and appropriate display of the material.

Gloucester Museum

REFERENCE was made recently in the columns of NATURE (July 15, p. 91) to the origin of certain of the provincial museums as centres of intellectual and social exchange in days of less easy transport and communication. An example of a museum originating in this manner and of the function it is now able to fulfil in municipal life is afforded by the Public Museum of the City of Gloucester. This museum was founded in 1859 by members of the Gloucester Literary and Scientific Association (now dissolved) and the Cotteswold Naturalists Field Club. The collections were housed originally in two rooms lent by Mr. Sydney Dobell, but were removed to the Art School in 1872, and finally transferred to their present home in the Price Memorial Hall in 1900, having been handed over to the Corporation by deed in 1896. A scheme of reorganization has been completed recently and the occasion marked by the issue of a "Short Guide to the Collections", which includes, in addition to the collections in the Public Museum, those of the Folk Museum in Bishop Hooper's Lodgings, opened by Dr. R. E. Mortimer Wheeler in 1935. The Public Museum covers both natural science and archæology; and specimens are available for detailed examination by students and research workers in a reference room set aside for the purpose. The archæological specimens are in the main of local derivation, and are arranged to illustrate the development of the material culture of early man in the local environment down to Saxon times. Historical relics later than the Norman Conquest are to be found in the Folk Museum, which illustrates the medieval and later economic and social life of the city and surrounding country in agriculture, trades—Gloucester is famous for its early iron-working—and the home. A special exhibit arranged for the jubilee conference of the Museums Association at Cheltenham in July had as its most prominent exhibit a selection of the local horn industry, which has existed in Gloucester since medieval times and still survives in one small factory.

Indian Association for the Cultivation of Science

THE annual report of the Committee of Management of the Indian Association for the Cultivation of Science for the year 1938 records a membership of 128 at the end of the year (Calcutta: Indian Association for the Cultivation of Science, 1939). Financial stringency has limited the purchase of reference books and periodicals for the library and also that of scientific apparatus, and for the same reason the Government of India has been unable to restore the ten per cent cut in the annual grant of 20,000 rupees for the year 1938-39. Appendixes include lists of periodicals available in the library and of books purchased as well as an account of research work carried out in the laboratories of the Association. An arrangement has been devised for magnetic measurements, at low temperatures in the range obtainable with liquid air, on typical paramagnetic salts of the rare earth and the iron group. Magnetic measurements on rhodochrosite, $MnCO_3$, indicate that this crystal should prove a more suitable substance than the hydrated sulphates and selenates of manganese for use as the medium for the production of very low temperatures by the demagnetization method. Other studies have included the magnetic anisotropy of hydrated gadolinium sulphate, crystalline fields in rare earth salts, magnetic studies in relation to valency problems and to crystal structure, magnetic studies on organic crystals of the aromatic class, and optical studies of the chrysene molecule. Other work has been concerned with the absorption spectra of arsenic and antimony sulphides and of the sulphur molecule.

Adult Education in Household Science

HOME-LIFE problems have become, under the impact of social and economic changes, increasingly complex and baffling, and among expedients employed in the United States for coping with the situation is the promotion of adult classes for home economics. Such classes are becoming increasingly important, and the Office of Education has issued a stimulating and helpful guide entitled "Homemaking Education Programs for Adults" (Washington, D.C.: Government Printing Office. Pp. 126. 15 cents). A detailed discussion of principles and methods of instruction appropriate for communities of different types and the preparation of teachers and leaders is followed by illustrations drawn from various parts of the United States. As an example of the scope of the work of the classes, here is a list of headings taken from a Kansas leaflet for use by itinerant teachers: food for the family, clothing, child-care and development, home-management, care of the sick, shopping, home-planning and furnishing, hospitality in the home. The extent and character of the existing provision for such classes vary widely in different parts of the country, but the discussion reveals the existence of an increasing emphasis in American theory and practice on the necessity for "the extension of educational activities beyond the confines of the school building into the community", involving acceptance by the public educational authorities of responsibility for provision of nursery schools and adult classes. The bulletin contains much that should interest household science schools, organizers of adult education and women's institutes.

Health Organisation of the League of Nations

THE annual report of the Health Organisation is contained in its recently issued *Bulletin* (8, Nos. 1–2, Allen and Unwin, Museum Street, W.C.1. 5s.). Prevention and treatment of malaria, cancer, leprosy, nutrition, housing and physical education, biological standardization and drug traffic are some of the subjects that are covered by the activities of the League's Health Organisation. A considerable report on rural housing and planning is contributed by M. Vignerot (France). The last article, of 260 pages, is a survey by Dr. Walch-Sorgdrager of Leptospiroses, diseases of man and animals caused by infection with minute spirilliform micro-organisms, which include infectious jaundice or Weil's disease of man and infectious jaundice of dogs. A recently differentiated epidemic disease of man, 'mud fever', is fully described. It occurs in regions of the Danube, Elbe and Oder which are liable to floods, though is not necessarily connected with flooded districts, and is caused by a species of Leptospira, *L. grippotyphosa*. The disease is an acute and severe febrile condition, but is never fatal. The natural habitat of this microbe is uncertain, as is also the problem of transmission to man. A bibliography of 70 pages completes this important article. A review designed to show how the Health Organisation functions, entitled "World Health and the League", is also issued by the League (Messrs. Allen and Unwin. 6d.).

Birth Customs in East Anglia

IN the June issue of *Folk-Lore*, Miss Barbara Newman and Mr. Leslie Newman record the result of a questionnaire sent to a large number of nurses in Norfolk, Suffolk, Essex and Cambridgeshire for information on husband's 'labour pains' and husband's pains other than labour, such as sympathetic morning sickness and toothache, the use of herbal remedies to ensure easy labour or to quicken labour, and customs connected with the placenta, umbilical cord and caul. Nearly all the midwives agreed that 'husband's pains' were quite usual. In one case a medical man had himself suffered therefrom, and had no doubt that in cases which had come under his observation the pains were both genuine and severe. As regards the prevalence of 'husband's toothache', it was reported that at a town council

(*Continued on p.* 437)

NATURE

SUPPLEMENT

Vol. 144 SATURDAY, SEPTEMBER 2, 1939 No. 3644

THE WESTERN ISLES THROUGH THE MISTS OF AGES

By Sir Albert C. Seward, F.R.S., President of the British Association[*]

Introductory

TWENTY-SEVEN years ago, when the British Association met for the second time in Dundee, Sir Edward Schäfer chose as the subject of his presidential address, "The Nature, Origin, and Maintenance of Life"; he discussed problems that will long continue to exercise the ingenuity and stimulate the imagination of biologists and chemists. A theme such as his is far beyond my reach. Seventy-two years ago, the Association met for the first time in this city. The Duke of Buccleuch occupied the presidential chair, and the opening words of his address are applicable to one who now finds himself in this privileged position The Duke said: "No man has a title to state that he is unworthy of the post he is called on to fill, whatever may be his private feelings as to his fitness for the post. To state that he is unworthy to be there placed is not only a disparagement to himself, but is no great compliment to those who thought him worthy of being so placed".

This, in my opinion, is not an occasion on which it is desirable to follow the easier course and address oneself in technical language to fellow-workers in the pursuit of natural knowledge. The position which it is my great privilege to occupy affords a rare opportuntiy of talking to a large and, I venture to hope, a sympathetic audience, including some at least who are repelled by the jargon of specialists. My intention is to speak in ordinary language on a subject of which I know enough to realize how little that knowledge is, and briefly to describe an example of the way in which, within one small patch of an illimitable field, a student asks questions of Nature and does his best to interpret the answers.

An Excursion into the Past

I invite my audience to accompany me on an excursion of a kind which has substantially contributed to the enjoyment and enrichment of my own life, an excursion into a world that knew not man, with the object of deciphering from such records as we find in the rocks a few pages of the story-book of the earth. Each one of us can say with Shakespeare's soothsayer:

> "In Nature's infinite book of secrecy
> A little I can read."

As that great Scotsman, Hugh Miller, wrote nearly a century ago: "We find the present incomplete without the past—the recent without the extinct". To reinforce his own opinion he quoted Samuel Johnson: "Whatever makes the past, the distant, or the future predominate over the present advances us in the dignity of thinking beings". We shall try to reconstruct a small part of an ancient land, a remnant of which is now called Scotland, and envisage a scene at a stage in the history of the earth separated from the present by at least sixty million years, a stretch of time difficult for us who have been called "the afterthoughts of creation" fully to appreciate. When we substitute geological standards for the modest time-scale of the human period and remember that the earliest chapters of the world's history are recorded in rocks at least two thousand million years old, sixty million years dwindle to comparative insignificance. All that it is possible to do is to lift a corner of the veil separating us from the world as it was and view through dimly illuminated vistas the forests and undergrowth on an ancient continent that is now represented by a few widely scattered, dismembered pieces.

---

[*] Presidential address delivered at Dundee on August 30.

THE HISTORY OF PLANT LIFE

The history of plant life in the sea and on land is a branch of natural knowledge not unworthy of consideration by us human beings who owe our existence to the vegetable kingdom. Green plants in one vital sense are our superiors: from air and water they build up the complex organic substances necessary to our life, a feat beyond man's power. As members of a subject race we should be interested in endeavouring to unravel the history of the plant kingdom—in trying to trace the origin and relations of the several classes and groups as defined by botanists. The documents that are the sources of the botanical historian are contained in the earth's crust: as a preliminary it is worth while to ask ourselves of what these documents consist; how they came to be preserved in the rocks.

In order to bring to life the past we must take the present for our guide: "speak to the earth, and it shall teach thee". There is no reason to think of Nature's methods as other than continuous. If we stand by the bank of a river flowing past tree-covered slopes, we see on the sand and mud by the edge of the channel or floating on the stream, leaves, twigs, and seeds that are random samples of vegetation scattered by wind or shed from overhanging boughs, debris swept along with off-scourings from the rocks to be carried eventually to a delta or an estuary where the water-borne material comes to rest. Beds of old sands and mud, with included fragments of contemporary trees and other plants, exposed on the faces of cliffs and ravines, are layers of sediment that have been raised to a higher level. In addition to leaves, twigs and other scraps easy to see on the split surface of sandstone or shale, sediments of former ages, especially such as are peaty, occasionally furnish another valuable source of information invisible to the unaided eye. Minute grains of pollen may be carried by wind to places where conditions are favourable for their preservation: fortunately the grains, or at least most of them, are protected by highly resistant coats and retain almost for all time their characteristic form and surface-sculpturing. With scarcely any exception, it is possible for a specialist, by comparative microscopical examination of fresh material, to assign fossil pollen-grains to their generic and occasionally their specific position in the plant kingdom.

There is another natural agency to which students of extinct plants are not infrequently indebted — the formation of rocks by volcanic action. From time to time, volcanoes that have long been dormant eject clouds of ash: these, with streams of lava poured over the rim of a crater, spread havoc among trees and shrubs that had colonized precarious sites during a peaceful interlude. Vulcanicity is not only destructive: paradoxical as it may seem, forces inimical to life have contributed to the reconstruction of life which they destroyed. Scotland is exceptionally rich in botanical treasures that are legacies from ages of fire, and indeed the fossil plants with which we are concerned here owe their preservation to volcanic forces.

The following botanical retrospect is based mainly on results obtained during the last two or three years, but not yet published, by the joint efforts of Mr. W. N. Edwards, keeper of geology in the British Museum, Dr. J. B. Simpson of the Geological Survey, and myself.

RECONSTRUCTION OF A FOREST SCENE

A. *The geological background:*

(i) *Prolonged and intermittent volcanic activity*

In order to present in true perspective the scene which it is my aim to bring to life, it will be helpful to visualize the physical features in north-western Europe some thousands of years antecedent to the phase of geological history chosen for closer examination. The chalk downs of England and part of the cliffs on the Antrim coast of Ireland are made of upraised calcareous material that was once a soft white ooze on the floor of a clear sea, a sea which had swept slowly and irresistibly over an enormous stretch of land, embracing the greater part of England, northern Ireland and part of the region that is now western Scotland. With the uplifting of the chalky ooze from the ocean bed and the gradual recession of the waters a new land was born; a new chapter was inaugurated in the history of the earth.

Following the great upheaval, as a consequential phenomenon, subterranean forces that had long been quiescent gained the upper hand: floods of semi-molten rock from deeply hidden reservoirs surged as a fiery deluge over the chalk downs, and over other and older rocks, converting thousands of square miles into barren lava-fields, extending over an area, not less than 2,000 miles from south to north, which reached far beyond the Arctic Circle.

This unprecedented manifestation of volcanic energy, which is by no means confined to Europe and the arctic regions, but recorded on an equally titanic scale in the peninsula of India and elsewhere, is one of the wonders of geology; it is convincing evidence that the earth after the lapse of many hundred million years had not lost her youth; there was no sign of senescence. During the period we are considering, most of Britain was land: we know that at a slightly later date a broad sea lay over the whole of what is now southern England. Travellers in the tube-railway in the London district may perhaps derive pleasure from the knowledge that they are being conveyed through a stiff clay upraised from the floor of that ancient sea. As an appropriate designation for the great northern land an American geologist suggested the name Thulean continent or province (see map, p. 417). In the early days of the period called by geologists the Tertiary era, the greater part of the Thulean province was covered with sheets of sombre-coloured lava in nearly horizontal layers, products of a series of outbursts from deep fissures rent in the earth's crust under the compelling strain of subterranean forces, and from localized volcanic centres of eruption. The columnar basalts of the Giant's Causeway, the columns of the 'cathedral of the sea' at Fingal's Cave, the basalts of Mull, Skye, Canna, Eigg, and other Western Isles, weathered into step-like terraces, which form a characteristic feature of Hebridean cliffs, the flat-topped McLeod's Tables of Skye (1,600 ft.), precisely similar basaltic platforms on the hills of Disko Island and the mainland of western and eastern Greenland—all these are parts of one stupendous whole, a plateau covering half a million square miles, that was once the Thulean continent. The widespread lava-flows represent one phase of volcanic activity in an age of exceptional unrest.

Another phase is illustrated by more coarsely crystalline rocks such as those of the dark Cuillin hills of Skye: they were not poured out as lava-streams over the land, but were forced upwards as great dome-like masses from a deeply seated subterranean source and, as their coarser texture proves, slowly cooled under the pressure of a thick superincumbent load: the comparatively large size of the crystals indicates gradual solidification from a molten mass.

These two phases of prolonged rock-building help us to appreciate the immensity of geological time. Describing the lava-flows of Mull, Sir Archibald Geikie wrote: "On Ben More we can walk over each bed of basalt from the sea-level to the mountain top, a height of 3,169 ft." The basaltic lavas we see in the cliffs of Mull, and many other islands are but a part of the original pile: those that remain furnish an impressive example of rock construction which must have extended over an enormous period of time. The second phase, on the other hand, is an equally impressive example of rock destruction as a measure of geological time. We see the jagged peaks of mountains rising to a height of 3,000 ft. above sea-level which, at no distant date as earth history is reckoned, were buried under a considerable thickness of younger rocks that have been utterly destroyed by the ceaseless operation of denuding agents.

The world to our limited vision appears to be almost static; the mountains we have been accustomed to think of as symbols of eternity, seen through geological spectacles, take their place as episodes in a series of events which have moulded the changing features of the earth's face. The rocky covering of the world viewed by geologists, "foreshortened in the tract of time", reveals itself as a dynamic, mobile crust responding from age to age to constructive and destructive forces which have operated since the earth's early youth, following a still earlier stage when, in the imagery of the poet,

"This world was once a fluid haze of light."

(ii) *Plant-bearing sediments indicative of quiescent intervals*

So far the events chronicled in rocks of igneous origin have been spoken of as though there had been continuous outpourings of lava with occasional showers of ash and, in some districts, upwelling of molten material that remained hidden below the surface until in the course of time the covering rocks were removed by erosion. There is, however, clear proof that the extrusion of lava and other rocks was intermittent: intercalated among the lava-beds are layers of sedimentary material, hardened sand and mud, layers of coal, and beds of fine-grained limestone containing beautifully preserved leaves, a few fruits and other plant fragments, also rare examples of insect wings and shells. The richest plant-containing layers occur near the base of the pile of basaltic lavas on Ardtun Head, the low 'headland of the waves' near the south-western corner of Mull, the island on which from his home on Iona—which has been aptly named 'the light of the western world'—Saint Columba must often have gazed. Trees, shrubs, and other plants were able to colonize portions of the lava-field during the long pauses between recurrent outbursts of volcanic fires.

The association of sedimentary material with the basalts at Ardtun Head was noticed by Abraham Mills so long ago as 1790; but it was not until the middle of the nineteenth century that Mr. McQuarrie of Bunessan discovered the fossil plants, which were very briefly described by Prof. Edward Forbes in an appendix to an important paper by the Duke of Argyll published by the Geological Society of London in 1851. The Duke spoke of the leaves as having been shed "autumn after autumn into the smooth still waters of some shallow lake, on whose muddy bottom they were accumulated, one above the other, fully expanded and at perfect rest". By far the richest collection of fossils was made by Mr. Starkie Gardner rather more than fifty years ago, and partially described by him in a paper read to the Geological Society of London in 1887. Descriptions of several fossil plants from the Mull beds have also been published by Dr. T. Johnson. The main collection is now in the British Museum. Additional specimens have been obtained by other collectors in more recent years.

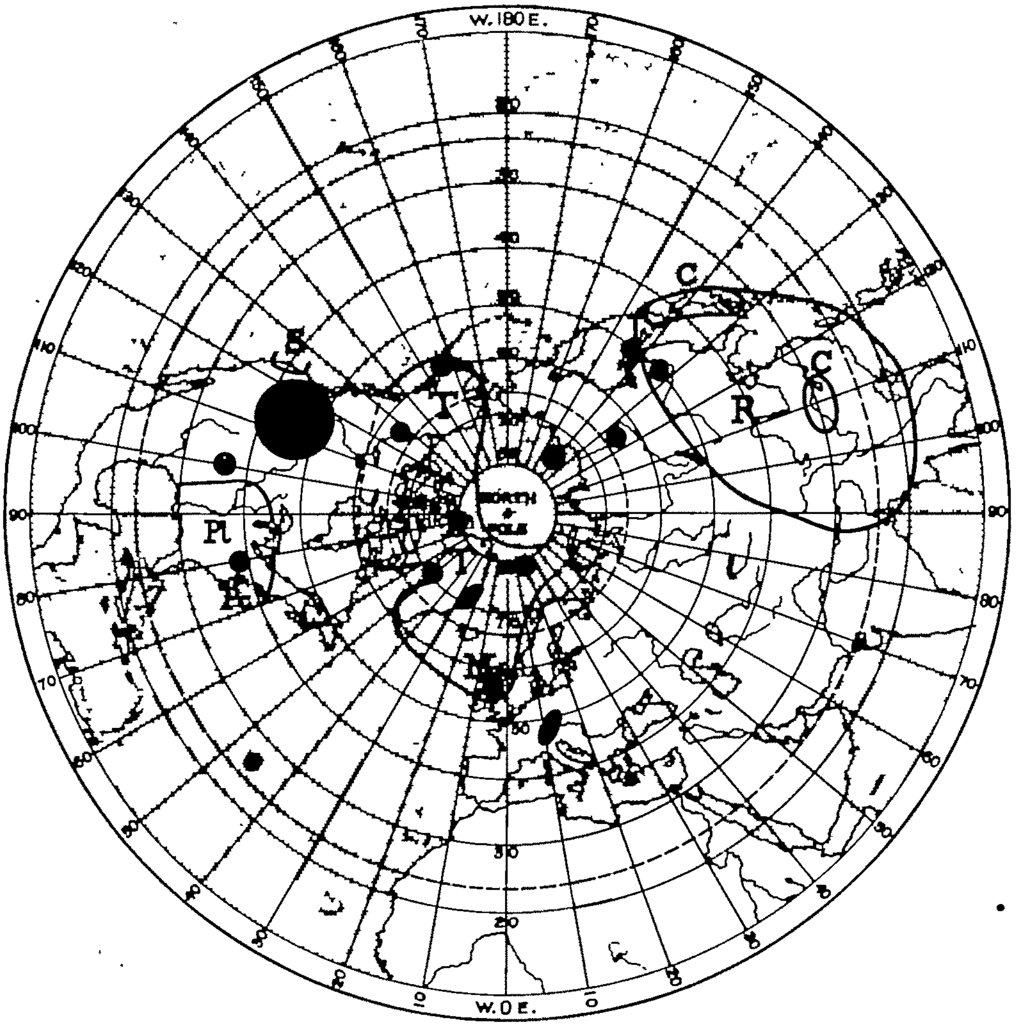
The work of deciphering the botanical records from Mull, Skye, and a few of the other islands is rendered mildly exciting by the danger of misinterpretation: fossil leaves, we are often reminded, are very uncertain guides—records left by Nature in a mischievous mood to mislead the unwary and over-confident student. Sir Joseph Hooker, in an address to the British Association at Norwich in 1868, spoke of fossil botany as "this most unreliable of sciences"; but he added by way of consolation—"the science has of late made sure and steady progress, and developed really grand results". One may cheerfully take the risk of being called an unscientific optimist by colleagues whose chief concern is with living plants. Botanists who confine their attention to recent plants have ample sources of information, not merely detached leaves but twigs bearing leaves, flowers, and fruits: it is natural, therefore, that they should tend to under-estimate the value of leaf-form and venation, often the only criteria available to the palæobotanist.

B. *The ancient flora of the Inner Hebrides.*

What then is it possible to say about the ancient flora of the Inner Hebrides without transgressing the limits of probability? We know very little of the smaller and simpler plants which lived under the shade of the forest trees or clung to the surface of stems where they were washed by trickling rills of rain-water. The three smallest plants which have left recognizable fragments are a fungus and two liverworts or, as they are often called, hepatics, a group allied to the mosses but of simpler construction. The fungus was found by Mr. Edwards several years ago on some detached leaves of a conifer from the Mull plant-beds; the manner of its discovery illustrates an interesting technique often employed with success by students of fossil plants. In many instances leaves preserved on shale are covered with a very thin, black coaly film produced as the result of chemical change in the plant tissues after death. It is often possible, by detaching a piece of the film and treating it with certain clearing agents, to remove the carbonaceous matter and obtain a sample of the surface skin of the leaf that is brown in colour, transparent, and suitable for microscopical examination. After treatment, the Mull leaves showed some minute dark spots on the surface film, and these on magnification were found to be circular disks made of rows of radially disposed cells. The disks were identified as organs of a fungus closely resembling reproductive structures of a living genus Phragmothyrium, a fungus now mainly tropical: the occurrence in Mull of a nearly allied form is, however, probably indicative of a moist rather than a tropical climate. One of the liverworts bears a close resemblance to a living species, *Pellia epiphylla*, which has a wide geographical distribution and is very common on damp earth in Britain; it has a flat green, forked body barely an inch in length. The other hepatic is a member of a different family, characterized by a slender thread-like stem bearing two rows of minute leaves; it bears a striking resemblance to some living species included in the order Jungermanniales.

These fragmentary remains of liverworts are worth mentioning because fossil examples of such plants are comparatively rare; also for a more important reason. A few years ago Prof. J. Walton of Glasgow published a description of some liverworts discovered for the first time in rocks containing remains of plants which grew in the forests of the Coal Age about 200 million years ago. The interesting fact is this:

the Palæozoic liverworts differ scarcely at all in the construction of the delicate plant-body from the much later forms from the Thulean continent : both are essentially modern and yet both are surprisingly ancient. We do not know much about the history of these plants, but it is clear that some liverworts persisted through a succession of geological periods with practically no modification of their simple design.



MAP OF THE NORTHERN HEMISPHERE ILLUSTRATING SOME OF THE SUBJECTS DEALT WITH.

C, C. The present geographical distribution of Cercidiphyllum, a Japanese and Chinese tree. Black patches mark localities and districts where fossil specimens of Cercidiphyllum have been found. Arctic and sub-arctic regions : Alaska, Mackenzie River, Grinnell Land and Ellesmere Land, West and East Greenland, Spitsbergen, New Siberian Islands, Lena River. Canada and the United States of America : several localities from British Columbia and California, and east of the Rocky Mountains in Montana, Wyoming, Oklahoma, etc. The oldest examples of Cercidiphyllum leaves are from early Cretaceous rocks in Maryland—the Potomac formation (*Pc*). Others are recorded from Europe—Mull, Switzerland, Bohemia, Silesia ; Eastern Asia ; Sakhalin Island and the Bureja River.

M. Mull and neighbouring islands.

Pl. The geographical distribution of the occidental plane.

R. Approximate boundary of the area within which are the present homes of the majority of trees and shrubs most closely related to extinct species of the Hebridean flora.

S. The present distribution of *Sequoia sempervirens* (redwood) and *Sequoia gigantea* (mammoth tree).

T. Hypothetical boundaries of the Thulean province.

The only fern so far discovered is very nearly related to the sensitive fern, *Onoclea sensibilis*, a familiar species in North America, ranging from Florida to Newfoundland and as far west as Saskatchewan ; it occurs also in northern China, Manchuria, Japan, and Corea: it has what is called a discontinuous geographical distribution. Onoclea, no longer a native of Europe, is often cultivated. The fossil fronds from Mull, both sterile and fertile, differ scarcely at all from those of the living fern. Records of the rocks show that Onoclea formerly grew in north-western Europe and in Greenland, regions where, through the vicissitudes of climate, it long ago failed to survive. Evidence furnished by fossils and the facts of geological history affords a clue to the present discontinuous range: in all probability Onoclea originated on the Thulean continent, perhaps north of the Arctic Circle, whence it spread radially into America, Europe, and the Far East; in the European region it became extinct, sharing the fate of many other plants that were unable to survive the rigours of the Ice Age. Its territory was originally continuous; now it is restricted to North America and eastern Asia. Another member of the class to which the ferns belong is the familiar Equisetum, the horsetails: one species, closely comparable with the living ***Equisetum limosum***—widely distributed in north temperate and arctic lands—has been found in the sediments of Ardtun Head. Equisetum may be described as an emblem of changelessness: nearly related forms grew in Palæozoic forests at least 150 or 200 million years ago: less closely related plants in the same forests—the calamites—were comparable in size with trees. The slender horsetails of the Coal Age and their much more robust and woody allies remind us that in the course of evolution some of Nature's early experiments survived unaffected by the production of new competitors, while others, less successful, left no direct descendants. As we follow the march of plant-life through the ages, evidence of progress accompanied by retrogression becomes recurrently apparent: in the varying green mantle of the earth there can be traced threads running through the whole, changing very slightly as we follow them onwards and upwards, preserving all the time a remarkable uniformity in essential characters.

By far the greater number of the fossils from Ardtun are leaves of trees or shrubs which belong to one or other of the two great classes of seed-bearing plants. In Gymnosperms, including conifers and some other less familiar plants, the seeds are naked. In members of the other class, the highest, the most various and most abundant in the vegetable kingdom, the seeds are more efficiently protected and are contained in a closed case; hence the name Angiosperms. Conifers played a prominent part in the Hebridean forests, but their representatives were not such as we find in modern Europe. A single and well-preserved seed attached to a relatively large wing affords evidence of the occurrence of a conifer allied to the silver fir (*Abies pectinata*) and some other species commonly cultivated in Britain. Firs, using the term for trees belonging to the genus Abies, and excluding the spruce fir (Picea), now occur in Europe, northern Africa, northern Asia and America: there is no British species of Abies. The Mull seed, it is important to note, agrees most closely with seeds of firs now living in China and Japan. Among other conifers discovered in the plant-beds of Mull and Skye are Cephalotaxus, Cryptomeria, and Sequoia. Recent species of Cephalotaxus are comparatively small trees confined to the Far East; some kinds are cultivated in our gardens. The foliage of the Mull species bears a striking resemblance to that of *Cephalotaxus fortunei*, a small tree widely distributed in China. Another genus which we believe to have been a member of the Hebridean flora is Cryptomeria: the fossils from northern Ireland and the Isle of Skye include foliage shoots, cones, and pollen-grains. The solitary living species is the Japanese *Cryptomeria japonica*, which occurs also in China: this is the tree of the famous avenue of Nikko in Japan, a noble memorial of a peasant who was too poor in worldly goods to contribute the usual building stone or a bronze lamp to the mortuary temple of an emperor, and instead offered to plant trees to protect visitors against the heat of the sun.

One of the most interesting of all living conifers is the genus Sequoia, of which there are two species confined within the narrow strip of hill ranges bordering Oregon and California on the Pacific coast—the redwoods (*Sequoia sempervirens*) of the Coast Range, watered in the dry season by mists from the western ocean, and the mammoth trees (*Sequoia gigantea*, often called Wellingtonia) of the Sierra Nevada. (See map, *S.*) Sequoia is an impressive example of the light thrown by fossil plants on the past history and wanderings over broad regions of the earth's surface of trees that, without man's protection, would be in danger of extinction. In earlier periods Sequoia was almost cosmopolitan; it ranged over wide spaces in the Old and the New World and overstepped the limits of the northern hemisphere. Foliage shoots preserved in the sediments of Mull were in all probability borne by trees closely related to the living redwoods, trees which are well worthy of inclusion among the wonders of the world; they attain a height of more than 300 ft. and the rings on cross-sections of giant trunks that have been felled bear witness to an age of 3,000 years and more. They were growing where they stand to-day 1,000 years before the Christian era. Trees next of kin to the redwoods once lived within a short distance from the Polar Sea several hundred miles farther north than the present tree-limit. Another species of Sequoia, more nearly allied to the mammoth tree, lingered on in Britain long after the disappearance of the Thulean forests: this we know from the discovery of fossil twigs and cones in the sediments of an old lake on the edge of Dartmoor in Devonshire. The two surviving species live in splendid isolation, dreaming of a greater glory that was theirs, their memories stored with secrets man can never know.

There was another naked-seeded tree in the forests into which we have intruded, a species of Ginkgo, the maidenhair tree. The barbarous name 'Ginkgo', invented in 1712 by the German naturalist Kaempfer, is in the opinion of the Rev. Dr. Moule, formerly professor of Chinese at Cambridge, a false transcription of 'sankyo', which probably means hill-apricot. Leaves perfect in form and venation were found in the chalky sediment of a lake that filled a hollow in the Hebridean lava-field; they differ from the foliage of the living tree only in a few minor features detected by the practised eyes of Dr. Florin of Stockholm in the microscopical structure of the superficial cells. Dr. Simpson discovered Ginkgo pollen-grains at another locality. The story of the maidenhair tree has recently been told (*Science Progress*, January 1938), and the temptation to linger over it here must be resisted.

Ginkgo of all trees furnishes the most thrilling example of a link with the past; its history, compiled from fossils of many geological ages and in many parts of the world, is an enthralling romance. This is but one of many histories recorded in Nature's story-book which makes us share the thought of Edward Fitzgerald: "Yes, as I often think, it is not the poetical imagination but bare science that every day more and more unrolls a greater epic than the Iliad". It would be rash definitely to assert that the maidenhair tree still exists under strictly natural conditions as a wild tree of the forest. Botanists who have searched for it in China, the country believed to be its last home, failed to discover convincing evidence of the occurrence of specimens which could not be ascribed to man's agency. On the other hand, a few years ago a Chinese botanist expressed the opinion that Ginkgo still grows wild in the province of Chekiang in eastern China. The oldest living examples occur in China and Japan, often in places where, as is fitting, they are venerated as trees endowed with healing properties.

The history of Ginkgo has been traced to periods antedating by millions of years the Thulean forests: we do not know of what sort its progenitors were; but we know that it is a survival from an age too remote for us to measure in terms which we can fully appreciate. We also know that Ginkgo, now a lonely relic in the present world, is a primitive and isolated type, the sole representative of a large family, including many different members, all of which save the maidenhair tree long ago fell by the way in the struggle for existence. When the tree lived in the Hebridean forests it was common in other parts of the Thulean continent from northern Canada to Greenland and Spitsbergen, in North America, Europe, and Asia. It was as widely distributed geographically as oaks, pines, and firs in the modern world. The history of Ginkgo is a record of endurance, of persistence with apparently little change in an unstable world. When we recall the amazing life-story of the tree and its forbears the autumnal colour acquires a deeper significance: we see in the pale yellow of the leaves a reflection of the golden age of a family that left a precious legacy. Would that the maidenhair tree were endowed with the oracular power of the oaks of Dodona and, in the trembling accents of its fluttering leaves, could tell us not of the future but of the varying fortunes of the family as age succeeded age.

The Ginkgo of Mull was not the last of its race in Europe: well-preserved remains have been found in younger rocks in France and Germany, proving that it survived in the Western world, though probably only in a few places, to an age preceding by a comparatively short period the invasion of temperate Europe and North America by arctic ice-sheets and glaciers, which had a far-reaching effect upon the vegetation in the Western world.

Leaving the naked-seeded plants, we pass to the flowering plants or Angiosperms. This class is more recent in origin than the Gymnosperms, at least so it would seem, and as in present-day floras so also in the Thulean forests, flowering plants contributed the greatest number of genera and species. We shall take first a few trees and shrubs which have descendants still living in Europe, and afterwards mention others that have no near relations in European floras. There were, we think, three or four kinds of oak, all different from those now living in Europe and America. The largest leaves from Mull assigned to the genus Quercus are oval, with a broadly rounded base and relatively small teeth; they resemble the foliage of a few Indian species, but the oak with leaves most closely resembling the fossil form is *Quercus serrata*, a native of China, the rain-forests of Assam, Japan, Korea, and the Himalayas. A second species from Mull is closely comparable with other Indian and Far Eastern oaks; and a third form of leaf is very similar in shape and venation to a species that now has its home in China, Assam, and the island of Formosa. It is noteworthy that none of the oaks of the Thulean forests conformed in pattern of the foliage to our familiar British trees.

One of the most conspicuous trees in the Hebridean woodland was a plane (Platanus) with large handsome leaves almost, but not quite, identical with those of the existing occidental plane of North America. The fossil evidence in this instance is supplied by male flowers and fruit-balls as well as leaves. As in all living planes, the expanded base of the leaf-stalk enclosed and protected a bud. There is, however, one interesting feature in which the leaves of the Mull tree differ from those of any living plane: there were two fairly large leaflets attached to the long leaf-stalk between the main part of the leaf and the base of the stalk. The significance of this peculiarity need not be discussed; it is one of those botanical problems of academic interest which excite the specialist. A more important fact for us is that plane trees in the period we are considering occupied a territory which extended very much farther north than the present area of distribution. Remains of plane trees have been found as far north as Spitsbergen in rocks approximately equivalent in age to those of Mull.

There are in the world to-day six or possibly eight different kinds of plane: the oriental plane (*Platanus orientalis*), the only species native in Europe, is one of the noblest living trees; it recalls the groves of the Academy in the golden age of Greece. One of the oldest specimens is the venerable stump bearing enormous arms in the market-place on the island of Cos where, legend would have us believe, Hippocrates, more than two thousand years ago, gave advice to his patients under the shade of the youthful tree. The oriental plane extends from Greece and the Aegean islands eastward to Asia Minor and the Caspian Sea; it is sometimes said to be wild in Persia and northern India, but more probably this eastward spread should be attributed to man. The most widely distributed species in the New World is *Platanus occidentalis*, growing usually in river valleys from Lake Ontario to Florida and west to Texas and Nebraska (see map, *p.* 417, *Pl*). On the western side of North America there are other species, in Mexico and along the Coast Range hills of California. The most familiar cultivated species in Britain is *Platanus acerifolia*, the so-called London plane: this favourite urban tree is regarded by some botanists as a hybrid between the oriental and the occidental plane; the time and place of its origin are not known with any certainty.

The geological record of Platanus affords a striking example of contrasts between past and present areas of distribution. Some of the oldest known fossil leaves and fruits are from early Cretaceous beds in Greenland, at least 300 miles north of the Arctic Circle. The occurrence of these remains, in sediments that were deposited in a remote northerly estuary before the chalk of the British Isles had been upraised from the sea-floor, affords definite proof that plane trees lived in arctic forests millions of years before they spread to the southern part of the Thulean continent. The birthplace of Platanus may have been in the far north, whence in course of time it spread to Iceland and Spitsbergen, from arctic to temperate North America and Europe, and wandered as far east as Sakhalin Island on the eastern confines of Asia.

One of the comparatively few trees in the Hebridean forests related to recent British species was a Corylus with leaves similar to those of our hazel but still more like the foliage of species now living in India and the Far East. Hazels were associated with planes not only in the ancient flora of Mull but also in circumpolar forests from which they travelled, in response to the urge of climatic change, to fresh and more genial homes farther south. Another tree in the Thulean forests was a cornel, a species of genus Cornus, which has a far flung distribution, in arctic and sub-arctic countries, in North America, Europe, and Asia. While fully conscious of the danger of placing excessive trust in leaves as evidence of affinity, we believe that a Chinese cornel (*Cornus chinensis*) agrees most closely in foliage with the Mull species. The cornels are members of an old stock represented in northern forests as long ago as the Cretaceous period.

Among the larger fossils from Ardtun Head are a few almost perfectly preserved leaves of a vine, which we believe to be specifically identical with specimens previously discovered in Alaskan rocks of approximately the same geological age as those associated with the lava-flows of Mull. Similar leaves have been described from Greenland, Iceland, Spitsbergen and more southern localities in America and Europe. Vines were widely distributed even as far back as the Cretaceous period: there is now only one European species, the wine-producing *Vitis vinifera*; but its leaves are unlike the fossils from Ardtun. The striking contrast between the present distribution of the vine in Europe and its former, much more extended distribution which included arctic and north temperate regions, raises the difficult problem of changes in climate from one age to another. Vine scrolls are a fairly common ornament on early Northumbrian Anglo-Saxon crosses, a motif adopted in still earlier ages by Greek and Roman sculptors, which, after the lapse of centuries, reached the highest expression of naturalistic treatment in England in the last two decades of the thirteenth century. Millions of years before vine leaves and fruit were fashioned in stone, one kind lived in pre-human days on the Thulean continent; and it is noteworthy that its nearest counterpart in the modern world occurs in the Far East.

We turn now to trees and shrubs belonging to genera which are no longer living in Europe. The first tree to be considered furnishes a striking contrast, in the narrow limits of its present geographical area, to the widely spread cornels and oaks. Cercidiphyllum is now confined to Japan and mountain valleys in some parts of China (see map, *C,C.*). The name Cercidiphyllum was chosen because of a superficial resemblance of the leaves to those of the Judas tree, *Cercis siliquastrum*; only a single species, with a few varieties, has survived, *Cercidiphyllum japonicum*, familiar to many tree lovers who cultivate it for the sake of the exceptionally beautiful gold, pink, and red parti-coloured autumnal foliage. In common with some other trees of ancient lineage, Cercidiphyllum lacks any near relations in the present age; it is one of a select company of Nature's anachronisms. Like the Maidenhair tree, it is an aberrant type, a relic living within a comparatively small area in the Far East: formerly it was one of the most widely distributed forest trees on both sides of the Atlantic Ocean. Several beautifully preserved leaves have been found in the plant-beds of Ardtun Head, leaves and occasionally fruits of Cercidiphyllum have been found in Grinnell Land and Ellesmere Land on the north-eastern corner of the Canadian Archipelago, in Alaska and at several localities on the Pacific and Atlantic coasts of North America, in Greenland, Iceland, and Spitsbergen, as well as in Switzerland and other parts of Europe (see map). Leaves, superficially at least indistinguishable from those of the existing species, are recorded from sedimentary beds in the valley of the Potamac River in Maryland assigned to the early days of the Cretaceous period when flowering plants were comparatively few in number and had not yet come into their own as the dominant class in the plant kingdom. When we remember the remote antiquity of Cercidiphyllum and its wanderings over the earth's surface during the passing of millennia, the autumnal glory of its foliage is enhanced a hundredfold and acquires a symbolic meaning.

The plant-beds on the headland of Ardtun have yielded very few recognizable fruits and seeds. Among the rare examples of fruits are some, about half an inch long, consisting of a slightly elongated seed-vessel surmounted usually by five leaflets, the enlarged and persistent covering of the young flowers, which served as efficient aids to dispersal by wind. The fossil winged fruits and associated leaves present a remarkably close resemblance to those of some living species of Abelia, a genus named after Mr. Clarke Abel, who discovered the shrub in China about one hundred and twenty years ago. Abelia is a member of the honeysuckle family (Caprifoliaceæ): most of the existing species have their home in Central China and are cultivated as flowering shrubs in European gardens. There are a few species in Japan, the Himalayas, and Mexico. Fruits of a Chinese Abelia agree most closely with the fossil specimens. Similar though not specifically identical fruits were discovered thirteen years ago by Mrs. Clement Reid and Miss Chandler in a collection of fossil plants from Bembridge in the Isle of Wight. The Bembridge flora is younger geologically than the flora of Mull and indicates a warmer climate. Other examples were recorded long ago from south-eastern France. It is therefore clear that shrubs next of kin to Abelias now living in China were once native in western and northern Europe. The introduction to British and Continental gardens in our time of Abelia, Cercidiphyllum, and other trees and flowering shrubs may be described as the reinstatement, through man's desire for horticultural novelties, of plants that had long been exiles from Western woodlands, where as natives they were never seen by human eyes.

So far, attention has been confined to a selection of plants identified from leaves and a few fruits. If time permitted, the list could be substantially enlarged by inclusion of the interesting results of Dr. Simpson's intensive study of pollen-grains, which he found by microscopical examination of broken-up pieces of lignite and coal, associated with sandy beds in Mull and on the adjacent peninsula of Morven. The pollen-bearing layers of rock are below the basaltic lavas and therefore slightly older than the leaf-beds of Ardtun Head. Dr. Simpson discovered several conifers and flowering plants confirmatory of identifications based on leaves; he also made many additions to the list compiled from leaves, fruits, and seeds. Three of his discoveries are selected for brief reference. He found pollen-grains of two kinds of alder (Alnus): the pollen of alders has a very characteristic structure and can easily be recognized. The occurrence of alders in the Hebridean flora supplies one of the few links between the extinct and the present European vegetation. The second genus chosen from Dr. Simpson's list is Magnolia: it is now represented by many species, both trees and shrubs, and is widely distributed on two sides of the Pacific Ocean: in Asia along the Himalayas and in parts of Tibet, over a large area in China, Japan and Korea, the Malay Archipelago, and Indo-China; in America from southern Ontario as far south as Central America and Cuba. It was shown many years ago that Mangolia formerly lived in Europe and flourished as far north as lat. 70° N. in Greenland; we now know that it played a part in the adornment of the Thulean forests.

Finally, a few words on the discovery of pollen-grains believed to belong to a species of Nelumbium: this genus is one of the most attractive water plants, a plant held sacred in ancient Egypt and venerated in the Far East. One of the living species is the sacred lotus, native in China and Japan and established as far west as the Caspian Sea; the other species has an extended range in North America, spreading as far south as the West Indies and Brazil. Nelumbium no longer grows in the Nile: long years ago it had a wide distribution in Europe, both in the Cretaceous period and in later ages. Looking backwards, we see its great circular leaves spread over the still waters of a Thulean lake.

It is important to note that Dr. Simpson's comparative investigation of fossil and recent pollen shows a preponderance of eastern Asiatic species in the Hebridean flora.

FANCY WITH FACT

We have attempted to re-create a scene in the past, and it is natural to ask—how does our reconstruction compare with reality? As it is impossible to satisfy curiosity by an actual flight to the Thulean continent, we can at least imagine ourselves miraculously transported to a destination where the past has become the present. At a very early stage of the backward journey we should see the greater part of the land being gradually obliterated by a covering of snow and ice; glacial conditions would be succeeded by a climate becoming more and more genial. Human beings would be missed before one-fiftieth of the flight had been completed. At last, after observing the moving panorama of land and sea, fluctuations in climate and changes in the character of the vegetation, let us imagine ourselves at the journey's end. Combining fact with fancy, we find ourselves, where in day-dreams we have often been, among the plants on the lava plateau. Thanks to the artistic co-operation of Mrs. Gwendy Caröe, it has been possible to give substance to our mental picture based on geological and botanical facts. It requires a special effort for us, who think of ourselves as overlords in Nature's realm, to visualize a world in which man has no place. Alone in a world which for millions of years to-come would be uninhabited by the human race, we could scarcely fail to look upon the beauty of Nature's pageantry with a strange and more penetrating vision:

> "Beauty, the eternal Spouse of the Wisdom of God
> and Angel of his Presence thru' all creation."

We should realize as never before man's insignificance: on the other hand, our estimate o spiritual values would be raised to a higher leve and we should experience a deeper sense of unio with the infinite. Our tendency is to think of the past, as we think of the present—in relation to man; we forget his very recent participation as an actor in life's drama. As we look at Nature as into a mirror, our own image obtrudes itself into the foreground. Had man been a dweller on the Thulean continent he would have seen, as we see, the sun by day setting in motion the living machinery of trees and herbs; the splendour of the evening sky; he would hear the wind in the trees, the music of running water and the songs of birds. The beauty of Nature is eternal. To the east and north beyond the lava-fields the Caledonian mountain ranges would be seen rising to greater heights than any of their peaks reach to-day; they were still to be exposed for millions of years to the destructive operation of Nature's sculpturing tools. Making a fresh demand upon our imagination, let us take a longer view over the curve of the earth towards the heart of Europe and far to the east to northern India. We should look in vain for the Pyrenees, the Alps, the Carpathians, and the Himalayas: these and other mountain ranges had not yet been lifted up; the time of their birth was not far off. We should see in their place a broad belt of water stretching from the Atlantic to the Indian Ocean, linking West with East. On the bed of this ancient sea—the Tethys Sea of geologists—sediments had long been accumulating, and these, with other rocks of igneous origin, would be involved at no distant date in a complete transformation of the earth's features and the crumpling of the crust into the "everlasting hills".

Returning to the Thulean continent at a place near the present geographical position of the Inner Hebrides, let us take a survey of the vegetation. We should be impressed by its luxuriance: at first sight the general aspect would seem familiar, but on closer examination of the trees and shrubs we should find only a few recalling modern European species; many would remind us of exotic plants of Eastern origin. Despite the immensity of the time interval separating us from the world we had left, we should not be aware of any such marked contrast in the general character of the vegetation as we might have expected. The plants had already put on their familiar dress and would seem to us surprisingly modern. But—and this would be the deepest impression—we should feel that we were among trees and shrubs that were reminiscent of remote Eastern forests. We should be conscious of the dynamic character of the plant-world; we should be driven to the conclusion that the forests were mainly composed of wanderers resting for a time in a temporary home whence, as conditions changed, they would pass to other stages in the long journey to their present refuges in Asia.

EVOLUTION

There remains another question which is always asked by those who attempt to reconstruct the vegetation of past ages: What contributions do the records of plant-life make towards a better understanding of evolution? The riddle of evolution remains a challenge and, as knowledge increases, we make fresh guesses. As a Cambridge friend writes in a recent volume of "Provocative Verse":

> "That life evolves was guessed of yore,
> Darwinians prove it true;
> Of how and why we know but little more
> Than old Lucretius knew."

The little more we know urges us to continue in hopeful expectancy the long and endless prying into Nature's methods. What then do we learn from the ancient flora of the Western Isles?

The facts do not substantially help us to trace the unfolding of life in the long interval separating the older part of the Tertiary era from the present time. There is little difference between the past and the present vegetation of the world as a whole in the nature of trees, shrubs and ferns: our knowledge of the earlier history of herbaceous plants is very meagre. The fossil flora of Mull represents an early phase of what may be called the modern type of vegetation, which overspread the world in the later stages of the Cretaceous period and has persisted with few major modifications until now. Evolution seems to have been characterized by bursts of production when new and successful types exercised a transforming influence; and these periods of exceptional creative activity were separated by periods of relative stability. The early Tertiary floras belong to a stage when a new order had become well established and an older order had passed its prime. The one great difference that emerges from comparison of the Mull flora and the existing European floras is not a difference in the components of the world forests, but a contrast in the geographical positions occupied by the various genera in the northern hemisphere: for the most part a Western home has been exchanged for a home in the Far East.

Drifting Continents

If we followed the vegetation on the southern part of the Thulean land farther to the north, we should be impressed by its apparent indifference to changing physical conditions as we travelled beyond the Arctic Circle; we should fail to notice any zonal distinguishing characters in the floras such as in our day reflect the passage from temperate to arctic regions. The evidence of fossil plants forces us to the conclusion that the vegetation on the Thulean continent, its northern boundary within a short distance of the polar sea, its southern border on the latitude of northern Ireland and western Scotland, was astonishingly uniform. How, we ask, can we explain this surprising and well-attested fact? There must, it is generally agreed, always have been climatic belts; high arctic and much lower temperate regions cannot have supported closely comparable floras possessing several species in common. Some of us are convinced that changes in geography from one period to another, land connexions where there are now arms of the sea, interference with paths of ocean currents and consequential changes in temperature are inadequate as explanatory causes. What then remains? Were it possible for us to make a survey of the Thulean continent as it was, we might find that the geographical relation of the northern part of the forest-clad land to the North Pole was by no means the same as it is now.

It is difficult, it is probably impossible, to explain the facts without calling to our aid the hypothesis of drifting continents usually associated with the late Prof. Wegener and recently discussed in an able book by Prof. A. L. du Toit of South Africa. This is a controversial subject beyond the scope of my address: I can do little more than reaffirm adherence to the view that plant records from rocks of many ages raise problems which seem to be insoluble unless we postulate movement and sliding of the earth's crust. As icebergs are slowly drifted by ocean currents, as masses of cumulus clouds rapidly changing shape pass across a blue sky; so, the rate of travel enormously reduced, large slabs of the outermost rocky shell of the world may have shifted their position in the course of geological time. It must, however, be admitted that as yet refined methods of measurement have not furnished any evidence of crustal movement. Dr. Nörlund of Copenhagen has stated that longitudinal determinations, carried out by the Danish Geodetic Institute in 1927 and 1936 with a modern transit instrument, both times on the same pillar at a locality on the west coast of Greenland, gave practically the same result. In his presidential address at the Norwich meeting of the Association in 1935, Prof W. W. Watts made an interesting and judicial reference to the Wegener hypothesis: he spoke of it as having been hailed by many classes of investigators as almost a panacea, and quoted one of several critics who called it a beautiful dream, the dream of a great poet.

Proof or disproof of the Wegener hypothesis will be forthcoming in the more distant future, when the precision of modern methods of measurement has been available long enough to provide trustworthy data. Meanwhile, we must be content to wait in sanguine expectation that an interpretation of the overwhelming evidence furnished by fossil plants will be provided by research workers in the geophysical field.

One of the most impressive examples of the bearing of fossil plants upon the fascinating problem of climatic conditions in the past has been furnished by Prof. T. M. Harris of Reading. The facts are briefly these: several years ago Prof. Nathorst of Stockholm described a large collection of fossil plants from rocks in Scania, the southernmost province of Sweden, demonstrating the existence of a flora many million years older than the one we have been considering. It was a very rich flora composed of numerous ferns, conifers, and other plants; it probably lacked flowering plants. More recently, Prof. Harris made a still larger collection of fossils during a long visit to eastern Greenland in the ice-bound district of Scoresby Sound where, under extreme arctic conditions, only a few stunted plants are able to exist.

Nothing could be more striking than the present contrast between the floras of eastern Greenland and southern Sweden. The arctic fossil plants of the same age as those from Scania demonstrate the former existence of a flora even richer than that from southern Sweden: comparison of the two floras affords no indication of any difference in the size of individual plants and no difference in the vegetation as a whole. A luxuriant and uniform vegetation occupied an area stretching from central Germany to southern Sweden and a thousand miles farther north beyond latitude 70° N. The fossils preserved in rocks at localities within this far-flung geographical area from south to north give no indication of any such change in the plant communities as we should expect and as we find when we contrast arctic and temperate floras in the present world. This uniformity, I venture to think, is inexplicable unless we assume a very considerable movement and reshuffling of the earth's crust. The geological historian needs the co-operation of astronomers and physicists in his endeavour to reconstruct the world at the successive stages of its development; he looks to them to prevent him from making assumptions inconsistent with conclusions reached by workers in other fields. On the other hand, geologists and palæontologists contribute facts that are incontrovertible however much they seem to be in opposition to the views of students whose primary interest is in geophysical problems.

NEGLECT OF EARTH HISTORY IN EDUCATION

There are still some people who ask, what is the use of the kind of information given in this address? My reply is that knowledge gained from a first-hand study of Nature, both animate and inanimate, has a value beyond price. Enjoyment of the romance of creation as recorded in the life of the past and of the present is within the reach of all who have the desire to read the open pages of Nature's book. In the rocks we find the soul of history: the whole world throbs with life, and the joy of it all is ours to share:

"I said it in the meadow path,
I said it on the mountain stairs—
The best things any mortal hath
Are those which every mortal shares."

We have caught here through the mists a glimpse of a scene on earth's stage separated from the present by a small fraction of time in relation to the whole span of geological history. The Thulean forests which we have visited included trees, shrubs, and other plants of surprisingly modern aspect, though it is not to be supposed that they were absolutely identical specifically with their living descendants; from the material available it is impossible to define or assess the difference. What we have seen throws little light on the evolution of the plant-world; it is equally true that the main conclusion forced upon us by our retrospect cannot fail to convince us that it is impossible to understand the present distribution of plants over the earth's surface unless we extend our survey into the past. Darwin spoke of geographical distribution as a noble science, "almost the keystone of the laws of creation". The living world cannot be fully appreciated as an expression of creative energy unless we free ourselves from the cramping influence of the environment in which we live.

As a botanist whose first love was geology, may I make a plea for wider recognition of physical geography and geology as branches of knowledge possessing an inestimable value as a means of bringing young people into close companionship with Nature and as a source of refreshment, a stimulus, and an inspiration. Most of us would probably agree with the spirit of a remark made a good many years ago by the late A. C. Benson: "I find it hard to resist the conviction that, from the educational point of view, stimulus is more important than exactness". Arguments in favour of introducing geology into schools were put forward in a report on scientific education presented at the Dundee meeting seventy-two years ago, and in 1936 and 1937 the Association published two reports on the same subject. Let me add another argument of no little value: Hugh Miller wrote in a letter to a friend: "Geology is, I find, a science in which the best authorities are sometimes content to unlearn a good deal". That is worth much: geology helps us to cultivate the not too common virtue of admitting that it is possible to make a mistake.

In conclusion, I cannot do better than quote with wholehearted agreement words spoken by Sir William Bragg in his presidential address to this Association eleven years ago: "Some speak of modern science as tending to destroy reverence and faith. I do not know how that can be said of the student who stands daily in the presence of what seems to him to be infinite". These words apply with equal force to searchers after truth whose main interest is in the living world, no less than to those whose objective is the elucidation of the structure of matter that is called by contrast dead and yet vibrates with life. The earth was once lifeless: when and how living protoplasm had its birth we do not know, nor do we know whereupon were the foundations of the earth laid. We can only echo in our hearts the voice out of the whirlwind:

"Whereupon were the foundations thereof fastened?
Or who laid the corner stone thereof;
When the morning stars sang together,
And all the sons of God shouted for joy?"

SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS

Instruments in Science and Industry

THE presidential address by Mr. R. S. Whipple to Section A (Mathematical and Physical Sciences) is largely devoted to showing how much the progress of the sciences depends upon the development of the instruments employed. A few well-known instruments are selected as examples—the microscope, telescope, spectroscope, etc. Their development has a long history and each can be adapted to yield accurate measurements by the addition of suitable devices.

One of the earliest scientific workers, the Dutch naturalist Leeuwenhoek, during the period 1674–1723, discovered by means of a single-lens microscope the protozoa and bacteria, and made many other discoveries of supreme importance. Although many variations in the design and mechanical construction of the microscope were made during the eighteenth century and the early years of the nineteenth, yet there is no invention of fundamental importance to record until the construction of the achromatic objective. This was first successfully completed by the French optician Chevalier about 1825. Abbe carried the corrections to a far higher degree of perfection, notably by using glasses of new types which at his suggestion had been worked out by Schott, to produce, about 1886, the so-called apochromatic objective. It is difficult to see how the resolving power of the microscope is to be increased further using light from the visible region of the spectrum; the alternative is the employment of rays of shorter wave-length.

J. E. Barnard has developed a successful technique in connexion with ultra-violet microscopy and has shown that it is possible to study and photograph living bacteria, which are normally transparent to light from the visible regions of the spectrum.

The use of short-wave radiation has proved so successful in the case of the ultra-violet microscope that great interest is being shown in the development of instruments using still shorter radiations. It is possible, in a suitably designed piece of apparatus, to use a beam of cathode rays to obtain photographs of bacteria and bacilli at magnifications as high as 20,000 diameters.

Although a Dutchman, Lippershey, discovered the telescope, yet it was Galileo who first produced an instrument worthy of the name. He ground and polished his own lenses and in 1610 discovered the satellites of Jupiter. Newton pointed out that the focal length of the refracting telescope could not be reduced owing to the refrangibility of light of different colours and the impossibility of focusing for all the colours simultaneously. In 1663, James Gregory suggested the reflecting telescope, and five years later Newton constructed the first satisfactory instrument.

Herschel made many specula of high quality, culminating in one of 4 ft. diameter for his Slough telescope. Owing to the increasing demand for telescopes of higher magnification, and of increased light-gathering power, the size of the mirrors used in modern instruments is steadily increasing. An instrument is now being constructed for the Mount Palomar Observatory in which the mirror is 200 inches in diameter.

The highest accuracy obtainable is required in the divided circles of astronomical and surveying instruments. In the latest form of theodolite the circles are made of glass, the divisions being etched upon them. The advantages of the divided glass circle are so marked that the new reversible transit instrument for the Royal Observatory, Greenwich, is provided with such circles, 28 inches in diameter.

The spectroscope is proving of great service in industry both as a tool for rapidly analysing samples of materials and for detecting impurities. The value of the instrument in advanced physical work cannot be easily exaggerated.

After discussing briefly the instruments used in the measurement of time, Mr. Whipple considers the importance of modern electrical instruments and the large part that will probably be played in their future development by the thermionic valve. In concluding, he stated that he was much impressed with the steadily growing demands for higher accuracy in all measurements. As new problems arise both in science and industry the requirements become more stringent. The instrument maker constantly receives incentives to progress from the scientific worker, to whom he owes not only suggestions but also many of his new materials. If knowledge is to progress, it is essential that theory and practice advance together. Nowhere is this more true than in the development of scientific instruments.

FILM REACTIONS AS A NEW APPROACH TO BIOLOGY

TOWARDS the end of the last century, the biologist considered that the biological entity was the whole living unit. In recent years the interest developed in specialized processes such as enzymatic reactions has tended to obscure approaches to the mechanism of co-ordination and integration of activities of a cell. Since an analysis of the colloidal properties of living matter reveals that a large fraction of the material and energy lies in a new phase, the interphase, it seems pertinent to inquire how far physical and chemical reactions may be modified when the reactants are confined to an interphase. This is the subject-matter of Prof. E. K. Rideal's presidential address to Section B (Chemistry). The general considerations in respect to composition and structure of the interfacial phases have long been known and have been exhaustively examined during the last twenty years. More recently, attention has been directed to the physical properties of monolayers of the macromolecules, such as the proteins and methylated celluloses and starches. These are of interest in that two-dimensional gels, prototypes of membranes, can be formed. The fact that the molecules in monolayers are orientated in respect both to the substrate and to their neighbours, and that this orientation can be affected by expansion or contraction of the monolayer, is shown to have an important bearing not only on the rates but also on the height of the potential barriers involved in the reactions. Many examples are noted in surface chemical reactions, including both enzyme activities and photochemical processes.

Since the molecules at the interfaces are orientated, in two component systems molecules of different species can be adlineated with respect to one another. Under these conditions the interaction energies comprising both the polar as well as the non-polar portions attain maximum values, and stable complexes frequently result. The formation of these complexes is brought about by the penetration of a monolayer of one species by the molecules of the penetrant. These penetrative reactions appear to be involved in various biological processes such as lysis, agglutination, or sensitization, and to play a part in the action of various drugs. Complexes formed in this way may be broken by other reactants and can likewise serve as carriers for an otherwise non-transportable reactant.

Penetrative reactions involve the penetration of a monolayer by a reactant containing but one reactive polar group. If the reactant contains two or more of such reactive groups, on injection beneath a monolayer the reactant will be adsorbed by the monolayer and form a series of interlinks. An extensive interlinking results in the formation of a non-dispersable tanned skin possessing distinct properties. Finally it is pointed out that action as opposed to injury currents can be imparted to such a system by periodic alteration of the orientation of the molecules of an interphase.

METAMORPHISM AND IGNEOUS ACTION

THE consideration of the relation between metamorphism and igneous action, which forms the subject of Prof. H. H. Read's presidential address to Section C (Geology), falls into two parts. First, a brief historical summary of the peculiarly national contributions serves to display the wide divergences in opinion on this question. The views of the Rosenbusch school of pure thermal metamorphism are contrasted with the imbibition notions of the French, and the work of Becke of Vienna, the Swiss, Sederholm of Finland and the Americans is reviewed. The classic investigations of George Barrow on zones of progressive regional metamorphism in the highlands north of Dundee and their causal relation to granitic injections are sympathetically summarized.

In the second part of the address, a discussion is presented of the origin of regional metamorphism, that is, of the transformations which have affected large portions of the earth's crust. Prof. Read objects to the customary view that regional metamorphism and dynamic metamorphism are equivalent terms, and suggests that, apart from the dominantly cataclastic effects produced in rocks by patent dislocations, metamorphism is not directly controlled by orogenic deformation. The preservation of original sedimentation textures, the coincidence of schistosity and bedding, the horizontality of schistosity over wide areas and mimetic crystallization generally are observed features which are incompatible with dynamic action.

To account for these features, the operation of a static or load metamorphism in which the transformation is considered to be due to the vertical pressure of superincumbent beds has been invoked by some. Objections to the validity of load metamorphism are, however, many. The existence of completely non-metamorphic rocks which have nevertheless been covered by an immense thickness of strata, high-grade metamorphic rocks resting on lower-grade rocks, and the narrowness of metamorphic zones are examples of these objections. Load, by itself, is not enough.

Prof. Read considers that metamorphism is not a function of depth. He suspects that the notion of the great depths of high-grade regional metamorphism flourishes because of the supposed necessity of carrying rocks down to be metamorphosed, and suggests that as an alternative we should consider bringing the metamorphosing agents up. This can take place in connexion with granitization and the formation of migmatites. Whatever be the origin of granitic magma, it has been demonstrated in dozens of localities that solid rocks have been converted into rocks of granitic character. In the production of such migmatites, replacement must be the essential process, and it is reasonable to believe that during this replacement there occurs an emigration of material into the country-rocks adjacent to the theatre of granitization. Around the migmatite core, therefore, zones of various characters depending upon the localization of different precipitation-fronts are formed.

One of the most firmly established facts of metamorphic geology is the close association of highest-grade metamorphic rocks, such as those of the sillimanite and cordierite zones, with migmatites. This association has been variously interpreted, but Prof. Read agrees with Barrow and others in seeing in it a direct causal connexion. These high-grade rocks, however, are but the final stages in the progressive series of zones which supply the common types of regionally metamorphosed rocks. It seems reasonable to suggest, therefore, that regional metamorphism as a whole is genetically related to igneous activity of some kind. Out from the central theatre of granitization there pass waves of metasomatizing solutions, changing in composition and in temperature as they become more distant from the core and promoting thereby the formation of zones of metamorphism about it. Relief is obtained in the outer and cooler zones by shearing, in the inner and hotter zones by internal reconstructions. Such a metasomatic metamorphism accounts for the superposition of high-grade on low-grade rocks, for the preservation of original textures, for the coincidence of schistosity and bedding, for the changes in chemical composition of the progressive zones and so forth.

Prof. Read's conclusion, which is offered for discussion, is that all rock transformations may be classed into two groups, those of dislocation-metamorphism associated with dislocations of the crust, and those of regional and thermal metamorphism, associated with igneous activity.

PERSPECTIVES IN EVOLUTION

THERE are some general problems regarding life and evolution which are best comprehended by analysis of long-range views of existence upon the earth. Some of these problems were restated in the light of recent knowledge by Prof. James Ritchie in his address to Section D (Zoology).

Investigation of the properties of living things has led to modification of the extreme mechanistic and vitalistic views of life and has gone far in reducing its mystery to terms of physics and chemistry. Theories of the cell as an electromagnetic unit and of life as the dynamic equilibrium between such units, or of life and the cell as originating in an etherial vortex are less convincing than the researches which show that certain activities of cells conform almost perfectly to the laws of osmotic systems, to Donnan's membrane equilibrium, and to catalytic action brought about by enzymes. None of these interpretations, however, reaches the ultimate secret of life, the quality of which is apparent in a perspective of evolutionary processes.

Living organisms have assorted and aggregated vast deposits of calcareous and siliceous ooze from the dilute solutions of the ocean, and have gathered great formations of coal and peat from the tenuous stores of carbon dioxide in the atmosphere. This is something quite different from the physical fate of gases or solutions, which normally progress towards maximum dispersal of their particles. Moreover, the evolution of life itself, from simple to more complex, is an increase in orderly arrangement apparently opposed to the thermodynamical law of increasing randomness. From this point of view the characteristic of livingness is that it appears temporarily to hold up or withstand the physical course of degradation of matter, if it does not actually reverse it, through its power of trading with the environment so that it can build up stores of high potential energy from materials of lower potential.

Another notable development which must influence evolutionary thought is the lengthening perspective of life upon the earth. Newer and consistent information about the ages of geological formations based upon the break-up of radioactive minerals in rocks emphasizes generally and in detail the stability of living organisms and the slowness with which evolution has taken place. It emphasizes still more the significance of man as an agent of change in the living world, for his active part in modifying life upon the earth is practically confined to our era and mainly to the last three hundred years. In that insignificant period he has wrought faunal changes in civilized lands which can be compared only with the great secular changes of world evolution.

Realization of the 1,200 million years through which life has been evolving leads to an attempt to view mankind and the future of man in evolutionary perspective. His past is insignificant in time; his long future is unknowable so far as science is concerned. But bearing in mind the impetus of evolution, it is reasonable to suppose that in the immediate future (geologically speaking) his progress will be continued towards perfection of social life and the widening of the social idea to include peoples and nations as well as individuals. What of his long future, in the vista of a thousand million years still to come? The history of life upon the earth makes it seem presumptuous to suppose that with the coming of man evolution should cease or should be tied for all time to come to trifling changes in brain-power or better social organization for mankind. It suggests that man, so far the greatest of the manifestations of life upon the earth, may be no more than a stage in life's progress and a milestone upon the path of evolution towards a greater future.

METHOD IN GEOGRAPHY

MR. A. STEVENS points out in his presidential address to Section E (Geography) that during the last thirty-five years, it has been customary in geographical writing to pay some sort of service to the concept of natural geographical regions as distinguished from the 'political' divisions of the earth formerly in use. Immaturity of thought is indicated by the terms in use: natural (physical) region, economic region, human-use region. It arises from the inclination to see the matter of geography as a duality and its method as synthesis or integration. Fertile scientific work, the definite emancipation from scholasticism of modern intellectual processes, has depended on confining each branch of study to a single material category, and this problem has not been solved in the case of geography. Neither synthesis nor integration is possible where the factors and conditioning circumstances are too complex and difficult fully to be enumerated, let alone evaluated, as they are in the field with which geography attempts to deal. As to method, the subject must limit itself to the analytic: further examination of the natural region concept should contribute to the definition of its matter.

The natural region must be defined with regard to neither the physical nor the human or economic severally, but to both in symbiosis, in natural synthesis. The natural geographical region is the organized or living region. Organization depends on occupation by man and the development of a system of communications the functions of which are analogous to those of both the circulatory and the nervous systems of living organisms. The functioning of such regions with special reference to space is the study proper to geography, as that proper to history is such functioning in time (or sequence). Space and time may not fundamentally be independent variables, but they may be made the basis of partial differentiation. There is the story of the evolution of communications from the porter to the aeroplane, from the smoke signal to the radio. There is also the question as to how precisely communications have managed space.

Organized regions have their ontogeneses. At a given time a region may be *saturated* and its development mature, as, some time in the past century and a half, occurred in Western Europe; or it may be undersaturated and juvenile as is the New World to-day. Until a certain degree of maturity has been attained, the region cannot be defined in detail. The conditions for saturation depend on the state of economic development.

The major natural geographical regions of Europe are the European countries. A geography of Europe not based on the characteristic European phenomenon of the nation-State is absurd. Spatially these regions are quite out of proportion to modern possibilities of communication, the means of organization and cohesion.

RATES AND TAXES

PROF. H. O. MEREDITH'S address to Section F (Economics) entitled "Rates and Taxes" is a plea for more serious consideration of the distribution of the tax burden through society in view of probable increase in the ratio of public to private expenditure.

It is alleged that while the policy of *laissez-faire*, as understood by the Victorians, has been abandoned, we have failed to develop a financial practice comparable in logical coherence with that of Gladstone. In consequence, our finance is more and more passive and less and less capable of advance in good time on constructive lines. "Instead of grasping our nettles, we wait until we are stung". Defect of intelligible principles is illustrated by the case of income tax abatements in respect of children, and the policy of derating; and the question is ultimately posed of whether any of our existing sources of revenue are really satisfactory with the exception of income tax and sur-tax and the duties levied on property passing at death. The case against indirect taxes upon commodities and the local rates is argued at considerable length, attention being directed particularly to the sinister influences which have in the past promoted indirect as opposed to direct taxation. The arguments in favour of these sources of revenue are also examined and the conclusion is reached that little, if any, force is attached to any of them here and now, whatever may be or have been the case in other countries or at other times. Special attention is directed to the disputable character of the widely held opinion that virtuous conduct may found a valid claim to exemption from taxation and vicious conduct establish a case for pecuniary penalty.

Finally it is claimed that these methods of raising revenue must inevitably, under modern conditions, distribute the burden of taxation partly in an indiscriminate and partly in a clearly noxious way. In its concluding section the address propounds the theses that taxation ought to be felt and that every citizen in a community ought to pay and know that he is paying at least some minimum contribution to the expenses of the State.

THE FUTURE OF FLYING

THE presidential address to Section G (Engineering) provides each year an opportunity for a survey of some aspect of engineering science which happens to be of especial importance at the time it is given. The subject chosen by Mr. Wimperis is "The Future of Flying". Of its importance at the present time there can be no doubt. Aviation is surveyed by the public with a tempered pride; pride it is true in man's achievement, but apprehension as to the use which is being made of it.

The aspiration towards winged flight was expressed with wisdom when, more than two thousand years ago, the Psalmist avowed his longing for "wings like a dove". Mankind possesses the power of flight—a marvellous scientific and technical triumph; but brilliant as was the work of the pioneers, the crown of achievement cannot be regarded as won until mankind sees that the wings gained are indeed the wings of a dove, not those of a bird of prey. Every new invention has its warlike use as well as its peaceful purpose, and each has challenged men's wits to ensure that good, rather than harm, shall result from the new discovery. To bend the newest invention of all, the conquest of the air, to the service of mankind is now his great task. In it, success is essential lest we presently find that it is the air that has conquered mankind rather than mankind the air.

That the cleaning up of the aerodynamic structure would carry aircraft performance much further than had hitherto been realized was first pointed out, little more than ten years ago, by Prof. B. M. Jones of Cambridge. This required that all excrescences should be removed, and of these some of the worst were then the interplane struts and wires. When that had been achieved it was realized that much of the equipment hitherto carried externally, especially in military types, must be put inside, and with that attained, after a severe struggle, there arrived the modern streamlined aeroplane with its undercarriage, and even its tail wheel retractable into the body of the structure.

As a consequence the speeds of military aircraft are now in excess of 400 m.p.h. and will rise to 500 and possibly even 600 m p h. But civil aircraft rarely go faster than 250 m.p.h., and it is doubtful whether it is economically advantageous to have even so high a speed as that. This at once makes a great difference between the two types. Moreover, the comfort and space needed for civil transport tend to produce a design of body which does not in the least resemble military requirements, and in so far as the civil types, in their really large sizes, come more and more to take the flying boat form, so are they the less like military types.

In Mr. Wimperis's view there will be no reason, once the international situation has cleared, why there should not be an agreed limitation, in respect of numbers or tonnage, of bombing aircraft—leaving the interceptor fighters entirely aside. It would be but cautious to agree on a limit to the speed of civil types; but as this would merely confirm what economic requirements would themselves require, it need be no hardship to anyone; excessively high speeds for civil types do not pay, are much more dangerous to passengers, are much more noisy to everyone, and need extravagant air ports.

SCOPE AND LIMITATIONS OF PHYSICAL ANTHROPOLOGY

ANTHROPOLOGY spreads its domain over unusually wide fields of scientific inquiry, and it is becoming increasingly impossible for the representatives of the different branches of the subject to maintain intelligent contact with each other and to judge of the validity of the evidence which is presented in branches other than their own. In his presidential address to Section H (Anthropology), Prof. W. E. Le Gros Clark discusses the present position of physical anthropology and its future prospects.

Intensive studies in comparative anatomy have established broadly the relation of man to the lower primates; but evidence of this nature is necessarily limited since it is often impossible to assess the relative taxonomic value of different anatomical or physiological characters The extension of our knowledge of the zoological status of man must now await the accumulation of palæontological data. The existing palæontological evidence of the origin of man is briefly reviewed, and stress is laid on the difficulties of interpretation when only fragmentary fossil remains are available for study. Physical anthropologists in the past have been somewhat too confident in the general inferences which they have drawn from such scanty evidence, and erroneous conclusions have frequently been based on an inadequate appreciation of the great range of variability in fossil and recent man. It is much more difficult than is generally supposed to draw even simple conclusions, such as those regarding sex and race, from the study of the skeleton alone.

The validity of taxonomic characters in the study of racial differentiation demands a careful study, and it is necessary that anthropologists should make more detailed inquiries into the genetic basis of the characters which they commonly use. There is evidence that even the shape of the skull is susceptible to nutritional and other environmental influences. Craniometrical evidence is further complicated by the possibility of parallel mutations, a phenomenon which is well known to occur with other physical traits. Consequently, craniometrical resemblances do not necessarily indicate correspondingly close genetic affinities. It is necessary to endorse the criticism of Prof. R. A. Fisher that, for the study of racial problems, physical anthropologists might more profitably direct their attention to living populations rather than rely on skeletal material, which too often is unsatisfactory and inadequate.

Apart from palæontology, it may be doubted whether physical anthropology as a historical science is likely to advance our knowledge of racial origins and racial differentiation very much beyond its present state with the techniques now commonly used. On the other hand, there are many profitable lines of inquiry which are waiting to be explored in other fields of physical anthropology. Many biological sciences have passed or are passing through what may be termed the 'museum stage' of their development, a stage involving the collection of material in the laboratory, its detailed examination and classification, and the interpretation of the facts which it presents in the form of general hypotheses. To complete its natural metamorphosis, physical anthropology should also now be emerging from the museum stage and developing along experimental lines or along the lines of active observation in the field.

The study of the bodily changes which man has undergone in the past gives a clue to the nature and extent of the changes which may be anticipated in the future. But what is far more important for the same purpose is the study of man as he is to-day. Sociological problems are becoming more and more forced on our attention which demand for their solution a conscious control of processes which have hitherto been left to chance. The improvement of health and physique and their relation to nutritional and climatic factors, the relative importance of hereditary factors in determining the distribution of physical characters, the results of the hybridization of different racial types, the effects on physical type of the redistribution of the populations of the world, the relation of changes in the reproductive rate to human variability and the composition of regional populations, all these are practical problems which can be approached systematically and scientifically only if we have adequate data regarding the physical nature of man in the conditions under which he now lives.

There is little doubt that the physical anthropologist of the future must be essentially a field-worker if he is going to develop his subject along progressive lines. Since, also, physical anthropology is one of the biological sciences, he must be a man of sound general biological training if he is to acquire a real insight into the problems which are set for him.

The science of physical anthropology has already contributed much to the study of the past history of the human species. By the study of modern populations it has a still more important function to fulfil, namely, the accumulation of data on the basis of which it will be possible in some measure to control the destiny of mankind.

THE ASSESSMENT OF PHYSICAL FITNESS

IN the House of Commons on Thursday, July 20, 1939, the Prime Minister said, "I am presenting a very serious argument. What is going to be the result of this increased expectation of life, coupled with the diminution in the birth-rate, which is going on at the same time ? In 1931 the number of persons of 65 years and over was, in proportion to the number of people between 15 and 65—the earning age—as 11 to 100. In 1955 that will have risen to 16 to 100 and in 1975 to 20 to 100. It may be said that that is a long way off and we shall not know anything about it, but surely we ought, if we have a proper sense of responsibility, to consider what is going to be the effect on the next generation of anything that we may be doing to-day. The implication of the figures have given is this : That as time goes on there will be an increasing proportion of the population who will be eligible for pensions and to whom pensions will have to be paid, and there will be a decreasing proportion of the population who will be earning wages and therefore able to make contributions to pay them."

In 1930, after the Contributory Pensions Act was passed, the cost to the Exchequer was £46,000,000. The estimates for the current year showed a charge of £69,000,000, and in the course of the next forty years the estimated annual cost will rise to £115,000,000 at the present rates of payment.

To blacken the picture still further, the only grade of the population that has a high birth-rate is the lowest in the social, economic and biological scale. It is therefore of importance to have some means of carrying out an audit of the physical fitness of the population so as to ensure a rational means of raising the general level of fitness.

Methods of assessing fitness are classified as somatometric, physiological and psychological. In his presidential address to Section I (Physiology), Prof. D. Burns reviewed the various indexes of fitness in general use and dealt with their validity. He restricted his discussion to the testing of subjects apparently healthy from the clinical point of view.

Somatometric assessment *per se* is of very little use as fitness is functional, depending not so much on the structure of the body as on the way it works, and on the speed and accuracy of the various correlations involved in action; and on the determination of the subject to do his best. Tests of cardio-vascular efficiency combined with some form of 'stunt' test may be considered reliable indexes of fitness.

MEASUREMENT IN PSYCHOLOGY

IN his presidential address to Section J (Psychology), Mr. R. J. Bartlett deals with measurement in psychology. In using the measurements of physics to evaluate the objective products of mental activity, psychology finds as an essential feature of its data a scatter which makes statistical treatment of that data necessary. No progress could have been made without accepting what Dr. Darwin, last year, in his presidential address to Section A, called "the fuzziness inherent in absolutely all facts of the world".

Intensity is a characteristic of sensory experience which has occasioned controversy that still leaves divided the committee of Sections A and J set up in 1932 "to consider and report upon the possibility of Quantitative Estimates of Sensory Events". Apparently much of the difficulty arises from confusion of two sources of 'error'. Sensitivity, in its true sense is a 'scatter error', would seem to be slightly superior to the demands of the Weber ratio, $\Delta I/I$, and is not subject to decrease with extreme stimuli. The rapid increase in the Weber ratio, as ordinarily determined, is due to a 'constant error', dependent on a memory factor and causing regression towards accustomed values.

After a review of experimental investigations of reaction times, bodily and mental work, and the physiological concomitants of emotional-conational experience, in which the methods and measurements used are those of physics and physiology, measurements peculiar to psychology are considered. In 1924 a Board of Education report on "Psychological Tests of Educable Capacity" concluded that intelligence tests were of value. The original 54 'manifold and heterogeneous' tests of Binet, compiled in 1905 for the diagnosis of mental deficiency, have become, in the 1937 revision of Terman and Merrill, two sets of 129 tests each, covering mental ages from 2 years to 22 years 10 months and measuring intelligence quotients up to 170 for children and 152 for adults.

Spearman's great contribution to work on intelligence was the introduction of methods of correlation to establish the value of tests. From his work he educed the two factor theory and tetrad criterion—a mathematical method of general application.

Work of the Industrial Health Research Board, the National Institute of Industrial Psychology and other research has given tests for abilities and skills of value in industry and for particular disabilities that unfit for certain occupations. These, as tests for vocational guidance and selection, are being used with increasing frequency.

There follows the measurement of personal attitudes and interests, as in the case of Thurstone and Chave's 'attitude to the Church scale', which enables a person's attitude to be assessed in a scale ranging from enthusiastic support to bitter antagonism. Similar methods have given social maturity scales and enabled a start to be made with the measurement of temperament and character characteristics.

Steady progress made, from measurement of sensory discrimination, through measurement of intelligence and measurement of abilities and skills, to measurement of attitudes and interests and measurement of temperament and character traits, justifies psychologists in expecting yet greater achievements and in not being unduly disturbed by the criticisms of those who continue to hold, with Malebranche, Leibniz and Kant, that psychological data contain nothing 'that can properly be called measurement'.

INTERPRETATION OF PLANT STRUCTURE

PROF. D. THODAY, in his presidential address to Section K (Botany), traces the change of outlook in plant anatomy from the adaptational and the phyletic to the causal and developmental.

Using xerophytes as example, he shows how difficult it is to assess the functional effects of structural features with exactitude. Xerophytes co-existing in the same habitat vary greatly in the efficiency of their structural provision for controlling the loss of water and are not as a class characterized by low rates of transpiration. Contrary to teleological expectation, stomatal frequency is higher in plants growing in exposed places; it is affected by the degree of expansion of leaves, under different conditions, after the stomata have been initiated. Correlations between vascular tissue in leaf and stem, too, require a causal rather than a functional interpretation and point to the influence of one part upon another during development. The discovery of hormones in plants, especially of auxins, which among other effects stimulate cambial activity, justify such an interpretation of structural correlations.

Phyletic studies have had only limited success in the tracing of phylogenies, but have revealed numerous instances of parallel evolution. These direct attention to the nature of major changes, which do not present the haphazard appearance of those which cytology has revealed. It is suggested that, from the lowest chemical plane upwards, the important factors were inherent probability of particular changes, and *selection of harmonious changes*, in dynamic systems. The study of development from a causal point of view may therefore throw light on the nature of the major changes in evolution. The material for comparative morphology consists, not of three-dimensional, but of four-dimensional patterns.

Prof. Thoday then approaches seedling structure from a causal point of view. He suggests that the shoot and root apices, as organizing centres, determine between them the vascular structure of the hypocotyl, the variations observed reflecting different degrees of dominance and extent of influence of one or the other, in different species and at different phases of development. The number of strands of procambium reflects the early influence of the cotyledons, sometimes also of the plumule. Exarch protoxylem, with flanking strands of phloem, reflect the influence of the root, and represent the smallest symmetrical arc-segment of the repetitive root-pattern. Subsequent centrifugal development of xylem shows the increasing influence of the shoot. Adventitious roots, especially polyarch roots of Monocotyledons, and the successful culture of excised root-tips, show that the root apex is self-determining as regards its structural pattern. In dicotyledons, however, no secondary growth is initiated apart from the shoot.

Williams's experiments with rhizophores of Selaginella show that hormones may throw light on morphological problems. While, however, hormones may be agents in the correlation of development, they do not account for the processes that are correlated. By reference to the development of the adhesive disk and haustorium of *Viscum album*, Prof. Thoday emphasizes that differentiation consists in the active response of living cells to various influences, which in this example are largely external, but in ordinary plant organs are mostly internal. Inheritance of structure is thus inheritance of behaviour patterns, the subtlety of which transcends our present conceptions of chemical or structural change in chromosomes.

EDUCATION FOR INDUSTRY

IN his presidential address to Section L (Education) Dr. A. P. M. Fleming directs attention to the vital part which the manufacturing industries play in the economic life of the nation, and points out that the well-being of these industries depends on the personnel engaged in them, so that the education and training of this personnel is a matter of great national concern.

The function of industry is to transform raw materials into useful commodities, and in both the social and economic sense it is the manufacturer's responsibility to the State to effect this conversion with the minimum of waste of time, effort and materials.

Industry is never static and particularly is influenced by the continual accession of new scientific knowledge. Hence there must be similar mobility as regards the outlook on industrial education.

The education of industrial personnel is considered in relation to two main groups of employees —manual and non-manual workers—and embraces entrants from all educational levels from the elementary school to the university.

In progressive manufacturing concerns it is becoming increasingly the practice—and this applies to all grades of personnel—to seek entrants who have received an appropriate education in fundamentals and to provide the required specialized training during the early years of employment. This practice applies equally to skilled artisans, foremen, supervisors, draughtsmen, designers, salesmen, research workers and those who eventually attain the highest executive positions.

The industrial education of the future must envisage the continual addition of new scientific knowledge, which is the basis of all industrial progress and particularly the development of entirely new industries.

The increasing mechanization of industrial processes and the tendency to reduce hours of labour should enable technical instruction to be given in the daytime and thus eliminate part-time evening technical study, leaving leisure for cultural pursuits and opportunities for increasing physical fitness.

At present the facilities for imparting practical instruction within industry are by no means fully utilized, and there is need in this respect for greater co-operation between industrial concerns. The practical training of industrial personnel is a national service to be conducted irrespective of any narrow commercial considerations.

The raising of the school-leaving age will have the effect of rendering practical training more intensive and will bring into prominence the question of the length of time really required for the effective practical training of every type of industrial personnel. Greater co-operation is needed between industry and education in the matter of providing adequate teaching staffs, notably in connexion with the technical institutions and universities. Post-advanced courses will, to an increasing extent, bridge the gap between the adoption by industry of newly developed scientific processes and the availability of knowledge of such processes in text-books used for the more conventional teaching courses. The extension of scholarships and fellowships to industrial students is desirable, especially those of such character as lead from general education to actual employment in a job after university education has been completed.

Though the importance of education and training of an industrial character is stressed, it is appreciated that all education must be liberal, and even to meet the urgent needs of industry no technical specialization should be permitted which excludes the possibility of time being devoted to broadening the mind in both the mental and the social sense.

SCIENCE AND AGRICULTURE

SIR THOMAS MIDDLETON, who takes as the subject of his address to Section M (Agriculture) "The Farmer's Position and the Scientific Worker's Programme", refers to the well-known motto of the Royal Agricultural Society of England, "Practice with Science", and contrasts the fortunes of the farmer and the scientific worker a century after the motto was adopted. The progress made by science would cause astonishment to those who chose the motto ; the condition of agriculture would disappoint their hopes. Agriculture's achievements were then judged by the capacity of the country to maintain its people, and the soils of Great Britain supported about seventeen millions. To-day, although no doubt the quality of our farm produce has improved. our soils support some fourteen millions only. Moreover, as is generally known, the difficulties of farmers are so great that even in a year when Parliament has been greatly pressed for time and the Exchequer for money, much time has been given to the discussion of agricultural matters and some money has been spared for assisting the farmer. Aid has been called for since, in the post-War years, rising costs, low wholesale prices and uncertain markets have depleted the farmer's resources to an extent that makes the requisite treatment of the soil impracticable.

References are made to the incomes of arable farmers in north-east Scotland and eastern England which show that, when a moderate interest is paid on capital, the farmer's earnings in recent years have approximated to the wages earned by cowmen and shepherds. In the United States in the early thirties the farmer's earnings did not equal those of his hired men, and similar conditions were faced by farmers in other countries, such as Canada, Holland and Denmark. Poverty among peasants and agricultural labourers has been widespread. A Committee of the International Labour Office has recently shown that in twenty-three countries studied by it an improvement in the condition of land workers was urgently called for.

The reasons for the meagre reward of those engaged in the production of man's primary need are discussed ; some are due to the producer's fellow-countrymen, others to the farmer himself. The nature of the farmer's calling is such that he finds it impossible to equate supply to demand. Thus, as a competitor in the food market, he occupies a weak place and is compelled to accept as remuneration for his work what is left over after others in the food industries have secured a margin which satisfies them.

In the second part of his address Sir Thomas Middleton alludes to the increase in the financial resources of scientific workers in agriculture and claims that this increase is justified because of the value of the work to the nation. The fact that markets may be over-supplied, though unfortunate for the farmer, benefits the public.

In the United States, where surplus commodities created great difficulties for the administration, there was no limitation of scientific work because of surfeited markets ; on the contrary, all available scientific assistance was enlisted in an endeavour to recover from the recent depression. A similar lead has been given by our own forefathers. When, in 1839, Britain had passed through difficulties as great as those recently encountered in the United States, the agricultural leaders of the day took "Practice with Science" for their motto. Since science is incomparably better qualified to help and farmers are far more ready to seek its aid than before, we have now, in facing an uncertain future, reason to do so with the courage, as with the motto, of our ancestors of 1839.

After a brief reference to investigations in progress at some of our agricultural institutions, the subject of food supply in war is discussed. The coming of the aeroplane calls for changes in English farming which would enable food production to be increased rapidly should war break out. Attention is directed to the ease with which production was increased in Scot'and in 1917 and 1918 as compared with the very great effort required in England, and it is argued that many English farmers, who now keep their land permanently under grass, should adopt the Scottish system of the temporary ley. The principal change desirable in English methods is thus the change for which Sir George Stapledon argued so strongly in his address to Section M at last year's meeting of the Association. It is a change which, superficially, would appear to be easy. In fact it presents many difficulties which call for careful study, and study from different points of view. Scientific workers in framing their programmes should ask themselves how best they may contribute to a solution of this problem and thereby enable agriculturists to increase food production rapidly should the need arise.

Although all our usual foods would demand attention, the chief effort in war would be to secure an increase of energy-supplying food. At the present time about 70 per cent of our energy supply is imported. Experience in 1914–18 suggests that, farmed as Britain now is, it would be difficult in war to provide more than 35 per cent of our requirements. This was the percentage which the United Kingdom raised at home in the years 1909–13. In 1918, favoured by the season, the figure was raised to 42 per cent, but since that year the area under grass in Great Britain has increased by nearly four million acres, and land under grass is unlikely to provide even one-fifth of the human food produced by cultivated land under cereals and potatoes.

The duration of wars cannot be predicted, nor can we forecast the effect on sea-borne supplies; we should not rely on storage and shipping to supply as much as 65 per cent of the food we should need in a prolonged war. The food production campaign of the future may be required to aim at a six months' supply. Britain now has about 17 million acres under permanent grass; if on four to five million acres of the most suitable land temporary were to replace permanent grass, so as to increase the area of arable land to about 16½ million acres (the area of fifty years ago) and the fertility of this arable land was maintained at a satisfactory level, the production of 50 per cent of our food in war should not prove to be beyond the combined efforts of our farmers and scientific workers.

LOCAL SCIENTIFIC SOCIETIES AND THE COMMUNITY

PROF. H. L. HAWKINS, in his presidential address to the Conference of Delegates of Corresponding Societies, emphasizes the opportunities for team-work that these societies afford. While the society should not become too parochial in its interests, nor lapse into a picnic-club, its local and social aspects are both essential to its success. Interest, not erudition, should be the criterion of membership.

Much useful work in natural history depends on observation, so that topics accessible to the majority of members will give most satisfaction. A society in a coastal town can study marine conditions that would be outside the scope of one located in a midland city.

Every local society should control the mania for collecting. Great advances in this respect can be recorded; rarities are rarely exterminated to-day in the name of science. But some people still need reminding that it is criminal to celebrate a meeting with a long-sought friend by dragging home his corpse.

Collecting specimens, living or inanimate, dissociates them from their environment. Specimens become curiosities of little value without particulars of the circumstances of their occurrence. For inanimate objects the collector can, if trained to observe, record all the features of their environment that are likely to be significant; but where living things are concerned, an individual cannot deal with all the factors that may have influenced their occurrence. The arrival of a migratory bird may be controlled by the appearance of a particular insect, and this may depend on the growth of some plant the development of which may have been affected by the weather of the previous season. Here is the opportunity for team-work.

Local scientific societies have a splendid opportunity for compiling statistics of transient phenomena. Every recurrent seasonal event invites, and should receive, accurate observation and a permanent record. Each society should encourage its members to keep statistics on all such topics. Large-scale maps for plotting localities, and a card-index for the records, and perhaps a retired business-man to keep order, would soon provide a mine of information packed with unsuspected wealth.

This suggestion may be thought to be concerned more with the relation of a scientific society to science than with its reaction on the community.

Such a view is not only narrow, but also out of date. Prophecy is based on knowledge of past history. The statistics suggested above are the raw material of prophecy. If such truly natural history of a few decades were available, many of the problems that confront every farmer, and so every consumer, would meet at least partial solution.

In these critical times, statistics of the natural resources of the country are being eagerly compiled. There could be no better compilers than local residents trained to observe facts and to tabulate them methodically. Many of the problems involve elaborate technical study; but their fundamental aspects are within the capacity of any reliable observer. All who love their country can find here valuable and congenial work for which the need is urgent.

The number of people in any district likely to join, and work with, a scientific society is small. But the study of natural or human history should develop a philosophical outlook that can supply a tonic for the world, and mitigate the attacks of the flesh and the devil. The mere existence of a body of people that declares its interest in matters bigger than political squabbles, preferring wider vistas than those of the daily headline, should ensure a nucleus of stability in the quicksands of suspicion and opportunism where civilization is floundering.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

meeting in an east-Midland town, when the question of dental service for expectant and nursing mothers was raised, a member declared that the husbands required treatment rather than the wives. The belief in the power of the caul to confer protection and good luck is gradually dying out, but at one time cauls were carried by the shore fishermen all along the coast of eastern England to protect them from death by drowning. In addition to the criminal use of savin and pennyroyal for abortifacient purposes, the legitimate employment of herbal remedies, especially raspberry tea, is widely spread in the eastern counties and north-east London for relieving the many inconveniences and minor troubles of pregnancy.

Ultra-Violet Lighting

MR. R. H. FINCH of the Lighting Section of the British Thomson-Houston Co. Ltd., has written a paper published in the *Electrical Review* for August 25 on the use in generating stations in war-time of ultra-violet lighting. The whole station could be bathed in ultra-violet energy and light produced only where needed, as, for example, on the handles of switches, meter scales, push buttons, telephones, doors, keyholes, tables, stairs, fire-extinguishers, etc., by the application to them of a dab of fluorescent paint or dye. Small press buttons should be surrounded by circles. Fuse positions can be delineated by outlining them, or by spotting the carriers with paint on the floor. In front of every switchboard a line should be painted about 12 inches away. The shape of every obstruction near an open switchboard or in a control room should be delineated by floor lines or patches of paint. Fluorescent chalks are also available for writing emergency warnings. The waves given off by the black lamps used are of a definite wave-length and produce no sun-burning or other dangerous effects. They are used in connexion with invisible fluorescent laundry marking systems and have been in constant operation for several years without a single case of ill effects to operators. Ultra-violet lighting is recommended for the emergency lighting in generating stations and similar premises in the Home Office A.R.P. Department pamphlet entitled 'War Time Lighting Restrictions for Industrial and Commercial Premises'.

African Linguistics

THE International Institute of African Languages and Cultures publishes in the July number of *Africa* a survey of linguistic questions relating to Africa, which includes a number of tasks with which the Institute is concerned. The issue by the Institute of a "Short Guide to the Recording of African Languages" has produced results of no little importance in their bearing on the study and classification of African languages. Prof. D. Westerman has compiled a list of no less than thirty-one previously and little-known languages which have been recorded through its use. This material has been sent to the Institute. Some will be published; the remainder, with such additional linguistic material as may accrue from time to time, will be available at the Institute for consultation by students. A valuable indication of the linguistic work already done, and of the field still to be covered in this department of investigation in Negro Africa, will be afforded by a series of articles which is to appear in *Africa*. The first in the current issue is a survey by Dr. Johannes Lukas of linguistic research between the Nile and Lake Chad. In addition to pointing out the regions to which future research can most usefully be directed, the series will serve as a preliminary classification of African languages. An interesting problem is discussed by Prof. C. M. Doke, who deals with the position and relation of European and Bantu languages in South Africa. While he admits that owing to political and economic factors European languages, and especially English, are ousting Bantu, he maintains that certain of the Bantu languages will persist for their cultural value in literary development and their private, family, and devotional use. Other contributions to this issue of *Africa* deal with indigenous literature, the study of intonation and of phonetics, and the facilities for the study of African languages in Great Britain, on the Continent and in South Africa. Consideration of the relation between language study and anthropology is reserved for future consideration.

Why Smallpox?

IN an editorial so entitled in *Public Health Reports* of June 23, it is stated that the United States leads all the other nations in the world except India in the number of smallpox cases reported in 1937, when there were 11,673 cases in that country. In 1938 the disease was more prevalent than it has been during the past five years, the number of cases being approximately 15,000. In 1936, according to the Health Section of the League of Nations, England and Wales, with a population of 40,839,000, reported only 12 cases. France, with 41,906,000 inhabitants, reported 273 cases, and Germany with a population of 67,346,000 had no cases. Some of the States in the Union have had no smallpox for several years. New Jersey, for example, with a population of about 4,400,000, has not had a case for more than seven years, while the States of North Dakota, South Dakota, Montana, Idaho, Oregon, Wyoming and Utah, with a combined population less than that of New Jersey, reported a total of more than 12,000 cases during the same period. The persistence of smallpox in the United States is simply due to neglect of vaccination, the explanation though not excuse for this being the comparative mildness of the disease in recent years and the reduced incidence compared with fifteen or twenty years ago. The possibility of the malignant type developing from the mild type is a disputed question, but there is always the possibility of the malignant type being introduced from foreign countries, especially in these days of air travel.

Olfactory Electricity

IT is stated in the *Beama Journal* of July that electricity is now being used to measure a smell. Various electrical devices are used in everyday work to make measurements in the domain of sight, touch and hearing and in some cases high accuracy can be obtained. We feel sure that if demand for a practical application of this device is sufficiently great it will develop into new applications just as photometry, telephony and television have developed. The first application is to measure leakage from gas mains. In this case a snout or 'trunk' is constructed of such a shape that it can conveniently be poked into crevices along the gas mains. The operator presses a button and if there is a leak a sample of the gas is inhaled quickly into a test chamber, where it flows over an electrically heated platinum wire and registers on the meter the percentage of gas present. We are told that the electric device can do something which the human nose cannot always do. It can tell infallibly the difference between town's gas and sewer gas.

U.S. Industrial Research Laboratories

A SIXTH edition has recently been issued of the valuable list prepared by the National Research Council of the Industrial Research Laboratories of the United States (Washington, D.C.: National Research Council. Pp. 270. Paper cover, 2.50 dollars; cloth, 3 dollars). It consists of an alphabetical directory of commercial companies in the United States which maintain research laboratories, and is compiled from information obtained in each case from the director of research of the laboratory concerned. In asking for this information, it was pointed out that laboratories concerned merely with routine testing should not be included, but it was left to the director of research to decide whether his laboratory came within this category or whether it could be said to conduct research. The present list comprises no less than 1,769 entries, each of which gives such data as officers-in-charge, address, fields of science or engineering represented, research activities, publications, co-operative research supported and number of personnel. Federal, State and municipal laboratories are not included, except the National Bureau of Standards, while those in educational institutions have been omitted unless they are directly supported by industry. Four indexes are provided: serial publications; geographical distribution; principal personnel; and subjects of research.

Spectrochimica Acta

IN May, Messrs. Springer of Berlin published the first number of *Spectrochimica Acta*, which is to be devoted to research in the domain of chemical spectral analysis (see NATURE, 143, 468; 1939). The first number has 92 pages, 17 cm. × 25·5 cm., 82 of which are devoted to papers on changes of intensities in spectra of aluminium alloys (in German), quantitative analysis of solder, spelter, magnesium and aluminium alloys (in English), quantitative estimation of europium in samarium (in German), a new use of emission spectra in local spectro-analysis (in German), the use of the arc in spectro-analysis (in German). The remaining pages contain abstracts of papers published elsewhere prepared by more than forty specialists. The price of the number is 8.60 gold marks, which at the present rate of exchange is about 15*s*. and seems unduly high.

Land-Speed Record

THE water-speed record set up on August 19 by Sir Malcolm Campbell has quickly been followed by a new record for speed on land. Mr. John Cobb, of London, in his Railton Red Lion motor-car, at Bonneville Salt Flats, Utah, is reported to have reached an average speed of 368·85 m.p.h. over a measured mile. The previous record of 357·70 m.p.h. was set up over the same course last September by Captain G. E. T. Eyston.

Dundee and District

A NOTEWORTHY and welcome feature of the "Scientific Survey of Dundee and District", prepared for the Dundee meeting of the British Association (Dundee: B.A. Reception Room. 2*s*.) is the inclusion of a new and very fine geological map of the country around Dundee. When it is remembered that the last official geological maps of most of this area date from last century (Angus, 1884, and East Fife, 1889) and that the last semi-official map was that prepared for the 1912 meeting of the British Association in Dundee, the value of the new map will be at once realized. The map, although not an official publication, was prepared in the Scottish Office of H.M. Geological Survey, and inevitably shows many changes in mapping when compared with the 1912 edition. These changes are in the main due to the revision work of the Survey officers in the Fife coalfields and to the researches of independent workers, as Allan, Balsillie, Cumming, and Walker. Geologists generally will welcome this new map. It is a pity that it has been bound into the volume instead of inserted in a bound-in envelope. A certain lack of uniformity of treatment is obvious in the natural science sections of the survey. This is due no doubt to lack of space, though it is very unfortunate that no room was found for mention of the geologists from Lyell, Hugh Miller, and Geikie onwards, whose labours have elucidated the geological problems of this very interesting part of Britain.

Announcements

THE second International Congress of Eugenics will be held at Bucharest on September 25–30 under the presidency of Prof. C. I. Parhon.

A LEAFLET of instructions for the correct application of the Schafer method of artificial respiration has been issued by the Royal Life Saving Society, 8 Bayley Street, Bedford Square, W.C.1, where it can be obtained free of charge.

ERRATUM.—In Table 2 of the letter by Dr. L. Hahn and Prof. G. Hevesy entitled "Phosphatide Exchange between Plasma and Organs" published in NATURE of July 29, p. 204, the percentage of organ phosphatide synthesized by the intestinal mucosa and the stomach have been interchanged; they should read: intestinal mucosa, 10·0; stomach, 4·1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 446.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Measurement of Neutron Dose in Biological Experiments

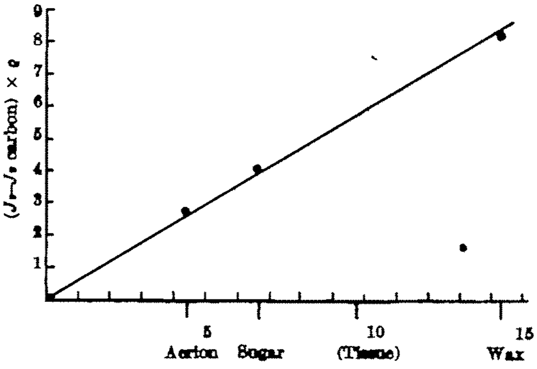
ZIMMER[1] has attempted an exact comparison of the absorbed neutron and gamma-ray energy required to produce an equal increase in the mutation rate in Drosophila sperm. In all other cases[2] neutron intensities have been measured in arbitrary units. In our own case[3] the unit dose was that amount of radiation which produced 1 E.S.U./c.c. of ionization in a graphite chamber having an air volume in the form of a disk 2 cm. diameter and 0·25 cm. deep. Taking as the unit of energy the increment of energy per unit volume of water subjected to 1 roentgen of gamma-radiation, we have now estimated the factor by means of which our arbitrary unit may be converted into energy absorbed per unit mass of tissue in three ways:

(1) The ionization produced by a beam of neutrons in free air has been calculated from the cross-sections for elastic recoil[4] and for nitrogen disintegration[5]. We estimate that 90 per cent of the recoil nuclei ionization and 40 per cent of the nitrogen disintegration ionization per c.c. of free air is measured by our graphite chamber. In addition there is the ionization due to the recoil carbon nuclei from the walls. This has been assessed in terms of the above mentioned data by comparing the ionization when the chamber was filled with pure oxygen with that when filled with air (0·71 : 1·0). A similar calculation gives the energy absorption in tissue ($H_2OC_{0\cdot2}$) and hence the conversion factor, which is found to be 7·3.*

(2) In the second method we avoided the use of collision cross-sections by comparing the ionization in the graphite chamber with that produced in chambers geometrically similar but with walls of 'Aerion'[1] ($C_6H_{4\cdot4}O_{1\cdot1}$), icing sugar ($CH_2O$), and paraffin wax ($CH_2$). Aerion and icing sugar are sufficiently conducting. The wax had a grid of graphite lines on it sufficient to produce a saturation field for gamma-ray ionization. As we were not confident that there would also be saturation for ionization by recoil nuclei the measurements were repeated with the wax covered with thinnest gold foil. The two sets were compatible and convinced us that the wax chamber results were reliable. Unit ionization in the graphite chamber corresponded to 3·35, 4·35, and 6·50 E.S.U./c.c. in the Aerion, sugar, and wax chambers respectively. It can easily be shown[6] that if J_v is the ionization per unit volume, W the average energy expended in the formation of a pair of ions in the gas, N the number of neutrons incident per square cm., n the number of gas atoms per c.c., σ_i the collision cross-section for atoms of type i, f_i the fraction of atoms of type i in the wall, $\overline{E}_i$ the average energy transferred from a neutron to a recoiling nucleus of type i, ρ_i the ratio of the mean atomic stopping power of the wall to that of the gas for recoil nuclei of type i, then:

$$J_v W = Nn\left[\Sigma_i \frac{f_i\ \sigma_i\ \overline{E}_i\ \varphi_i}{\rho_i} + \sigma_g\ \overline{E}_g\ \varphi_g\right],$$

where φ is a fraction, depending on the dimensions of the chamber and the effective range of the recoil nucleus, which approaches unity when the range is great, as is the case with recoil protons which are responsible for the majority of the ionization in chambers of wall material rich in hydrogen. φ may be calculated with sufficient accuracy in other cases. σ_g, $\overline{E}_g$ and φ_g refer to gas atoms.



DEPENDENCE OF NEUTRON IONIZATION ON THE HYDROGEN CONTENT OF THE WALL MATERIAL.

Since the hydrogen recoil term is very much greater than that for carbon recoils, J_v multiplied by the stopping power of the wall material for protons would be expected to increase very nearly linearly with the hydrogen content of the walls and this was in fact observed (see accompanying graph). Applying the above equation to the five sets of data—graphite-air $J_v = 1\cdot0$, graphite-oxygen 0·71, Aerion-air 3·35, sugar-air 4·35 and wax-air 6·50, we estimated the values of $N\sigma_i\overline{E}_i$ for hydrogen, oxygen, and carbon, and hence the energy absorption per c.c. of tissue, which is $N[n_H\sigma_H\overline{E}_H + n_o\sigma_o\overline{E}_o + n_c\sigma_c\overline{E}_c]$. The conversion factor is thus found to be 6·4.

(3) Finally, all calculated constants may be eliminated by filling the chambers with mixtures chosen from hydrogen, carbon monoxide, and acetylene, so as to have the same atomic composition as the walls; since φ and ρ are then exactly unity

---

* Our former estimate of the factor 11·5 ignored the contribution from the disintegration of nitrogen and assumed somewhat different values for interaction cross-sections.

and the equation becomes

$$J_g \overline{W} = N n_g \left[f_H \sigma_H \overline{E}_H + f_o \sigma_o \overline{E}_o + f_c \sigma_c \overline{E}_c \right],$$

where n_g is the number of gas atoms per c.c. $\overline{W}$, the mean value of W for the gas mixture, was determined experimentally, relative to air, by means of gamma-rays. Measurements with Aerion, sugar, and wax would completely determine the three terms $\sigma_H \overline{E}_H$, $\sigma_o \overline{E}_o$ and $\sigma_c \overline{E}_c$. Unfortunately the 'sugar gas' measurements were not satisfactory—possibly on account of chemical action between the carbon monoxide and hydrogen under the influence of ionization—and so collision cross-sections were invoked for the *ratio* of the two small terms $\sigma_o \overline{E}_o$ and $\sigma_c \overline{E}_c$. The factor, determined in this way, was 6·9.

The three methods show satisfactory consistency, and suggest that a neutron beam which produces 1 E.S.U./c.c. of ionization in our graphite chamber will give the same energy absorption per c.c. of tissue as 7 roentgens of gamma-rays (± 20 per cent).

While the procedure which we have outlined is of general applicability, the particular value of the conversion factor is peculiar to a graphite chamber of the given dimensions, and to neutrons of about 3 Mev. energy. Comparison with Zimmer's results is, however, possible, since, through the courtesy of the German Cancer Campaign, the Aerion chambers used here were those used by Zimmer for Li-D neutrons. Dividing our factor of 7 by our observed ratio of neutron ionizations in Aerion and graphite, we obtain 2·1 as the figure by which the ionization in the Aerion chamber must be multiplied to obtain energy absorbed in tissue. Zimmer estimated this factor to be 1·8. The difference may in part be due to experimental error and in part to the different energy of the neutrons. Interaction cross-sections have been reported to show a marked dependence on neutron energy[7,8]. At the present stage of neutron dosimetry, the agreement must be regarded as satisfactory.

We gratefully acknowledge the financial assistance of the British Empire Cancer Campaign.

L. H. GRAY.
J. READ.
The Mount Vernon Hospital
and the Radium Institute,
Northwood, Middlesex.
July 29.

---

[1] Zimmer, *Str. Th.*, 63, 517; 63, 528 (1938).

[2] The conversion of the American neutron results to absolute energy units is at present under investigation by Aebersold.

[3] Spear, Gray and Read, NATURE 142, 1074 (1938).

[4] Kikuchi and Aoki, *Phys. Rev.*, 55, 108 (1939).

[5] Baldinger and Huber, NATURE, 143, 894 (1939).

[6] Gray, *Proc. Roy. Soc.*, A, 156, 578 (1936).

[7] Salant, Roberts and Wang, *Phys. Rev.*, 55, 984 (1939).

[8] Seely, Zinn and Cohen, *Phys. Rev.*, 55, 679 (1939).

Microcalorimetric Measurement of the Mean Energy of Disintegration of Radium E

THE mean energy of the β-rays from radium E can be evaluated either by integration of the continuous spectrum of the electrons emitted by the source or by a calorimetric measurement. The calorimetric method permits the determination of the energy of the electrons independently of the secondary processes which take place while they are going through matter, and furthermore with practically the same precision for both slow and fast particles. It is, on the other hand, necessary to know for a given source the number of atoms which disintegrate per second and also the number of electrons emitted by each disintegrating atom.

Two calorimetric determinations of the energy of disintegration of radium E have been made earlier; one is due to Ellis and Wooster[1], the other to Meitner and Orthmann[2]. Their results are only accurate to within 10 and even 15 per cent.

We decided to repeat these experiments owing to the fact that the Radium Institute in Paris could provide us with strong radium E sources and also because we could measure the absolute value of the polonium content with a very great precision. Furthermore, one of us had perfected considerably the technique of calorimetric measurements in radioactivity[3]. These improvements resulted from the adaptation of Swietosławski's adiabatic microcalorimeter[4]. The principle of this calorimeter is as follows: with the help of a thermocouple, one maintains the same temperature in the calorimeter and in its surrounding water insulation, with a difference never exceeding a few ten-thousandths of a degree; the heat given out during the experiment is measured in such conditions by the increase in temperature of the water tank.

In our experiments the calorimeter was a nickel cylinder weighing about 10 gm., inside which the radioactive sample was placed in such a way as to allow no β-rays to come through before being absorbed by more than 3–4 mm. of nickel. The calorimetric capacity was tested by the measurement of the heat given out by a strong source of polonium (2,000–4,000 E.S.U.) deposited on a nickel foil, as was done with the radium E. This polonium source was measured with a precision of 1 or 2 per cent with the absolute apparatus of Mme. P. Curie[5].

The quantity x of polonium existing in the radium E sources at the beginning of the experiments was measured in the same way after deflecting all the β-rays by a strong magnetic field. This quantity, about 50–300 E.S.U., being at the limit of the sensibility of the apparatus, the precision of measurement is very small. Furthermore, the absorption of the alpha-rays by the radioactive deposit is very often not negligible. An evaluation of this absorption was made at the end of the experiments (when radium E has practically disappeared) by comparing the quantity of polonium determined by the calorimeter with that found electrometrically. Finally, in each set of experiments, x was evaluated within an accuracy of 10 per cent, which does not affect much the precision of the final results owing to the fact that our radium E sources were more than 40 mc. strong. The calorimetric measurement of the polonium at the end of the experiments allows us to evaluate at the same time, within 1 or 2 per cent, the quantity of radium E present at the beginning.

We made two sets of measurements: the first with a source of 80 mc. of radium E electrolytically deposited on a nickel foil ($x = 55$ E.S.U.); the second with 45·5 mc. of radium E deposited by evaporation in argon ($x = 270$ E.S.U.). In the second set, the calorimeter was filled with nitrogen in order to eliminate any possible influence of chemical reactions due to the presence of oxygen.

In each set of experiments the measurements made in the first 36 hours give values which are systematically too high. The measurements made in air (mean value: 323·6 ± 3·5 ekv.) are also slightly higher than those made in nitrogen (mean value: 317·6 ± 2·5 ekv.) and less coherent. The mean energy of disintegration of radium E deduced from our measurement is 320,000 ± 5·000 ev. The most probable value is rather near the inferior limit given by our results.

The detailed description of our experiments will be given elsewhere.

M. LECOIN.

Institut du Radium,

I. ZLOTOWSKI.

Laboratoire de Chimie Nucléaire,
Collège de France,
Paris, 5e.
July 14.

---

[1] Hills, C. D., and Wooster, W. A., *Proc. Roy. Soc.*, A, 117, 109 (1928).

[2] Meitner, L., and Orthmann, W., *Z. Phys.*, 60, 143 (1930).

[3] Zlotowski, I., *J. Phys.* (7), 6, 242 (1935).

[4] Swietoslawski, W., *Ann. Chim.*, 15, 251 (1931).

[5] Curie, Mme. P., *J. chim. Phys.*, 22, 143 (1925).

Thickness of Built-up Films

THE thickness of films built up on solid surfaces has formerly been measured by several methods: optically[1,2,3,4], by X-ray measurements[5,6], by the use of an interferometer[6], and directly with a screw-micrometer[6]. All these, except one modification of the first, required the deposition of some hundreds of layers, and the modification[4] involved a comparison with barium stearate films. During our investigation of protein films on solid surfaces, we have used a method which avoids this comparison and enables thicknesses of as little as 20 A. to be measured rapidly and accurately.

For a thin film on a metal surface the difference of optical path between the ray reflected from the film surface and that from the film metal interface is $d = 2\mu . e \cos \theta$, where μ is the refractive index of the film, e the thickness, and θ the angle of refraction. For minimum intensity of reflection, d must equal an odd number of half wave-lengths, that is, $4\mu . e \cos \theta = (2n+1)\lambda$, where n is any integer. Instead of keeping the wave-length, λ, constant and increasing e until two intensity minima are observed[1,2], we have measured the change in λ necessary to preserve an intensity minimum as the thickness of the film is increased by the addition of further monolayers.

The wave-length of the light which gives an intensity minimum for a given film-thickness was determined by means of a Hilger-Nutting spectrophotometer. This instrument is well suited for such measurements, since the monochromator enables any visible wave-length to be used for the photometric measurement, and the light reflected from the plates is polarized before passing through the spectrophotometer. Measurements must be carried out with the ordinary ray owing to the birefringence of the film. The accuracy of the method was tested with films of barium stearate deposited on stainless steel plates by the method described by Blodgett[1]. Measurements were made on films of ten or twelve monolayers deposited on a base of approximately forty stearate layers. The thick base is essential in order to bring the wave-length for minimum intensity into the visible region. Column *A* below gives the wave-length in angstróms for the intensity minimum of the base, *B* the number of monolayers deposited on the base, and *C* the new wave-length for an intensity minimum. The light was incident at 75°.

A	*B*	*C*	*D*
5550	10	6650	24·2
4990	12	6310	24·2
5060	10	6160	23·8

Column *D* gives the thickness in angströms per layer, t, calculated from the equation, $t = \Delta\lambda/(4\mu \cos \theta . \Delta N)$, where $\Delta\lambda$ is the wave-length increment, μ the refractive index[5], taken as 1·491, θ the angle of refraction, and ΔN the number of additional layers deposited. The validity of the method is established by the agreement of the calculated mean thickness of 24·1 A. for barium stearate with the value 24·2–24·4 A. obtained by other methods.

Further details, with the results obtained for protein films, will be published elsewhere.

G. L. JENKINS.
ALFRED NORRIS.

Dyson Perrins Laboratory,
Oxford. July 27.

---

[1] Blodgett, *J. Amer. Chem. Soc.*, 57, 1007 (1935); *J. Phys. Chem.*, 41, 975 (1937).

[2] Blodgett and Langmuir, *Phys. Rev.*, 51, 964 (1937).

[3] Langmuir, Schaefer and Wrinch, *Science*, 85, 76 (1937).

[4] Langmuir, Schaefer and Sobotka, *J. Amer. Chem. Soc.*, 59, 1751 (1937).

[5] Holly and Bernstein, *Phys. Rev.*, 52, 525 (1937).

[6] Astbury, *et alia*, NATURE, 142, 33 (1938).

Kepler's Law of Refraction

IN his review of the second volume of the new edition of Kepler's works in NATURE of August 19, p. 306, Prof. H. C. Plummer states that Kepler's formula for the law of refraction is

$$\alpha - \beta = k\alpha \sec \beta,$$

where α is the angle of incidence and β the angle of refraction. This reduces to the law

$$\sin \alpha = n \sin \beta$$

for small angles if $(1 - k)^{-1} = n$. Prof. Plummer also states that as the formula is really empirical, being founded on the flimsiest physical argument, it seems strange that a form so inconvenient for the derivation of β from α should have been adopted.

The following table which I published fourteen years ago in the *Notes of the Edinburgh Mathematical Society* may be of interest in this connexion:

α	β Vitellio's observations	Excess of β calculated by Kepler's formula over Vitellio's observations	Excess of β calculated by modern formula over Vitellio's observations
10°	7° 45′	− 11′	− 16′
20°	15° 30′	− 29′	− 39′
30°	22° 30′	− 19′	− 28′
40°	29° 0′	+ 2′	− 10′
50°	35° 10′	+ 14′	+ 4′
60°	40° 30′	+ 22′	+ 1′
70°	45° 30′	+ 19′	− 41′
80°	50° 0′	+ 0′	− 2° 22′

The first two columns give Vitellio's observations on air-water. The third gives the excess of β over Vitellio's observations calculated by Kepler's formula for $n = 1·317$ and the fourth the excess of β over Vitellio's observations calculated by the modern formula for $n = 1·333$. It will be seen that Kepler's formula agrees much better with the observations than the modern one does, owing to the last experimental value being very far out.

The result, of course, bears out the statements made in the previous paragraph of the review, that Kepler was no experimental physicist and that the experimental data at his command were incredibly slight.

R. A. HOUSTOUN.

University,
Glasgow.
August 19.

Mechanism of Nitrogen Excitation in the Night Sky

THE light emitted by the night sky is a remarkable afterglow associated with recombination of atomic oxygen in the upper atmosphere[1]. Two normal atoms of oxygen could not recombine with emission of light; the recombination occurs only in presence of a third body to satisfy the principles of conservation. If that third body is an oxygen atom ^3P, it can attain the level ^1S by the following process:

$$O(^3P) + O(^3P) + O(^3P) \rightarrow O_2(X, v = 5) + O(^1S).$$

The total energy absorbed by the vibrations of the molecule and by the excitation of the atom ($0·93 + 4·18 = 5·11$ volts) agrees closely with the energy supplied by the recombination. Thus can be explained the emission of lines λλ 5577–6300 by the night sky. But if the third body is a nitrogen molecule in the normal state, the available 5·09 volts is insufficient to excite it, and we have to consider the three-body collision:

$$O(^3P) + O(^1D) + N_2(X) \rightarrow O_2(X, v_1) + N_2(A, v_2).$$

In such a collision the energy made available is $D = 7·05$ volts; hence the possibility must be considered of emission of Vegard-Kaplan bands $N_2(A \rightarrow X)$. Only those bands the upper level of which does not exceed 7·05 volts will be emitted, and the corresponding quantum number v_2 is at most equal to 5.

Now the upper energy levels of the most intense Vegard-Kaplan bands are $v_2 = 2$ and $v_2 = 3$. To find the cause of this selection, we must consider the vibration of the oxygen molecule after collision. To bring the O_2 molecule to the v_1 level, E_1 volts are necessary; and we have at our disposal only the difference $D - E_1$ for the N_2 molecule. Consider the necessary energy $A + E_2$ to excite the nitrogen molecule to the A state with the vibration quantum number v_2. We can admit that the excitation does not occur unless the available energy $D - E_1$ and the required energy $A + E_2$ are very close, calling in a resonance effect. The following table gives, on this hypothesis, the probability of emission of the Vegard-Kaplan bands.

	Energy available		Energy required		Difference
I	$v_1 = 0$	$D - E_1 = 7·05$ volts	$v_2 = 5$	$A + E_2 = 6·99$ volts	+0·06
II	1	6·89	4	6·83	+0·06
III	2	6·67	3	6·66	+0·01
IV	3	6·48	2	6·49	−0·01
V	4	6·30	1	6·32	−0·02
VI	5	6·12	0	6·14	−0·02

The transitions III and IV should be the most probable, thus explaining the intensity of the Vegard-Kaplan bands $v_2 = 3$ and $v_2 = 2$ in the spectrum of the night sky.

The probability of a collision of the second kind has been studied for a long while. It is granted that the probability increases as the difference between the exchanged energies decreases. Kaplan[2] quotes, in confirmation of this, the experiments of Bonhoeffer and Mohler on the fluorescence sensitized by atomic hydrogen. Following Kaplan, the formation of a molecule H_2 on vibration level v_1 requires a triple collision with a metallic atom capable of absorbing very exactly the liberated energy $D - E_1$ ($D = 4·34$ volts). Whence the possibility of emission from certain atoms (Na, K, Cd), whilst others (Zn, Mg) do not emit light.

Unfortunately the value of the dissociation potential of hydrogen accepted to-day is no longer 4·34, but 4·46 volts, and the coincidences that Kaplan thought he observed have disappeared. Also Kaplan has not apparently considered the rotation of hydrogen molecules. The total energy absorbed by a molecule is $E = E_v + B_v J(J + 1)$, where J designates the rotation quantum number. It would be sufficient, for the excitation of metallic atom to occur, that the required energy should be very near one of the possible values of $D - E$. But we multiply thus the theoretical possibilities of excitation, and metallic atoms, such as Zn or Mg, which have given nothing in the experiments quoted above, ought to emit the resonance radiation. The resonance potential of Zn is equal to 4·01 volts; that of Mg is 2·70 volts. Now, in the formation of a molecule H_2 ($v = 2$, $J = 7$), the liberated energy is 4·05 volts; it is 2·75 volts in the formation of a molecule H_2 ($v = 3$, $J = 7$). But perhaps the differences $4·05–4·01 = 0·04$ and $2·75–2·70 = 0·05$ volts are already too large to show excitation.

However, we observe also in the night sky spectrum a selection of the bands of the first positive system of nitrogen. The band λλ 6500–6550 emitted in the transition B ($v = 7$) → A ($v = 4$) is much the most intense. Now the excitation of the normal nitrogen molecule on the level B ($v = 7$) requires 8·71 volts, an energy which we do not find in the night sky. We must therefore consider the two consecutive transitions X ($v = 0$) → A ($v = 2$) and A ($v = 2$) → B ($v = 7$). The second absorbs 2·22 volts, which is only a little less than the 2·23 volts supplied by the O (^1S) atom in returning to the ^1D level. We can thus explain the enhancement of the 6500–6550 band in the sky by collision of the nitrogen $A(v = 2)$ molecules and oxygen ^1S atoms. In these collisions, the absorbed energy is equal (at about 0·01 volt) to the available energy.

JEAN CABANNES.
ROSE AYNARD.

Faculté des Sciences,
Université, Paris, 5e.
July 17.

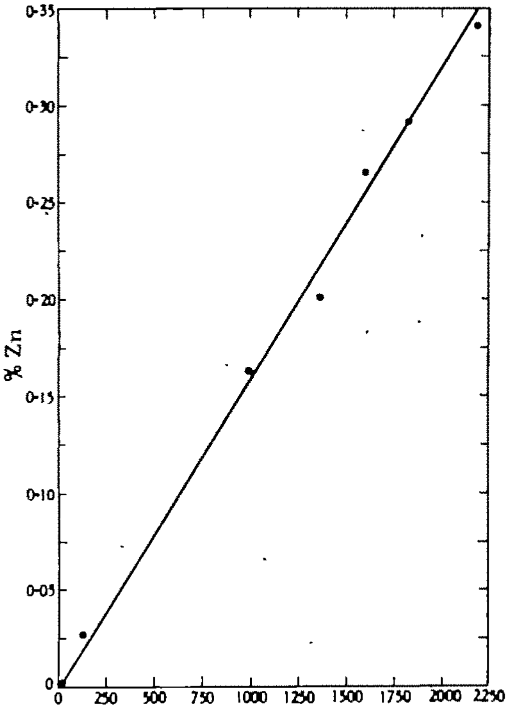
---

[1] Chapman, *Phil. Mag.*, 10, 369 (1930) and 23, 657 (1937).

[2] Kaplan, *Phys. Rev.*, 31, 997 (1928).

Carbonic Anhydrase

IT was shown by Henriques[1] that the rate at which carbon dioxide is evolved in the reaction $H_2CO_3 \rightleftharpoons CO_2 + H_2O$ is greatly accelerated by the presence of laked blood, mere traces of which are sufficient to catalyse this reaction[2]. That this acceleration is not due to hæmoglobin was clearly demonstrated by Meldrum and Roughton[3,4] who have separated from the red blood corpuscles a new enzyme capable of catalysing both phases of the above reaction. They described this enzyme under the name of carbonic anhydrase and gave a detailed account of its properties. Their purified preparation of this enzyme was a colourless substance, very active and sensitive to KCN, H_2S and NaN_3. The amount of this enzyme-preparation was, however, very small and scarcely sufficient even to recognize it with certainty as a protein compound. In the course of our study of metallo-protein compounds[5] present in the red blood corpuscles, we have found that the fractions of our preparations left after the complete removal of hæmocuprein had a very high content of zinc and a high carbonic anhydrase activity. By adapting our methods of purification to preparations on larger scale, such as 10 litres of blood at a time, and taking special care to increase the yield of the zinc fraction, we have obtained a highly active preparation of carbonic anhydrase. The activities of different fractions have been tested both by the manometric 'boat' method[3] and the colorimetric method[4]. The zinc in different fractions was determined by the dithizone and by the iodometric ferricyanide methods and was also isolated as a crystalline zinc quinaldinat salt.



RELATIONSHIP BETWEEN ACTIVITIES (AS DEFINED BY MELDRUM AND ROUGHTON[3]) AND ZINC CONTENTS OF DIFFERENT FRACTIONS OF CARBONIC ANHYDRASE.

From carefully washed corpuscles of 10 litres of ox blood, which give about 17 litres of alcohol chloroform extract, we have obtained about 250 mgm. of colourless protein containing 14·95 per cent nitrogen and 0·31–0·34 per cent zinc and showing a high carbonic anhydrase activity. This preparation tested chemically was found to be almost completely free of other metals known to occur in blood, such as iron, copper, manganese or magnesium. Moreover, the spectrum analysis of such preparations kindly carried out by Prof. H. Dingle confirmed the above results and revealed only traces of other metals. The fact that its zinc content has already reached such a high value shows that this preparation contains probably only one protein compound. The very high carbonic anhydrase activity of this preparation suggests, therefore, that the enzyme is the zinc-protein compound. This is, moreover, supported by three other considerations, namely: (1) the parallelism between the carbonic anhydrase activities and zinc contents in different fractions, at least up to our purest preparation (see accompanying illustration); (2) the perfectly reversible inhibition of the enzyme activity by KCN, H_2S and NaN_3 which are known as specific inhibitors of reactions catalysed by metallic compounds; (3) the absence of other metals in the highly active preparations of carbonic anhydrase.

By comparing the catalytic activity and the zinc content of our purest preparation with those of the laked red blood corpuscles, it appears that the total zinc present in the corpuscles belongs to the zinc-protein compound of carbonic anhydrase.

It may be mentioned finally that zinc belongs to the universally distributed micro-constituents of plants and animals and is therefore much more widely distributed in Nature than carbonic anhydrase. Like iron and copper, zinc forms probably with different proteins several compounds having different properties and functions.

D. KEILIN.
T. MANN.

Molteno Institute,
University, Cambridge.
August 13.

---

[1] Henriques, O., *Biochem. Z.*, 200, 1 (1928).

[2] Brinkman, R., and Margaria, R., *J. Physiol.*, 72, 6P (1931).

[3],[4] Meldrum, N. U., and Roughton, F., *J. Physiol.*, 80, 113 and 143 (1934).

[5] Mann, T., and Keilin, D., *Proc. Roy Soc.*, B, 126, 303 (1938).

[6] Philpot, F., and Philpot, J., *Biochem. J.*, 30, 2191 (1936).

Artificial Hibernation

As I have already shown in preliminary communications[1,2], artificial hibernation is produced in hedgehogs in autumn by giving them injections of magnesium simultaneously with insulin and transferring the animals to an ice-box. Thereby, for example, the heat regulation of the animals was disturbed, and they passed from a warm-blooded state into a cold-blooded one. At the same time, the blood sugar value was decreased to the level of that found in normal hibernation. In the first series of experiments I employed comparatively large amounts of magnesium and insulin. Similar amounts of insulin given without magnesium always caused fatal hypoglycæmia.

This summer I have continued the experiments with more material. The experiments have been carried out with fully awake hedgehogs at the end of June and at the beginning of July. Artificial hibernation was produced in these experiments in midsummer by administering to the hedgehogs subcutaneous injections of magnesium simultaneously with insulin and transferring the animals into an ice-box (at + 2 – 5° C.). The amounts injected were much smaller than those used in autumn (usually 0·5 c.c. 1 mol. magnesium chloride and 4 I.U. insulin per 480–750 gm. body weight). The same amount of magnesium only and cold had no effect on the animals; but on the other hand, the same amount of insulin only and cold caused the hedgehogs to go into artificial hibernation. Laufberger[3], Dworkin and Finney[4], and Dische, Fleischmann and Trevani[5] have also produced artificial hibernation with insulin injections. Especially noteworthy is the considerable increase of serum magnesium in the hibernation brought about by insulin, as in the natural hibernation[6,1].

	Blood sugar (mgm. %)	Serum Mg (mgm. %)	Ca (mgm. %)
Normal hedgehog	109	2·5	11·4
Artificial insulin hibernation	38	4·4	11·0
Natural deep hibernation	49	6·1	10·6

The hedgehogs have remained hitherto in the artificial hibernation continuously for 10 days.

When the animals in which hibernation was induced with both magnesium and insulin or with insulin alone were removed from the ice-box to a warm temperature (21 – 23° C.) they awoke in a natural manner and returned again to the warm-blooded state.

A more detailed account of the investigations will appear in the near future.

PAAVO SUOMALAINEN.

Biochemical Institute,
Helsinki.
July 8.

[1] *Suomen Kemistilehti*, B, 11, 29 (1938).

[2] NATURE, 142, 1157 (1938).

[3] *Z. ges. exper. Med.*, 42, 570 (1924).

[4] *Amer. J. Physiol.*, 80, 75 (1927).

[5] *Pflüg. Arch.*, 227, 235 (1931).

[6] Suomalainen, NATURE, 141, 471 (1938).

Mesomerism and Orientation

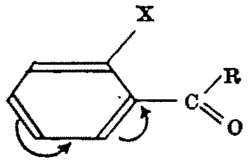
THE brief reference to the apparently anomalous nitration of the acetyl derivative of 2-*m*-xylidine to a 4-nitro derivative and its interpretation in the paper just published by Ingham and Hampson[1] makes it desirable to point out that many of the anomalies associated with ortho-substituents (and usually grouped under the heading of 'ortho effects') find their explanation in the steric hindrance of resonance discussed by Ingham and Hampson. This view had been arrived at independently in connexion with a systematic study of isomerizations produced by aluminium chloride[2]. It is hoped to publish an account of the further development of this work in the near future, but meanwhile the following selected illustrations of the more general application of this view may be cited.

Steric incompatibility between an *o*-methyl or -methoxy group and a dimethylamino group is reflected in an enfeebled mesomeric relationship of the latter group with the nucleus, as exhibited on one hand in a minimized tendency to *p*-substitution, for example, by nitrous acid, benzene diazonium chloride, formaldehyde, or benzaldehyde[3], and on the other, in predominating basicity of the *o*- over its *p*- and *m*-isomerides, which is in striking contrast with the relationships of the toluidines, their monoalkyl derivatives and 1.8 dimethyl 1.2.3.4 tetrahydroquinoline[4]. The abnormally slow alkaline hydrolysis of *o*- relative to *m*- and *p*-acettoluides[5] is similarly explained.

Reduced mesomerism of the carboxyl group is illustrated by enhanced acidity, greater activation energy of acid-catalysed esterification, and reduced activation energy of alkaline ester hydrolysis, in the case of *o*-toluic acid as compared with benzoic acid; *o*-tertiary butyl benzoic acid, again, is even stronger than *o*-toluic acid[6]. However, if a reaction involves orientations which are hindered by an *o*-substituent, this hindrance may partly reveal itself in an elevation of the activation energy representing an 'energy of orientation'. The conversion of 3-nitrophthalic acid into its 1-methyl ester by ordinary esterification, and of the anhydride into the 2-methyl ester by treatment with methyl alcohol[7] are interesting illustrations of the principle just discussed. *O*-tolylphenylchloromethane[8] shows, as expected, a greater 'ortho effect' than does *o*-methylbenzyl chloride[9] in acid hydrolysis. The phenyl boric acids[10] and the phenols[11] show no 'ortho effect' because hindered mesomerism is out of the question in each case owing to absence of mesomerism and steric orientation respectively.

In general, only monoketonic derivatives are produced from benzene and its homologues by the Friedel-Crafts reaction, yet di-*o*-alkyl substituted aryl ketones, and these alone, are amenable to further substitution under these conditions[12]. This is the more striking in view of the fact that mesityl methyl ketone combines exothermally with aluminium chloride; the consequent deactivation is, however, not transmissible to the nucleus owing to the steric conditions. The same factor may well be operative in determining the extraordinarily facile dinitration of mesitylene. Similarly, it must be expected that the *o*-nitrothiophenoxide ion is a more nucleophilic reagent than the *p*-isomeride, while *p*-nitrochlorobenzene is more reactive to such reagents than its *o*-isomeride.

There are numerous examples of carbonyl attached to an aromatic nucleus undergoing hydrolytic fission with acids[13]; almost without exception, an *o*-substituent is a necessary condition. This 'ortho effect' probably has a two-fold origin: (*a*) the previously discussed steric hindrance of mesomerism ($-T$) of the carbonyl group; and (*b*) steric promotion of the polarization in the nucleus which allows a displacement of a nuclear attached atom out of the plane of the nucleus to relieve the crowded orientation. Both these steric effects facilitate electrophilic attack.



In α-tetralone, on the other hand, the atoms in question are coplanar with the nucleus, and in consequence hydrolytic fission and inter- and intramolecular rearrangements with aluminium chloride are not observed.

Sterically enhanced nuclear polarizations no doubt facilitate such observed conversions as *iso*-durene and hexamethylbenzene into mesitylene with hydriodic acid[14]. The inter- and intra-molecular rearrangements brought about by aluminium chloride frequently find their origin in this twofold steric effect of *o*-substituents on mesomeric and electromeric effects.

G. BADDELEY.

College of Technology,
Manchester.
July 7.

[1] Ingham and Hampson, *J. Chem. Soc.*, 981 (1939).

[2] Compare Kenner and Baddeley, *J. Chem Soc.*, 303 (1935).

[3] v. Braun, *Ber.*, 49, 1101; 51, 252.

[4] Davies and Addis, *J. Chem. Soc.*, 1622 (1937).

[5] Davis, *J. Chem. Soc.*, 1397 (1909); *Z phys. Chem.*, 353, 369 (1912).

[6] Dippy, Evans, Gordon, Lewis and Watson, *J. Chem. Soc.*, 1421 (1937).

[7] McKenzie, *J. Chem. Soc.*, 1135 (1901).

[8] Norris, *Z. phys Chem.*, 101, 233 (1921).

[9] Olivier *et al.*, *Rec. trav. chim.*, 1922–1926.

[10] Branch, Yabroff and Bettmann, *J. Amer. Chem. Soc.*, 56, 937, 1865 (1934).

[11] Boyd *et al.*, *J. Chem. Soc.*, 105, 2117 (1914); 115, 1239 (1919). Burkhardt *et al.*, *J. Chem. Soc.*, 17 (1936).

[12] Meyer, V., *Ber.*, 28, 3213; 29, 848, 2564.

[13] Short and Hill, *J. Chem. Soc.*, 1123 (1935).

[14] Klages, *Ber.*, 37, 1715.

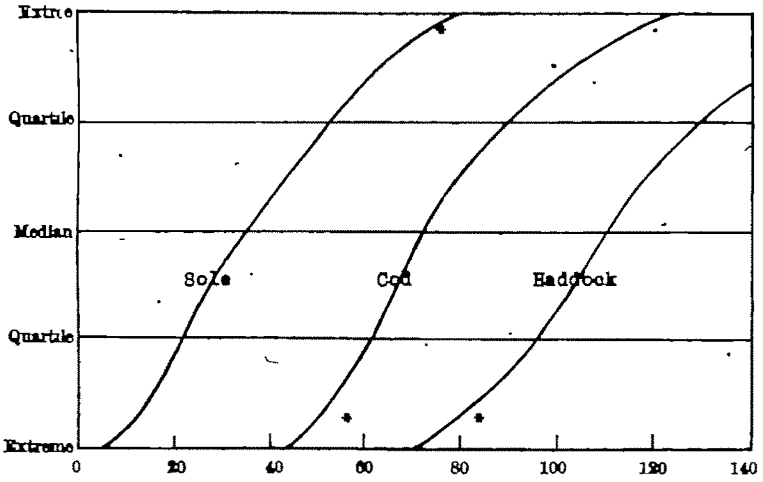
Fishery Statistics

When we compare the catch of fish of one year with that of another, we find one greater or less than the other, and that seems at first sight the end of the matter. But if we analyse each year's total into its monthly parts we see in every case a certain seasonal periodicity; and it follows that we may expect to find not only differences of total quantity, but also of phase and amplitude, the two ways in which one periodic function differs from another. Let us reduce the monthly quantities to percentages of their annual totals, and then compare the periodicity of one year with another or with a mean. To show, briefly, how orderly and how instructive the rough market statistics are, let us merely compare one year's monthly data with another's:

Aberdeen Landings of North Sea Plaice; monthly percentages of annual catch

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1932 ..	7·7	9·5	8·4	9·9	7·9	8·7	7·4	9·4	9·7	9·3	7·2	4·9
1937 ..	3·3	3·6	3·9	6·2	6·8	7·7	9·2	14·5	17·5	11·4	8·8	7·1
Difference	4·4	5·9	4·5	3·7	1·1	1·0	−1·8	−5·1	−7·8	−2·1	−1·6	−2·2

The monthly discrepancies yield a nearly regular fluctuation, and show at a glance how the phase of the periodic function was accelerated in one year and retarded in the other.



North Sea Landings (Aberdeen): 1912–37
*** Catches of 1937.

While writing on this point let me mention another, though it is no more than a statistical gadget; I think it is new, and Mr. Udny Yule says it is new to him. We want to compare, say, last year's catch with twenty previous years, and not in order of time but of mere quantity. We take, as usual, the extremes, quartiles and median of the series; we shall find these five points enough to draw, approximately, a curve of distribution of the whole. It will obviously be an S-shaped curve; and we may mark it with an asterisk to direct attention to a particular year. The annexed chart thus shows at a glance how 1937 was all but the worst year for cod and haddock, and all but the best year for soles, in six-and-twenty years.

D'Arcy W. Thompson.

University,
St. Andrews.
July 30.

Symphyogenetic Development

There has existed a need for a term to express the idea of the interaction of hereditary and environmental factors in producing the development of an organism. It must be a term to signify that the organism is the resultant of the integration of the two sets of factors. It must convey the idea that has been almost universally accepted by writers in the field of development that the organism is always 'becoming something' and 'tending somewhither', because it is a result of an interrelation between an environmental milieu and hereditary potentialities which together constitute the necessary materials and conditions to produce a living thing through their interaction. The term *symphyogenetic development* seems to be suitable for expressing this idea.

Symphyogenetic is derived from the three Greek stems, σύν, meaning *with*, φύειν, meaning *to grow*, and γίγνεσθαι, meaning *to come into being* or *to be*. Literally, it conveys the idea of something coming into being and growing as a resultant of the interaction of two or more factors, and thereby undergoing development. The word symphyogenesis has had a previous usage. The "Century Dictionary and Cyclopedia" gives its meaning as follows, "In *bot.* the forming by union of previously separate elements". The "Webster's New International Dictionary" defines it thus, "*Bot.* Development of an organ by the union of previously distinct organs". The present proposed usage of symphyogenetic does not violate either of these definitions of symphyogenesis.

To define symphyogenetic in terms of its proposed use, where it is to be employed as a modifier of development, it would mean, *the combining of hereditary determiners and environmental factors to produce the characteristics manifested in an organism's structure and behaviour.* Symphyogenetic development would be used in contrast to maturational development, which emphasizes the ordering of the hereditary determiners for producing the sequential regularity of development, other things being equal. Its usage would be in contrast to epigenetic development, which emphasizes the production of differentiations in development as a result of the influence of environmental factors acting upon a relatively simple structure in the beginning. Obviously it is in contrast with the ancient idea of preformism.

Wilton P. Chase.

Women's College,
University of North Carolina,
Greensboro:
July 17.

Skin Cancer due to Handling Coal Tars Used for Preservation of Fishing Nets

COMPLAINTS that several fishermen had contracted cancer of the skin after handling tar used for the preservation of nets resulted in an interested firm submitting a sample of their tar to this department to investigate its carcinogenic effect on mice. This particular tar (our No. 7) was said to have been manufactured in a horizontal retort at a temperature of 1100° C. It was found to be highly carcinogenic for the skin of mice, 75 out of 100 bearing malignant tumours after bi-weekly applications of the tar for forty weeks. This result compared very unfavourably with a number of tars, used for various purposes, previously tested by us.

Later, three further tars from the same firm were submitted to us for test: (1) our No. 14, made in a vertical retort at 1390° C.; (2) our No. 16, as before but said to be cut back with light tar oils; (3) our No. 15, said to have been made from oil pitch and light tar oils.

Results of animal experiments showed that Nos. 14 and 16 were almost as carcinogenic for mice as No. 7. but that No. 15 was considerably less carcinogenic, only 17 mice out of 100 contracting skin cancer after forty weeks, although twenty of the mice survived for this period.

Preliminary tests with samples of creosote oil and anthracene oil revealed that both are carcinogenic for the skin of mice.

In our opinion, if gas tar as such is used for preservation of fishing nets, only that made in vertical retorts using a temperature as low as practicable should be used.

J. M. TWORT.
R. LYTH.

Department of Cancer Research,
University, Manchester.
July 26.

The Garner Principle of Co-operative Activation

IN a letter in NATURE of August 12, p. 287, Prof. W. E. Garner has made, in my opinion, a most important contribution to the advancement of physico-chemical science. It seems probable that the Garner principle will be of great value in the understanding and formulation of many catalytic phenomena, including the interlinked sets of reactions which are now known to occur in the operation of many enzymes and co-enzymes.

F. G. DONNAN.

23 Woburn Square,
London, W.C.1.

Points from Foregoing Letters

L. H. Gray and J. Read, working on the biological effects of neutrons, have used the ionization produced in air in small graphite ionization chambers as a measure of neutron dose. Experiments have now been made which make it possible to correlate the ionization with the actual increment of energy per unit volume of tissue due to the recoil atoms generated by the neutrons. Calculations based on interaction cross-sections agree with two different lines of experimental investigation in showing that a neutron beam which produces 1 E.S.U./c.c. of ionization in a graphite chamber will give the same energy absorption per unit volume of tissue as 7 roentgens of γ-rays (20 per cent).

M. Lecoin and I. Zlotowski have measured very carefully with an adiabatic microcalorimeter the mean energy of disintegration of radium E. They obtain the value 320,000 ± 5·000 ev., and the lower limit is regarded as very near the most probable value.

G. I. Jenkins and A. Norris describe a new method of measuring the thickness of built-up films on metal by finding the wave-length at which minimum intensity of reflected light occurs at constant angle of incidence. The method makes possible a measurement of the thickness of very small numbers of layers and seems especially promising in the field of protein investigation for which it was devised.

Surprise has often been expressed that Kepler failed to find the true law of refraction. R. A. Houstoun shows that Kepler's formula satisfies the observations that were available to him better than the modern formula does.

The spectrum of the N_2 molecule in the light of the night sky is well known to-day. The upper energy level of the most intense Vegard-Kaplan bands are $v = 2$ or 3; among the red bands of the first positive system, the band $B(v = 7) \rightarrow A(v = 4)$ is much the most intense. J. Cabannes and Rose Aynard try to explain that selection by resonance phenomena.

Evidence is brought forward by D. Keilin and T. Mann that carbonic anhydrase isolated from the red corpuscles of ox blood in a pure state is a zinc-protein compound.

P. Suomalainen has previously produced artificial hibernation by injecting magnesium and insulin into hedgehogs and transferring them into cold conditions. The quantities used, however, were so large that an equal amount of insulin alone killed the animals. The author has now decreased the amounts of injections, and artificial hibernation is brought about with insulin only and cold. Serum magnesium is considerably increased in the insulin hibernation, as in the natural hibernation.

G. Baddeley shows that the more general application of sterically hindered mesomerism is illustrated by strengths of acids and bases, velocities of side-chain reactions and nuclear substitutions, and by the hydrolytic fission of carbonyl attached to an aromatic nucleus. Steric promotion of nuclear polarizations is also considered a factor contributing to the 'ortho effect'.

Sir D'Arcy W. Thompson suggests that, as the catch of fish is a periodic phenomenon, it should be both useful and easy to take note of differences between one year and another in phase and amplitude as well as in the annual total. A new form of statistical chart is also suggested.

RESEARCH ITEMS

Cranial Deformation among the Ancient Maya

Two cases of artificial deformation of a remarkable and unusual character have been described by A. J. E. Cave (Smithsonian Institution, *Anthropological Papers, Bull.* 123; 1939). They were derived from Maya mounds in the Corozal District of British Honduras excavated by the late T. W. Gann. The first specimen is the mutilated brachycephalic cranium of an elderly subject, probably female, which lacks almost the entire facial skeleton. It has an auricular height of 111 mm., a maximum length (glabella-inion) of 150 mm., a maximum (biparietal) breadth of 165 mm., a minimum frontal breadth of 92 mm., and a cephalic index of 110. The whole calvaria is fairly symmetrical; but it is curiously and quite artificially deformed. Mechanical flattening of the supra-inial occiput has produced an enormous lateral out-thrust of the cranium in the mid-parietal transverse axis. The frontal region has not been directly compressed and merely shares in the general lateral bulging of the whole skull. In each temporal fossa there is an obvious and artificial groove ascending over the alisphenoid and anterior portion of the parietal to be lost above the superior temporal crest. These grooves must be the product of tightly applied bandages. In norma verticalis the cranium suggests an abortive 'bilobed' appearance. The cranium is actually of greater breadth than length. The same condition appears in the second specimen—the calvaria of an adult, middle-aged subject, presumably male. It is imperfect, and also partially a restoration, but enough remains to show that despite deformation it was brachycephalic and of corresponding type to Specimen I. Its measurements are auricular height, 100 mm.; length, 154 mm.; breadth, 171 mm., min. frontal breadth, 101 mm., cephalic index, 111. Artificial deformity has been produced by pressure applied to the supra-inial portion of the occipital, and the hinder portion of both parietals, resulting in a squashing forward of the vault and an enormous exaggeration of the biparietal diameter, which exceeds the maximum length of the skull. Two artificial grooves indicate the application of bandages. Like Specimen I, this skull also shows a tendency to the bilobed condition.

Tuberculosis among Young Adults in England

While the general death-rate from tuberculosis of the lungs has been steadily declining during the last 60–70 years, that for young men and women, aged 15–24 years, which followed the general trend during last century, has been almost stationary during this century. This set-back is particularly evident among young women, whose pulmonary tuberculosis death-rate per 100,000 fell from 276 to 112 in the thirty years between 1871–80 and 1901–03; but remained almost stationary in the next thirty years, being 107 in 1911–13 and again in 1931–33. This problem has been examined, so far as England is concerned, by P. D'Arcy Hart and G. Payling Wright, whose findings are set out in a recently issued report ("Tuberculosis and Social Conditions in England". National Association for the Prevention of Tuberculosis, London. Price 3*s*.) The phenomenon has been examined mainly in relation to social conditions, including general standard of living, housing, internal migration and volume of occupation. The retardation in decline of phthisis mortality has affected young women more severely than young men, and at present nearly half the deaths from all diseases among young women are due to phthisis. On the whole, urban areas are more seriously affected than rural districts. The unsatisfactory course of pulmonary tuberculosis among young adults seems to be due to a complex of factors. Unsatisfactory trends in the national standard of living, and the rapid industrialization of young women, appear to have played important parts, while bad local social conditions, in particular bad housing, have increased the effect in certain localities.

Anatomy of Apple Roots

The possibility of predicting the performance of apple varieties on different rootstocks is brought nearer by the observation that vigour is correlated with certain anatomical features of the stock roots. A. B. Beakbane and E. C. Thompson (*J. Pom.*, 17, 141; 1939) have examined sections of the roots of eighty-six four-year-old apple trees on Malling stocks VII and IX and on eight new clonal stocks worked with Lane's Prince Albert. A striking negative correlation was found between the relative area of bark to wood, as seen in transverse section, and the vigour of the scion. The percentage areas of fibres, vessels, rays and to a less extent, of parenchyma, estimated from photographic prints of sections, were found to be related to scion vigour. Vigorous rootstocks were found to have an almost equal amount of living and dead tissue, whereas the dwarfing stocks had twice to three times as much living as dead tissue, that is, more parenchyma and ray cells. The vigorous stocks had a larger number of vessels and nearly twice as many xylem fibres as the dwarfing stocks and there was a tendency for the vessels to be larger in the vigorous stocks. If the tendency thus observed persists in older trees, examination of internal structure may enable breeders to classify new rootstocks according to vigour without the lengthy field trials now necessary.

Spraying and Photosynthesis

The application of a spray fluid for the control of insects or fungi has usually been regarded solely from the pathological point of view. R. A. Hyre has shown, however (Cornell Univ. Agr. Exp. Sta. Memoir 222, Ithaca, N.Y., April 1939), that certain sprays lower the photosynthesis of the plant to which they are applied. Lime-sulphur may even reduce it by as much as 28 per cent at ordinary summer temperatures, but Bordeaux mixture, on the other hand, has little effect. Emulsified sulphur pastes were found to be intermediate in their effect upon photosynthesis. Respiration was not markedly affected by spray fluids. Studies upon such factors as the biennial bearing of tree fruits show that these plants cannot sustain any considerable loss of photosynthesis with impunity. The loss in anabolism through spray applications is not of many days' duration but it is likely to occur at the critical time of flower bud formation, when the extent of the subsequent year's crop is being determined. The use of Bordeaux mixture instead of lime-sulphur in the summer spray programme would provide a practical means for the achievement of pathological control without physiological disturbance.

Narcissus Mosaic

A LEAF-MOTTLING virus disease of narcissi has been known for some considerable time, but details of its etiology and physical properties have only recently appeared ("Studies on Narcissus Mosaic" by Frank A. Haasis, Cornell Univ. Agr. Exp. Sta. Memoir 224, Ithaca, N.Y., U.S.A., April 1939). Affected plants are stunted, they bear inferior bloom and produce poor bulbs. Their foliage and flower stems are mottled by yellow stripes, whilst the flowers are occasionally distorted and streaked with white, though symptoms vary with the variety. Transmission to a healthy plant can be effected by grafting a portion of a diseased bulb, by the normal vegetative propagation, and by various mechanical means, but neither by root contact nor through soil contamination. The virus appears to be of moderate virulence, its resistance to ageing *in vitro* is slight, it can withstand but little dilution and it is inactivated by a temperature between 70° and 75° C. Control presents the difficulties usually associated with virus diseases, and little can be done beyond the removal of infected plants, and the growth of selected stock within insect-free cages.

'Packet Velocity' of Dispersive Elastic Waves

K. Sezawa and K. Kanai have recently discussed this problem (*Bull. Earthq. Res. Inst., Tokyo*, 17, Pt. 2, 208–232; 1939). The basis of the discussion was a wide range in wave-length of Rayleigh and Love waves which could be adapted to an extensive range of dispersion conditions of waves of irregular form. From a mathematical investigation of the chosen examples it was ascertained that even should the wave form be irregular, the energy of the waves was transmitted with a special group velocity. If the sinusoidal components composing the irregular waves had different group velocities, it appeared likely that the centroid of the wave energy, that is, the centroid of the energy of the wave packet, would be transmitted with the group velocity that corresponded to the waves of infinite length involved in the irregular waves. If the group velocity differed with difference in length of the sinusoidal waves, even should the disturbance be of sine form of finite extent, the centroid of the same disturbance was still transmitted with the group velocity of sinusoidal waves of infinite length. If the dispersion formula was of the form $c = A \pm Bf^n$, the centroid of a packet of irregular waves was transmitted with velocity A, that is, the group velocity of the longest possible waves composing the wave packet.

Fluidity and Temperature

A SIMPLE relation between fluidity (θ) and absolute temperature (T), namely, $\theta/T = a + bT + \ldots$, has been established by E. C. Bingham and S. D. Stookey (*J. Amer. Chem. Soc.*, 61, 1625; 1939) for a large number of liquids, apparently failing only for alcohols. It has also been shown to apply to some types of solutions. It is found that the constant a is a function of the homologous series to which the compound belongs, and the constant b a function of the molecular weights of the members of the series, so that an equation may be obtained containing constants which are functions only of the series concerned, and not of individual members of the series, namely, $\theta/T = A_s + \alpha T 10^{(\beta/M - \gamma/M^2)}$, where M is the molecular weight and α, β and γ are constants. It is thus possible to calculate the viscosity of any member of a non-associated series up to ten carbon atoms at any temperature by means of only four constants.

Structure of Cyclo-Octatetrene

The evidence for the structure of 1,3,5,7-cyclo-octatetrene, discovered by Willstätter and Waser in 1911 and widely used in discussions concerning the structure of the aromatic nucleus, rests chiefly on its mode of synthesis from pseudo-pelletierine and on its hydrogenation to cyclo-octane. C. D. Hurd and L. R. Drake (*J. Amer. Chem. Soc.*, 61, 1943; 1939) have now prepared both 1,2- and 2,3-butane-*bis*-(trimethylammonium) bromides from pure specimens of 1,2-dibromobutane and 2,3-dibromobutane. Pyrolysis of the *bis*-quaternary hydroxide from the 1,2-salt gave rise to ethylacetylene and methylallene, but no 1,3-butadiene. Pyrolysis of the *bis*-quaternary hydroxide from the 2,3-salt yielded 1,3-butadiene and methylallene (or methylallene and dimethylacetylene), the latter being slightly in excess of the 1,3-butadiene. The assumption of the former authors that conjugated unsaturation results exclusively during pyrolysis of a functional group in the quaternary hydroxide molecule is unjustified and the fact that 1,3-butadiene was not the exclusive product from 2,3-butane-*bis*-(trimethylammonium) hydroxide is regarded as casting serious doubt on the structure of Willstätter's cyclo-octatetrene and on the conclusions drawn from it.

A Possible Explanation of Very Slow Adsorption

IN a series of papers published during the last four years (*Curr. Sci.*, 4, 405; 5, 645; 6, 446; 7, 182; *Proc. Ind. Acad. Sci.*, 4, 97; 1936: *Kolloid-Z.*, 84, 138; 1938: 86, 205; 87, 272; 1939), K. S. Gururaja Doss describes further experiments showing that the rate of adsorption and lowering of surface tension, in aqueous solutions of various colloidal electrolytes, is frequently very slow. This slow accumulation at the surface, which had been previously observed with paraffin chain salts in dilute solution, is now explained as due to the existence of a potential energy barrier at the surface, caused by the electrostatic repulsion exerted by the electrolytically dissociated end groups of those molecules which first arrive at the surface, on the similarly charged end groups of other molecules attempting to diffuse to the surface. Only those molecules, therefore, which possess unusually large kinetic energy can pass this barrier; but once arrived at the surface, their hydrophobic portions retain them at the surface. To such molecules travelling towards the surface, an energy 'hump' must be surmounted, in order that the charged end group may pass through the diffuse double layer set up by the molecules first adsorbed; once this is passed, the molecules find an energy 'trough' at the surface, caused by the natural tendency of the hydrocarbon portions of molecules to cover the surface of water. Consequently a considerable energy of activation is likely to be required for the adsorption of molecules containing electrolytically dissociated end groups, and some hydrocarbon, in their constitution, and this may account for the slow adsorption.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

LIÈGE MEETING

IN response to the kind invitation of the University of Liège, the French Association for the Advancement of Science met during July 17–22 for the third time in Belgium; the previous meetings were at Liège in 1924 and at Brussels in 1932.

The International Water Exhibition at Liège which marked the inauguration of the Albert Canal gave the meeting a special interest. Prof. C. Fabry, president of the French Association, presided over the meeting, and Prof. Dehalu, *administrateur-inspecteur* of the University of Liège, was president of the local committee.

The opening ceremony took place on July 17 in the hall of the University. Prof. Dehalu expressed his pleasure at receiving the Association at Liège for the second time, and Senator Buisseret, speaking on behalf of the burgomaster, welcomed the members of the congress. Prof. C. D. Ellis, Wheatstone professor of physics at King's College, London, representing the British Association, and Dr. C. Romaña, representing the Argentine Association for the Advancement of Science, brought messages of good will for the success of the meeting. Prof. Fabry, after having expressed the thanks of the Association to the local committee at Liège, delivered his presidential address, on interstellar space.

Prof. Fabry showed how a profound study of the light of the stars has enabled us to detect, in interstellar space, matter in a state of extreme rarefaction (1 kgm. nearly in a volume equal to that of the earth). In addition to matter, there exists also in interstellar space energy in the form of radiation emitted by the stars. These results have demonstrated the fruitfulness of collaboration of diverse scientific disciplines and of pure and applied science. Such collaboration is also the object of the French Association and of similar bodies.

The scientific meetings were held in the magnificent Institutes of Civil Engineering and Chemistry of the University of Liège at Val Benoît on July 17 and the following days. July 19 was devoted to an excursion on the Albert Canal and to a visit to a colliery at Beeringen. July 21, the day of the national fête of Belgium, was taken up with a visit to the Water Exhibition.

The several sections of the Association showed great activity. The question of water occupied a prominent place in the programme, and was the subject of the following papers: M. Wyart, the states of solid and liquid water studied by X-rays; M. Cabannes, the Raman spectrum of liquid water; M. Kraft de la Saulx, history of the construction of hydraulic machines; M. Tongas, thermodynamic properties of steam; M. Trochon, microphysics of mists considered as aerosols; M. Roulleau, hygrometry; M. Rocard, kinetic theory of liquids; M. Hubault, pollution of waters, their industrial utilization and modifications of their fauna.

The Section of Civil and Military Engineering, under the presidency of M. Campus, was divided into three subsections: theoretical and applied hydraulics; navigable channels and ports; hydraulic works. One session was devoted to colonial hydrography.

The Section of Physics heard communications, among others, from Profs. F. Joliot and F. Perrin. The work of the Section of Geology was completed by field excursions; the Section of Botany also had excursions in which the Royal Society of Botany of Belgium and the Liège Botanical Circle joined.

The Sections of Biogeography and of Zoology held several joint sessions, with papers on the biology of equatorial lakes (M. Damas), the relations between the internal and external media in aquatic animals (M. Florkin), and the phreatic fauna (M. R. Leruth).

Mention should also be made of the communications presented to the Section of Geography (streams, their utilization and management, demographic and social aspects of water); and to the Sections of Medical Sciences (metabolism of water), of Psychology and Pedagogy, of Radiology and of Odontology.

Special subsections considered technical applications of water, applications of electricity, archæology and folklore.

The communications presented at the meeting will form a special volume published in connexion with the Liège meeting.

The French Association will meet in 1940 at Nice, some time in July, under the presidency of Prof. Pieron, professor at the Collège de France, and director of the Institute of Psychology of the University of Paris.

SOCIAL AND INTERNATIONAL RELATIONS OF SCIENCE

THE first annual report of the Division for the Social and International Relations of Science of the British Association, founded by resolution of the General Committee of the Association in August 1938, was presented at Dundee and is printed with the Report of Council of the Association.

A statement of the aims and objects of the Division, together with a request for information on any work in the field of social relations of science, was circulated to some three hundred and fifty associations, institutions and learned societies in the British Isles and abroad. The replies received indicated that much work of this nature has been done, or is in progress, and in certain instances opportunity has already been found for the Division to exercise its function of co-ordination. Many offers of co-operation were received from bodies particularly interested in the social impacts of science, and several valuable contacts have been made. Notably, the Division learned that P E P (Political and Economic Planning) proposed to prepare a report on the organization of research in Great Britain, but was hampered by lack of funds to start the work. The Council of the Association, at the instance of the Divisional Committee, voted £100 as salary for the research worker appointed by P E P to collect the factual material. This enabled the work to proceed immediately, pending the acquisition of funds to maintain the inquiry from other sources. The necessary support has since been obtained from the Leverhulme Trustees, who have made available sufficient funds to carry on the inquiry until the autumn of 1940. The Division is represented on the committee supervising the work and will be associated with the report to be published in due course.

Some of the topics submitted to the Division for attention were referred to sections of the Association, and as a result several discussions and papers were arranged for the Dundee meeting.

A number of sub-committees have been appointed to deal with specific aspects of the Division's activities. One of these is considering the desirability of supplementing existing national research organizations whether in normal circumstances or in times of emergency. With the view of ascertaining details concerning systems of controlling and distributing grants in aid of research in other countries, an inquiry was directed to correspondents in the United States, France, Belgium, Holland, Denmark and the Dominions. Memoranda have been prepared by Prof. A. C. G. Egerton, and by Prof. J. D. Bernal and Dr. Julian Huxley, respectively, dealing with expenditure of public funds on research and discussing the question of a Research Co-ordination Council.

The sub-committee on nutrition and agriculture was responsible for a meeting at Reading to discuss milk in its nutritional and allied aspects. A resolution put forward from this meeting to the Council of the Association runs as follows:

"In view of the proved danger of the spread of epidemic and other diseases by the consumption of raw milk, of the efficiency of controlled pasteurisation in abolishing this danger and of the slight damage to the nutritive and other properties of milk caused by effective pasteurisation, it is essential for the national health that it be made compulsory in all urban areas with a population of 20,000 or more to pasteurise effectively all milk before sale to consumers to ensure its safety and to assist in securing that increase in the *per capita* consumption of liquid milk which is essential for improvement in the national level of nutrition." The Council, after consideration and consultation with the Nutrition Sub-Committee, considered it desirable that before taking any action on this resolution, a factual report on the whole question of the pasteurisation and sterilization of milk should be procured, and steps are being taken to do this.

Other sub-committees have been appointed to consider the economic requirements of nations, the influence of scientific and technical developments on industry, and on social psychology.

A Finance Sub-Committee made a recommendation to the Council of the Association that consideration should be given to the desirability of an appeal for funds to (*a*) private individuals and firms, (*b*) trusts at home, (*c*) trusts abroad, (*d*) H.M. Government. The Council adopted this recommendation, with the provision that of these possible sources, the first-named should be first explored.

Meetings arranged by the Division were held during the past year at the University of Reading, in London at the Royal Institution, and at the University of Manchester.

RADIO EXHIBITION, OLYMPIA

THE exhibition of radio apparatus organized annually by the Radio Manufacturers' Association was opened at Olympia on August 23 and is remaining open each weekday until September 2. This year's exhibition was conspicuous for the greatly increased attention and interest devoted to television receivers and also to several somewhat novel features which had a strong appeal to the more technically minded members of the public.

As regards the general display of sound broadcasting receivers, no fresh and outstanding change in technical design was in evidence this year. The large variety of models shown indicated that manufacturers have devoted attention for once to a steady improvement in efficiency and reliability, and the listener who is more concerned with service than with novelty may be assured that he can buy a new set with complete confidence. Most manufacturers now supply some form of 'push-button' tuning selection as part of one of their standard designs. A notable increase in the number and variety of portable receivers shows that there is a maintained demand for this type, and an innovation this year is the portable receiver operated entirely from dry batteries. This is the result of the introduction during the past year of new types of valves with a very low filament current consumption, so that a complete receiver may be operated under normal average conditions for several months, without changing or re-charging batteries.

It was in the field of television that the most marked change was evident in this year's exhibition of receivers. Most manufacturers' are now in a position to supply several types of television receivers, and these range from the table model with a small although very clear picture, up to an imposing cabinet model with a picture size about 24 in. × 18 in. In all cases frequent daily demonstrations were given on the manufacturers' stands, while, in addition, a specially arranged 'television avenue' enabled the visitor to inspect some fifty different models in operation on the same programme and so judge their relative merits. Considering that, so far, television reception is limited in Great Britain to the programmes radiated from the one station at Alexandra Palace, the prospective purchaser of a receiver was very well catered for at the exhibition.

Among the conspicuous features of the layout of this year's show were the uniform flat-roofed stands, and also the models of Broadcasting House and the

Alexandra Palace tower at opposite ends of the main hall. The B.B.C. provided several technical exhibits, including a television studio and control room in operation. A sound-recording van, complete with studio and associated apparatus, a motor-car fitted up for film recording purposes, and the 80-ft. telescopic aerial of the mobile television unit were also part of the display provided by the B.B.C. The Post Office demonstrated apparatus used for short-wave radio telegraph and telephone purposes, and illustrated the various stages in the dispatch and receipt of telegrams. Other novel features included technical exhibits by the radio departments of the services, such as field equipment as used by the Royal Corps of Signals, a replica of the wireless office of a destroyer by the Royal Navy, and a layout of the various electrical and radio equipment of aircraft by the Royal Air Force. An interesting and popular feature on the stand of the latter service was a 'link trainer', designed to represent the cockpit of a modern aircraft. It contains all the controls and equipment of a real cockpit, and with it all conditions of flying can be simulated on the ground. The exhibit was used to demonstrate the manner in which a pilot may fly in fog or at night, navigating entirely with the aid of wireless instruments receiving signals from beacons on the ground.

Reverting to the manufacture and production of ordinary broadcasting receivers, a number of firms had contributed to the model factory which was set up in the exhibition. Various stages in the assembly and production of receivers or their components were shown in full operation under normal factory conditions. In addition, the various stages in the assembly of several manufacturers' standard receivers were shown on a rotating drum model in continuous operation. This section of the exhibition was designed not only to interest the technical enthusiast but also as an attempt to induce the ordinary listener to learn something of the internal construction and mode of operation of his receiving set.

Altogether, the exhibition demonstrated a successful attempt on the part of the organizers to make a wider appeal to the broadcast listening public, and it was extremely unfortunate that it was held during a period of such acute international tension.

R. L. S.-R.

DENTITION OF AUSTRALOPITHECUS (PLESIANTHROPUS)

A COMPARATIVE and phylogenetic study of the dentition of the extinct South African man-ape *Australopithecus* (*Plesianthropus*) *transvaalensis* Broom has been made by W. K. Gregory and Milo Hellman, who visited South Africa in 1938 at the invitation of Dr. Robert Broom and Prof. Raymond Dart to examine the evidence at first hand for this purpose (*Annals of the Transvaal Museum*, 19, 4; 1939).

One of the most astounding features of the type *A. transvaalensis* is the combination of a natural braincast, which is somewhat smaller than that of a large gorilla, with a dentition of almost human appearance. According to the experience of palæontologists the material available, though insufficient to satisfy statistical requirements, is adequate for determining the systematic position of Plesianthropus among the higher primates; and it is affirmed with Broom that in South Africa there once lived apes which had almost become men.

In the female Plesianthropus the premaxillary prognathism is much more pronounced than in the Ramapithecus from the Siwalik Hills, though the latter is a much smaller and more delicately built form. As compared with Sinanthropus the premaxillo-maxillary regions of Plesianthropus are more prognathous. Likewise in the lower jaw, the available evidence indicates that the forepart of the jaw in Paranthropus was shorter and more retracted than in the apes, and was approaching the stage of Sinanthropus. In this respect Paranthropus was structurally intermediate between the existing apes and primitive man. The excessive thickness of this jaw and the extreme flattening of the facial plate are unique characters, which though by no means excluding Paranthropus from the dryopithecine stock, are conspicuous differences from Sinanthropus and other hominids, and tend to justify Dr. Broom's choice of the name Paranthropus as indicating a side branch of the pre-human stock.

Turning to the evidence of the teeth themselves, the upper central incisor of Plesianthropus is unknown, but indications point to a derivation from certain conditions present in Siwalik dryopithecines, and from this stage the Sinanthropus-Mongoloid series (with extreme shovel-shaped first and second incisors) is derivable merely by further emphasis in the same direction. In modern man further emphasis of the method of growth produces peg-like crowns, while an emphasis on the basal swelling sometimes produces results observable in Palæanthropic man and some modern apes. Hence in respect to the stage of evolution of the upper permanent incisors Plesianthropus was intermediate between the ancestral dryopithecine stock and the primitive palæanthropic man; and it was more primitive than most modern anthropoid apes.

In regard to the canines Plesianthropus, starting from a primitive dryopithecine stage, was again approaching human conditions in the form and relations of its upper and lower canines. The small size of the canine teeth favours the conclusion that the small size of the canines in modern man is due to a secondary reduction. The lower canines are closer to Sinanthropus than to Sivapithecus. The edge-to-edge bite of upper to lower canines is again a primitive hominid condition, though occurring occasionally in old, very much worn, ape teeth.

In all the features of the premolars Plesianthropus was again intermediate between the primitive dryopithecus and the early human stage. Its upper premolars are more primitive than those of Sinanthropus in having lower, less taurodont, crowns and divergent buccal and lingual roots.

The molars, both upper and lower, in the South African fossil man-apes are unusually large, being exceeded only by *Sivapithecus giganteus* and by male gorillas. They differ, however, from those of gorilla, chimpanzee and other modern apes by certain easily recognizable peculiarities. In several respects their pattern has progressed towards the primitive human stage. It is not improbable that the great size of the third upper and lower molars was only a temporary phase preceding the reduction of these teeth in man.

The evidence from the Taungs infant is completely concordant with that of the Sterkfontein and Kromdraai adults, namely, that there lived in the upper Pleistocene of South Africa a group of small-brained man-apes that were derived from the widespread dryopithecine stock and were the less progressive cousins of man.

EIGHTH INTERNATIONAL CONGRESS OF REFRIGERATION

PLANS are being made to hold an international refrigeration congress at Cologne and Berlin during July 1–6, 1940. These congresses are held at intervals of about four years under the auspices of the International Institute of Refrigeration, which was set up by an international convention in 1920 and is supported by the majority of the nations.

After the Hague Congress in 1936, the scientific and technical side of the work of the International Institute of Refrigeration was reorganized and the control of that work entrusted to seven commissions, under a technical board composed of the presidents of the commissions dealing with various aspects of refrigeration. The reorganization became effective in 1938, when meetings of the commissions and technical board were convened in the rooms of the Royal Society. A one-day Conference on Refrigeration was also held following these meetings, and at this conference a number of papers were read which had been selected to embrace topics of especial interest to refrigerationists.

On July 14–16 last, similar meetings were held at Baden Baden and Karlsruhe, Germany. At the meetings of the technical board, a draft programme for the 1940 Congress was outlined.

On July 15, a Conference on Refrigeration took place at the Technical University at Karlsruhe, which has a department dealing with the engineering and physical side of refrigeration. In the grounds of the University is situated the Reich Institute of Foodstuff Preservation which is under the Ministry of Agriculture.

At the Refrigeration Conference four papers were read. Georges Claude dealt with the production and utilization of krypton. He indicated the advantages of the use of krypton for filling incandescent lamps, and stated that the production must be a separate field of activity rather than a by-product from liquid oxygen. G. Maiuri described machines working on the absorption principle and diffusing the refrigerant vapour in an inert gas. He stated that it is possible to attain temperatures below – 100° C. Ezer Griffiths dealt with various forms of hygrometers adapted to meet special requirements, and with humidity control. R. Plank dealt with air-conditioning in deep mines.

The meetings of the Technical Board were attended by representatives of various nationalities, and at the Refrigeration Conference there was a good attendance of German refrigerationists.

THE CAUSATION OF APPENDICITIS

APPENDICITIS is an inflammation around the cæcum, involving the vermiform appendage, and frequently associated with perforative ulceration. Previous to 1900, the disease was generally described under the names 'typhlitis' and 'perityphlitis'. The modern term 'appendicitis' began to be used in America between 1890 and 1900, and as a cause of death it first appears in the Registrar-General's annual report for 1901.

The immediate cause of appendicitis is a bacterial infection, but although the disease is a common one, the causes that predispose or precipitate an attack still remain but little understood, though stagnation of the intestinal contents in the appendix resulting in the formation of hard concretions is probably an important factor in many cases. There is a certain amount of information which suggests that habits of life, and in particular dietary habits, are of importance in predisposing to the disease.

In an endeavour to elucidate the causation of appendicitis, Dr. Matthew Young and Mr. W. T. Russell have surveyed the mortality statistics of Great Britain and of other countries and the statistics of certain hospitals, and their report is now published ("Appendicitis: A Statistical Study". Medical Research Council, *Special Rep. Series*, No. 233. H.M. Stationery Office. 1*s*. net). The figures relating to the frequency of appendicitis confirm that it is very prevalent and that it has been on the increase in recent years. Another point brought out is that the mortality in the highest social class is at least two and a half times greater than in the poorest social class, although the majority of diseases, especially those involving bacterial action, are commoner among poorer people. A curious feature of the mortality rates from appendicitis in women is that the figures strongly indicate that the mortality is greater among single than among married women.

The suggestion has been made that the nature of the diet may have an influence in predisposing to appendicitis, either an excess of food or possibly certain types of food, and both of these factors are probably more common among the well-to-do. The taking of purgatives or laxatives is another cause suggested, and this practice is probably more common in the higher social class and among women. No data bearing on these factors were obtained, though it is significant that the mortality from appendicitis in females fell during the war years 1915–18, when food restrictions were imposed, and increased afterwards

THE BRITISH ASSOCIATION, 1839

On September 7, 1839, the *Athenæum* said: "The Birmingham Session of the British Association closed its peaceful labours on Saturday, and the many distinguished persons who had there met in furtherance of one common object—the advancement of science, and the good of all mankind—are already scattered far and wide, not less content, we hope, because a leading political journal has been pleased to pour out on them its vials of wrath and scorn—how justly, our readers can now determine. . . ."

The meeting had been presided over by the Rev. William Vernon Harcourt (1789–1871), a son of Edward Harcourt (1757–1847), archbishop of York, and the father of Sir William Harcourt (1827–1904), the statesman. Harcourt served in the Navy for five years before entering Christ Church, Oxford. Taking holy orders in 1811, he held various ecclesiastical appointments in Yorkshire, and in 1824 was elected F.R.S. He took an active part in the founding of the British Association, was the first general secretary, and at the inaugural meeting gave an address in which he said: "I propose to you to found an Association including all the scientific strength of Great Britain, which shall employ a short time every year in pointing out the direction in which the researches of science should move, in indicating the particulars which most immediately demand investigation, in stating problems to be solved and data to be fixed, in assigning to every class of mind a definite task, . . . I am not aware that in executing such a plan we should intrude on the province of any other institution. Consider the difference between the limited circle of any of our scientific councils . . . and a meeting at which all the science of these kingdoms should be convened, which should be attended by deputations from every other society, and in which foreign talent and character should be tempted to mingle with our own. With what a momentum would such an Association urge on its purpose; what activity would it be capable of exciting."

A great part of Harcourt's presidential address in 1839 was devoted to the Antarctic Expedition and magnetic observations, but towards the end, he said: "The system of your meetings, Gentlemen, has brought together things which ought never to be disjoined—the principles of science, with their application to human use. After gathering your first members from our ancient schools of learning, you passed to the marts of commerce, and are now come to the heart of the manufacturers of England, and look around on all the resources and creations of mechanical art. The theorist and the mechanician here meet together to the mutual advantage of both; witness on the one part the instrument now working in the Philosophical Institution of this town, and almost supplying the place of a constant observer, which is about to measure the force of the wind at every instant of time, at St. Helena, the Cape of Good Hope, Van Dieman's Land and near the South Pole. But here I would not go further than the immediate vicinity of this town for an instance, the most striking on record, of the mighty influence which the introduction of a new principle in science an exercise on all the arts of life; the history of the improvement of the steam engine by Watt fully illustrates this truth. . . ."

FORTHCOMING EVENTS

British Association for the Advancement of Science (Dundee Meeting).

Sunday, September 3

At 8.30 p.m.—Sir Richard Gregory, F.R.S.: "Contacts of Religion and Science" (Division for Social and International Relations of Science).

Monday, September 4

At 10 a.m.—Dr. C. H. Desch, F.R.S., Dr. A. G. G. Gwyer, Prof. A. von Zeerleder, W. C. Devereux: "Light Alloys" (Discussion: Section B).

Dr. G. P. Douglas, Dr. A. Busemann, Dr. J. W. MacColl, C. N. H. Lock: "Problems of High-Speed Flight" (Discussion: Section A).

Prof. W. M. H. Greaves, Prof. R. W. Ditchburn, Dr H. R. Hulme, Dr. D. Chalonge, Dr. R. v. d. R. Woolley: "Surface Temperatures of Stars" (Discussion: Section A†).

Prof. H. H. Read, F.R.S.: "Metamorphism and Igneous Action" (Section C: Presidential Address).

Prof. L. M. Fraser, Prof. A. G. B. Fisher, R. L. Hall: "The Economics of Socialism" (Discussion: Section F).

Prof. R. A. Fisher, F.R.S., Dr. D. C. Wilson, D. M. Lubbock and Dr. I. Leitch: "Nutrition and Physique" (Joint Discussion: Sections H and I).

T. Thomson, Dr. R. Melville: "Seed Provenance, Local Races and Breeding of Forest Trees (Joint Discussion: Section K and K*).

T. M. Herbert, Dr. W. G. Radley: "Aspects of Industrial Research" (Discussion: Section L).

M. Jones, Dr. S. J. Watson, E. J. Roberts and Prof. W. Kerr: "Grass Conservation" (Discussion: Section M).

R. S. Finlow, J. K. Eastham, J. R. Walker, A. King, W. E. Billinghame, J. K. Anderson: Second Special Session on Jute.

At 11.15 a.m.—Prof. W. McClelland, W. A. F. Hepburn: "Recent Educational Research in Scotland" (Discussion: Section L).

At 2.15 p.m.—Prof. F. G. Baily, Sir Robert Robertson, F.R.S., Dr. R. W. Butcher, W. Malloch: "River Pollution" (Discussion: Conference of Delegates of Corresponding Societies).

At 3 p.m.—Prof. G. Murray, Prof. F. G. Donnan, F.R.S., Dr. J. S. Huxley, F.R.S., Prof. G. Dahlberg: "International Intellectual Co-operation" (Discussion: Division for Social and International Relations of Science).

At 6.30 p.m.—Dr. H. W. Melville: "New Lamps for Old" (Popular Lecture).

Tuesday, September 5

At 10 a.m.—Prof. M. Born, F.R.S., Dr. Ezer Griffiths, F.R.S., Dr. W. H. Hatfield, F.R.S., W. J. Todd, Dr. R. W. Powell, J. H. Awbery, Prof. J. Satterly: "High-Temperature" (Discussion: Section A).

Dr. E. V. Appleton, F.R.S., H. W. Newton, A. D. Thackeray, Prof. L. Vegard, Prof. W. M. H. Greaves, Prof. F. J. M. Stratton: "Solar and Terrestrial Relations" (Discussion: Section A†).

Prof. A. McKenzie, F.R.S. and Dr. R. Roger, Prof. M. Tiffeneau, Dr. S. F. Birch, Dr. A. K. Mills, Dr. T. S. Stevens: "Intramolecular Change involving the Migration of Groups" (Discussion: Section B).

Prof. H. O. Meredith: "Rates and Taxes" (Presidential Address: Section F).

Prof. D. Burns, Dr. I. H. Pearse, Prof. E. P. Cathcart, F.R.S.: "The Assessment of Physical Fitness" (Discussion: Section I).

R. Knight, J. L. Hardie, Dr. R. H. Thouless, Dr. C. A. Mace: Training the Mind" (Discussion: Section J).

Miss L. Grier, J. B. Frizell, A. E. Henshall, D. E. Collier: Discussion on the Spens Report (Section L).

T. A. Wedderspoon, Dr. G. Cockerham, Dr. T. McIntosh: "Seed Potato Growing" (Discussion: Section M).

At 10.30 a.m.—Dr. M. Macgregor, Dr. W. Q. Kennedy, Prof. G. Hickley, F.R.S., Prof. T. N. George, Prof. W. T. Gordon, Dr. T. S. Westoll: "The Boundary between the Old Red Sandstone and the Carboniferous" (Discussion: Section C).

At 2 p.m.—Colonel R. B. Campbell, Miss H. Drummond, Prof. A. Hemingway and H. R. Noltie: "Physical Fitness" (Discussion continued: Section I).

At 3.30 p.m.—N. F. Sheppard, Prof. H. J. Fleure, F.R.S.: "Anthropology in Education" (Discussion: Section H).

At 8.30 p.m.—Dr. Isaiah Bowman: "Science and Social Pioneering" (British and American Association Lecture).

Dr. D. A. Spencer: "Some Aspects of Colour-photography" (Public Lecture).

Wednesday, September 6

At 10 a.m.—Sir John Orr, F.R.S., L. Harris, D. Lubbock, Prof. P. Sargent Florence: Discussion on Nutrition (Division for Social and International Relations of Science).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

RESIDENT ENGINEER (temporary) of a Small Arms Ammunition Factory at Cullane, Co. Clare—The Secretary, Department of Defence, Parkgate, Dublin, N.W.5 (September 8).

ASSISTANT LECTURER in the Mathematics and Physics Department—The Principal, Municipal Technical College, Halifax (September 8).

ASSISTANT TRANSPORTATION SUPERINTENDENT (Rolling Stock), Traction Branch of the Great Indian Peninsula Railway—High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting 1/30A) (September 15).

LECTURER AND CHIEF DEMONSTRATOR IN ZOOLOGY in the Victoria University College, Wellington, New Zealand—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1 (October 1).

GRADUATE LECTURER IN MECHANICAL ENGINEERING in the Royal Technical College, Salford—The Director of Education, Education Office, Salford 5, Lancs.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Home Office, Ministry of Health and Scottish Office. Final Report of the Inter-Departmental Committee on the Rehabilitation of Persons Injured by Accidents. Pp. vi+194+8 plates. (London: H.M. Stationery Office.) 3s. 6d. net. [118

County Council of the West Riding of Yorkshire. Report on a Study of the Diets of 206 Families in the West Riding of Yorkshire. Pp. 26. (Wakefield: County Hall.) [128

The Harper Adams Adviser. Advisory Report No. 14: A Review of Advisory Work in the West Midland Province, 1938–39. Pp. 20. (Newport, Shropshire: Harper Adams Agricultural College.) [128

Seventy-fifth Annual Report on Alkali, etc. Works. By the Chief Inspectors. Proceedings during the Year 1938. Pp. iii+59. (London: H.M. Stationery Office.) 1s. net. [168

Forestry Commission. Bulletin No. 14 (revised 1939): Forestry Practice; a Summary of Methods of Establishing Forest Nurseries and Plantations with Advice on other Forestry Questions for Owners and Agents. Pp. 99. (London: H.M. Stationery Office.) 1s. 6d. net. [178

Edinburgh and East of Scotland College of Agriculture. Calendar for 1939–1940. Pp. 96. (Edinburgh: Edinburgh and East of Scotland College of Agriculture.) [218

British Association for the Advancement of Science. A Scientific Survey of Dundee and District. Prepared for the Dundee Meeting, 1939, by various Authors. Edited by R. L. Mackie. Pp. 124. (London: British Association.) [218

British Association for the Advancement of Science, Dundee Meeting, August 30–September 6, 1939. Official Guide to the City and its Environs. Edited by R. J. Mackie and J. B. Salmond. (Published for the Local Executive Committee.) Pp. 136. (Glasgow: John Menzies and Co., Ltd.) [308

Other Countries

The Rockefeller Foundation. Annual Report, 1938. Pp. x+515. (New York: The Rockefeller Foundation.) [118

Union of South Africa: Department of Mines, Geological Survey. The Geology and Mineral Deposits of the Omaruru Area, South West Africa; an Explanation of Sheet No. 71 (Omaruru, S.W.A.). By Dr. S. H. Haughton, Dr. H. F. Frommurze, Dr. T. W. Gevers, C. M. Schwellnus and P. J. Rossouw. Pp. 152. (Pretoria: Government Printer.) 5s., including Map. [128

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 15: The Inheritance of Gumming Disease Resistance in Sugarcane Breeding. By G. C. Stevenson. Pp. 9. (Port Louis: Government Printer.) 15 cents. [128

Tanganyika Territory. Department of Lands and Mines: Land Division. Annual Report 1938. Pp. 12. 1s. Department of Lands and Mines: Mines Division. Annual Report 1938. Pp. 36. 1s. Department of Lands and Mines: Survey Division. Annual Report 1938. Pp. 22. 1s. (Dar es Salaam: Government Printer.) [128

Annual Report of the Public Health Commissioner with the Government of India for 1937. Vol. 2. Pp. vi+157. (Delhi: Manager of Publications.) 2.6 rupees; 4s. [148

Smithsonian Miscellaneous Collections. Vol. 98, No. 21: The Weekly Period in Washington Precipitation. By C. G. Abbot and N. M. McCandlish. (Publication 3547.) Pp. ii+4. (Washington, D.C.: Smithsonian Institution.) [14

U.S. Department of the Interior: Office of Education. Bulletin, 1938, No. 11: Principles and Procedures in the Organization of Satisfactory Local School Units. By Henry F. Alves and Edgar L. Morphet. (Local School Units Project.) Pp. vii+164. (Washington, D.C.: Government Printing Office.) 25 cents. [148

Bulletin of the Department of Zoology, Panjab University, Vol. 2. Fauna of the Dal Lake, Kashmir. 1. On some Leeches from the Dal Lake, Kashmir. By Dr. M. L. Bhatia. Pp. 17+1 plate. (Lahore: University of the Panjab.) 1 rupee. [148

Pasteur Institute of India. The Thirty-seventh Annual Report of the Director of the Institute for the Year 1937. Part 2. Pp. 46. (Kasauli: Pasteur Institute of India.) [148

Tanganyika Territory. Department of Lands and Mines: Geological Division. Annual Report 1938. Pp. 27. (Dar es Salaam: Government Printer.) 1s. 6d. [14

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 110: Contributions t Special Scientific Meetings, 1939. Pp 112. (Copenhague: Andr Fred. Høst et fils.) 6.00 kr. [14

Geological Survey of British Guiana. Bulletin No. 13: Report o a Short Visit to Marudi Mountain Gold Workings, Rupununi District 1934. By Dr. D. R. Grantham. Pp. ii+5+1 plate. (Georgetown Geological Survey.) 12 cents. [14

Report of the Haffkine Institute for the Year 1938. By Lt.-Col. S. S Sokhey. Pp. iii+90. (Bombay: Government Printing and Stationer Office.) 3 annas; 4d. [16

Government Museum, Trivandrum. Annual Report, 1113 M.E Pp. 8. (Trivandrum: Government Museum.) [16

Smithsonian Miscellaneous Collections. Vol. 98, No. 29: Th Determination of Small Amounts of Chlorophyll—Apparatus an Method. By Earl S Johnston and Robert L Weintraub. (Publicatio 3545.) Pp. ii+6+2 plates. (Washington, D. C.: Smithsonia Institution.) [16

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium, Vol. 26 Part 9: A Revision of *Besleria*. By C. V. Morton. Pp. vi+395–474+vii–ix. (Washington, D.C.: Government Printing Office.) 1 cents. [16

U.S. Department of Agriculture. Farmers' Bulletin No. 1828 Grasshoppers and their Control. By J. R. Parker. Pp. ii+38. (Washington, D.C.: Government Printing Office.) 10 cents. [16

American Anatomical Memoirs. No. 18: A Resurvey of the Developments of Lymphatics and Associated Blood Vessels in Anuran Amphibi by the Method of Injection. By Henry McElderry Knower. Pp 125 (19 plates). (Philadelphia: Wistar Institute of Anatomy an Biology.) [16

N.Z. Department of Scientific and Industrial Research: Api Observatory, Apia, Western Samoa. Annual Report for 1935. Pp 145. (Wellington: Government Printer.) 6s. [17

U.S. Department of the Interior: Office of Education. Vocationa Division Monograph No. 20. Discovering Occupational Opportuniti for Young Men in Farming. By J. W. Hatch. Abbreviated an rearranged by F. W. Lathrop. Pp. iv+9. (Washington, D.C.: Government Printing Office.) 5 cents. [18

Commonwealth of Australia: Department of Health. Physica Aspects of Radium and Radon Therapy. By Dr. C. E. Eddy an T. H. Oddie. Second edition. Pp 57. (Canberra: Governmen Printer.) [21

Survey of India. Geodetic Report, 1938. Pp. iv+86+11 chart (Dehra Dun: Survey of India.) 3 rupees; 5s. [21

Royal Observatory, Hong Kong. Meteorological Results, 193 Prepared under the direction of C. W. Jeffries. Pp. iv+142+41+6 3 dollars. Report of the Director for the Year 1938. Pp. 8. 30 cent (Hong Kong: Royal Observatory.) [21

Publikationer fra det Danske Meteorologiske Institut. Aarboge Isforholdene i de Arktiske Have (The State of the Ice in the Arct Seas) 1938. Prepared by Helge Thomsen. Pp. 17+5 maps. (København: G. E. C. Gad.) [21

U.S. Department of Agriculture. Leaflet No. 184: The Elm Le Beetle. By C. W. Collins. Pp. 6. 5 cents. Miscellaneous Publicatio No. 341. The Species of *Pantomorus* of America North of Mexic By L. L. Buchanan. Pp. 40. 10 cents. (Washington, D.C.: Government Printing Office.) [22

Editorial & Publishing Offices:
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, SEPTEMBER 9, 1939 No. 3645

THE VOICE OF SCIENCE

ONCE more the burden of war is laid upon us. Once more, as in 1914, the cynical disregard of Germany for the rights of small nations has constrained the British people to take up arms in the cause of justice and fair dealing in international relations. The challenge of the German Reich has been accepted reluctantly, and with no illusions as to the nature of the glories of modern warfare, only after every effort to secure a peaceful but equitable settlement of the differences between Germany and Poland has failed. It has been accepted with full realization of the gravity of every implication of the decision. But in turning to war as the last resort, the British people has acted with a unanimity such as never before in its history, and with a grim determination that no effort shall be spared in the endeavour to ensure that the cause which it holds just shall prevail.

From 1914–18, the Allies opposed dynastic ambitions in the interests of the freedom of peoples. No longer were the people to be the pawns of the political intrigues of their rulers. The world, it was said, was to be made safe for democracy—words that now have a mocking ring. In 1939, the canker has sunk deeper. It is not merely political liberty that is at stake, though that too is jeopardized. It is the spirit of man.

In no previous war has science played so great a part as that which will be demanded of it in the struggle that is at hand. For a time, while the issue hangs in the balance, it is the duty of the man of science to lay aside his just misgivings whether the greatest force of the human intellect should thus be harnessed to the forces of destruction. For the moment, the interests of pure science as an intellectual pursuit and discipline must remain in abeyance. The energies, the abilities, and the knowledge of each and every individual with scientific training must be directed without remission to the service of the Allied cause. Nevertheless, the end to be attained, and the end which science should hold ceaselessly before the eyes of the Allied peoples, is not destruction, but a constructive ideal—to ensure in the future such conditions as will make possible the advancement of all the peoples of the world without discrimination, according to the status and the traditions of each, in the light shed by reason and scientific knowledge. To keep alive the aims of science in furthering the pursuit of truth in the universe and the relation of that truth to the developments of man's nature, without regard to tribal and racial distinctions, should be, indeed, must be, the ultimate function of the scientific thinker, whatever may be his more immediate preoccupations.

As to the form in which that ideal will find embodiment, at the moment, in the turmoil of initial operations, it is too soon to attempt a forecast; but that it is no idealist's dream is certain. The failure of the League of Nations as a political organization has cast discredit in the popular mind on such forms of international co-operation. Possibly the League of Nations came before its time, and this has obscured in the popular verdict the enormous value of its scientific work in the study of social and economic problems, and the progress which has followed, where the practical application of the solutions suggested has not conflicted with the trends of nationalist development. To extend the fields in which such co-operation between peoples may be applied is the task of the future, when the time comes, as it surely will, for reconstruction.

CENTRAL REGISTER OF SPECIALISTS

IN NATURE of April 8, reference was made to the formation by the Ministry of Labour, for war-time use, of a central register of those with scientific, technical and professional qualifications, and the scheme was recommended to the attention of our readers. The need has now arisen, but fortunately the Register has reached an advanced stage, due to helpful co-operation of a great many learned bodies and professional institutes, and the Committees of the Council which advises the Minister on the Register have been reviewing the position reached.

We are informed that, at the end of July, 86,000 names were on the Register as a whole; the scientific research part of the Register contained at that date 7,000 names. The cards completed by the volunteers are held at the Ministry of Labour classified under the scheme of classification approved by the Committees, and a duplicate set of cards in the research classifications is held by the Royal Society.

The immediate purpose of the Register, which is under the guidance of the Advisory Council and its Committees, is to meet demands in war-time for the services of scientific and other personnel made by Government Departments (who will draw upon the Central Register for all their demands for persons possessing these qualifications) and by other employers engaged on work of national importance. Enrolment is voluntary, as indeed is the whole scheme. The services of panels of the Committees of the Council will be available for the selection of candidates for submission to the posts offered. In making the submissions, regard will be paid to the importance of the work offered in relation to that on which the volunteer is already engaged. The question of remuneration will be a matter for settlement between the volunteer and the employer concerned.

The Register will be operated centrally, but in the event of war exigencies compelling regional operation in any area, regional panels, nominated by the Committees, will act on their behalf.

How far those enrolled on the Register will be called upon can only be a matter of conjecture, and no promise is given that any particular individual will, in fact, be required. Those enrolled on the Register need not be deterred from undertaking any of the forms of national service (consistent with the Schedule of Reserved Occupations), but where such undertakings will involve full-time service they are asked to notify the Central Register.

There can be no question that, in the war which is now on us, a great demand will arise for the resources of scientific knowledge available for defence, and this section of the Register constitutes an extremely useful part of the general organization which the Government has set up for national defence.

A separate register of teams of scientific workers which it may be desirable to keep intact during at least the earlier stages of war has been compiled by the Department of Scientific and Industrial Research, and close liaison is naturally being maintained between this register and the Central Register.

The section of the Register relating to scientific research is dealt with by the Scientific Research Committee of the Council, with Prof. A. V. Hill, one of the Secretaries of the Royal Society, as its chairman, and is made up as follows: Prof. C. G. Darwin (mathematics), Dr. E. V. Appleton (physics), Prof. J. C. Philip (chemistry), Prof. R. V. Southwell (engineering science), Dr. E. B. Bailey (geology), Prof. V. H. Blackman (botany), Prof. D. M. S. Watson (zoology), Prof. A. V. Hill (physiology), Prof. W. W. C. Topley (pathology), Prof. F. C. Bartlett (psychology), Mr. C. S. Wright (director of scientific research, Admiralty), Dr. H. J. Gough (director of scientific research, War Office), Dr. D. R. Pye (director of scientific research, Air Ministry), Dr. R. E. Stradling (director of scientific research, Home Office), Dr. A. Landsborough Thomson (Medical Research Council), Sir E. J. Butler (Agricultural Research Council.)

The Committee has the following sub-committees: (1) Bacteriology and Pathology, (2) Botany, (3) Chemistry, (4) Engineering Science, (5) Geology, (6) Mathematics. (7) Physics, (8) Physiology and Biochemistry (9) Psychology, (10) Zoology.

The method of compiling this section has already been explained in the article in NATURE referred to above. The response to the appeal made for volunteers has been the best of any section, and is extremely gratifying. The proportion of those qualified scientific research workers approached by the Royal Society who have offered their services in their professional capacity for work of national importance in the event of war was already, at the end of July, 88 per cent.; it is now greater.

The Committee with its Sub-Committees has made recommendations regarding the Schedule of Reserved Occupations as affecting science. It has also directed attention to the need for facilitating the entry of suitable scientific workers into special branches of the defence forces.

The cards of the volunteers in the ten sub-sections of this section of the Register have been carefully reviewed by the sub-committees with a view to the best possible use being made in war of the special qualifications and experience of each individual. A certain number of research workers within the various categories were earmarked, before war broke out, for service with research branches of the defence departments.

The Committee had placed great importance on the preliminary training of research workers for war work, and the defence departments are arranged this summer for preliminary instruction at experimental stations, etc., of volunteers.

In view of the prominent part which industrial chemistry will be called upon to play in war-time, reference may be made to the Industrial Chemistry Section of the Register. The Committee advising on this Section of the Register has as its chairman Prof. J. C. Philip, and its members are as follows: Dr. W. A. S. Calder, Dr. W. Cullen, Mr. J. Davidson-Pratt, Dr. L. H. Lampitt, Sir Gilbert Morgan, Sir Robert Pickard, Dr. R. E. Slade.

As a result of the Committee's recommendation the leading chemical societies and related bodies had invited their members to volunteer for the Register. The Association of British Chemical Manufacturers had also, with the Committee's approval, approached its employer members asking them to encourage qualified members of their staffs who are not in membership of one or other of the co-operating technical bodies to apply for inclusion in the Register. It is, of course, still open for any individuals not members of the associations mentioned, who are qualified by training and/or experience, to volunteer by communicating directly with the Central Register Branch, National Service Department, Ministry of Labour, Montagu House, Whitehall, S.W.1.

The Industrial Chemistry Committee also has been studying in greater detail the cards filed in the various sub-sections of the industrial chemistry classification, and, apart from certain necessary adjustments as between this section and the section for research chemists, it is proposed to consider the steps which should be taken to supplement those sub-sections where the present number appears to be inadequate in relation to war-time demands.

The number of volunteers enrolled in this section was 4,985, at the end of July. While this result is regarded as moderately satisfactory, it is understood that there has been reluctance on the part of some employers to allow qualified members of their staff to enrol. This may be due to a misconception of the use to which the Register will be put in war-time. The selection of persons for submission to posts will be made by experts in the particular field, working within the general scheme of priorities laid down by the Government.

Further, before volunteers already in employment are submitted for alternative posts the observations of their existing employers will be carefully considered by expert committees appointed for the purpose. It is therefore hoped that in the national interest employers will encourage their qualified staffs to enrol on the Register, so that it may be equal to the calls made upon it. It is to be remembered also that the Register will be available for the use of employers as well as of Government Departments, and that in certain circumstances they may find it of great use for securing replacements of staff.

Reference has been made above to two only of the several sections of the Central Register of Specialists, namely, scientific research and industrial chemistry, the detailed working of which will be of special interest to readers of NATURE. The complete register covers every aspect of professional and intellectual activity of a modern civilized State. The whole conception is an eminently scientific undertaking, approached in a scientific manner with full consideration of all the pitfalls of which the experience of the war of 1914–18 made the community aware. However much we may deplore the circumstances through which the Central Register has arisen, it should be welcomed as an invaluable record of the scientific and learned life of Great Britain which will prove of inestimable service now and in happier times when reconstruction begins.

STANDARDS OF PHYSICAL MEASUREMENT

National Physical Laboratory Collected Researches
Vol. 24: Standards. Pp. iii + 450 + 19 plates. (London: H.M. Stationery Office, 1938.) 22s. 6d. net.

STANDARDS provide the foundation for the intelligent co-ordination of all physical measurements. The refinement with which this co-ordination may be carried out rests fundamentally upon the precision with which the values of these standards are known and the extent to which they are utilized by research men in expressing their experimental results. The present volume of ten papers on standards shows the fidelity with which the National Physical Laboratory is carrying out its functions in establishing standards of measurement worthy of the name.

Electrical Measurements. The 'International' system of electrical units was adopted by the International Electrical Congress held in Chicago in 1893. Great difficulty was later encountered in establishing precise standards on the basis of the mercury ohm and the silver voltameter. The situation was temporarily met in 1910 through a joint decision of the standardizing laboratories of the leading nations to adopt consistent values for their standard resistances and standard cells, based on an intercomparison of their national standards. But some of these national standards began to drift, and the temporary uniformity was lost. Furthermore, it was soon recognized that the 'International System' departed by several parts in 10,000 from the absolute system of electrical units.

In 1929, the International Committee on Weights and Measures requested the various national laboratories to undertake the establishment of the electrical units in absolute measure. Two of the papers in the volume under review represent the contribution of the National Physical Laboratory to this undertaking.

The first of these deals with Vigoureux's absolute determination of the ampere. The current balance used in earlier work at the National Physical Laboratory was modified for this purpose, the most important change being the construction of new coils. Numerous measurements led to the conclusion that the unit of current at the National Physical Laboratory as realized by means of resistance coils and standard cells is 14 ± 3 parts in 100,000 less than the absolute ampere.

The accuracy of this result is believed by Vigoureux to be affected mainly by (1) systematic errors, (2) want of exact knowledge of the linear dimensions of the coils and (3) uncertainty in the absolute value of the local acceleration of gravity, which was derived from the Potsdam measurements. It may be stated parenthetically that recent absolute measurements of g both at the National Physical Laboratory and at the National Bureau of Standards give values slightly less than the classical Potsdam determinations.

A second paper by Vigoureux deals with the absolute determination of the ohm by the method of Lorenz. The Lorenz machine erected at the National Physical Laboratory in 1912 was used in this work, but new apparatus was constructed for adjusting the four inductance coils coaxially with the shaft and for determining the distance between the coils. The dimensions of the coils were also re-measured. The results showed that the National Physical Laboratory 'International' unit of resistance exceeds the absolute ohm by 50 ± 3 parts in 100,000.

Two other electrical papers appearing in the volume afford significant examples of international co-operation. "The Capacitance and Power Factor of a Mica Capacitor" is a joint contribution of Curtis and Sparks of the National Bureau of Standards and Hartshorn and Astbury of the National Physical Laboratory. Two radically different methods were used. At the National Bureau of Standards the mica capacitor was compared by alternating current with an air capacitor, the capacitance of which can be evaluated in terms of resistance and time. At the National Physical Laboratory the comparison was made by means of alternating current with a mutual inductance, which can be evaluated from its dimensions. The two methods gave results in agreement within 1 or 2 parts in 10,000, which is about the accuracy of the measurements.

The "International Determination of the E.M.F. of the Normal Weston Cell in International Volts" by Vigoureux likewise gives the results of a joint investigation by the Physikalisch-Technischen Reichsanstalt, National Physical Laboratory and National Bureau of Standards. The final value was 1 0183 volts at 20° C., which confirms the recommendations of the International Technical Committee in 1910.

A paper by Davis, Bowdler and Standring deals with the difficult problem of measuring peak voltages. Two methods were employed: (1) The voltage on the low-voltage arm of a condenser-divider was rectified. (2) The current through a condenser connected across the voltage to be measured was rectified and the mean current used as a measure of the peak voltage. Agreement to 2 parts in 1,000 was obtained.

The Thermometric Scale. A temperature between 0° C. and 100° C. on the 'International Temperature Scale' is evaluated by means of the platinum resistance thermometer. In his paper on this subject, Hall compares the platinum scale with the earlier N.P.L. scale maintained by mercury in verre dur thermometers. He found differences as large as 0·02° C. between individual mercury thermometers, but for selected thermometers the change to the platinum scale did not change the N.P.L. scale more than 0·002° between 0° C. and 50° or more than 0·005° between 50° C. and 100° C.

Another example of international team-work is to be found in the paper "International Comparison of Temperature Scales between 660° C. and 1063° C." by Roeser of the N.B.S., Schofield of the N.P.L. and Moser of the P.T.R. After exchanging thermocouples and samples of silver, the temperature scales of the three laboratories were brought into agreement within 0·1° C. at all points in the range covered.

Metrology. Stott's investigation of pivots and jewels as used in instruments and meters is an outstanding contribution to this subject. It covers the production of accurately shaped pivots, deformation under loading, friction, wear and lubrication. The paper should be studied by everyone who uses pivots and jewels in fine instrument design.

Under the title "Determinations of the Fundamental Standard of Length in Terms of Wave-Lengths of Light", Sears and Barrell present the results of their precise measurements in this field. An accompanying paper describes the apparatus. Their determination of the metre in wave-lengths of the red radiation of cadmium is in good agreement with the results of other observers. In fact the mean of all these determinations is practically identical with the value obtained by Benoît, Fabry and Perot, upon which all modern spectroscopic wave-length tables are based. The authors wisely urge that this relationship be preserved in any future definition of the unit of length in terms of wave-lengths of light.

Sears and Barrell also carried out for the first time a direct determination of the length of the Imperial yard in terms of wave-lengths of the red radiation of cadmium, from which the ratio of the yard to the metre may be derived. They direct attention to the advantage of re-defining the yard in terms of light-waves so chosen in number that 1 inch = 25·4 mm. or 1 yard = 0·9144 metre, exactly. This simple factor represents closely the mean between the present yard of Great Britain and that of the United States. Its official adoption would involve a change of not more than two parts in a million by either nation. It would not disturb industry in the slightest, because as a matter of fact this ratio has been in industrial use in both countries for many years. The National Bureau of Standards is in hearty accord with this proposal.

LYMAN J. BRIGGS.

BUILDING RECOMMENDATIONS

Principles of Modern Building
Vol. 1: Walls, Partitions and Chimneys (Department of Scientific and Industrial Research). By R. Fitzmaurice. Pp. 400+20 plates. (London: H.M. Stationery Office, 1938.) 10*s.* 6*d.* net.

ONE of the principal functions of the staff engaged at the Building Research Station, Garston, is to provide answers to the numerous inquiries received from all branches of the industry. These have led to the examination of building practice from every possible point of view, and this volume, compiled by the member of the staff responsible for dealing with these inquiries, contains information which has been collated from an experience unique in its extent and in its authoritativeness. This volume deals only with walls, partitions and chimneys, and is the first of a series the preparation of which has been undertaken at the joint request of the Royal Institute of British Architects and the Chartered Surveyors' Institution. It represents also the first fruits of a suggestion contained in the interim report of the Ministry of Health Committee on the Construction of Flats for the Working Classes.

Here is no mere recapitulation of established method and practice. The aim has been to formulate a statement of the functions of a building, as these are now understood, and the elements in its composition, and thus to guide the practical man in adapting his work to meet present-day requirements. Such problems as those of obviating dampness in walls, of avoiding smoky chimneys, and of providing insulation against the penetration of sound are representative of the useful points discussed. Of special value are the sections which deal with load-bearing walls both of the solid and of the cavity types and those in which new or recently introduced materials are discussed. An outstanding feature of the book is the concise, clear manner in which practical recommendations are given.

The necessity for such an authoritative series of volumes of reference can be understood when it is remembered that, until recently, building practice was subject only to very gradual changes. The rapid developments of modern times have led to the introduction of a multitude of innovations, some of which can be described as ill-advised. In showing the designs and methods which have been closely scrutinized and finally approved at the Building Research Station, this volume can be seen to be an invaluable contribution to the formulation of a code of good practice. It has been attractively prepared, is profusely illustrated with photographs, drawings and graphs, and is supplemented by lists of references and of appropriate British Standard Specifications.

THE CALIFORNIAN DESERTS

(1) The Californian Deserts:
a Visitor's Handbook. By Edmund C. Jaeger; with Chapters by S. Stillman Berry and Malcolm J. Rogers. Revised edition. Pp. x+209. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1938.) 9s. net.

(2) Deserts
By Dr. Gayle Pickwell. (Whittlesey House Publication.) Pp. xiv+174 (64 plates). (New York and London: McGraw-Hill Book Co., Inc., 1939.) 15s.

(1) HERE is a model guide-book, for its presentation is artistic, its facts correct and well chosen and the deductions therefrom modern. A desert is a place of high summer temperatures with steady, drying winds and a rainfall not exceeding five inches; these are usually accompanied by a high, diurnal temperature range, here about 40° F. There are complications, for the rain-carrying winds rise in the Gulf of California, cross mountains and descend in occasional bursts on a dissected, mountainous land, extending from the Colorado River for two hundred miles along the inland half of California. The possible evaporation appears to be 80–100 inches, so that the intensity of the aridity is considerable. These conditions have only been reached since the end of the Pleistocene, and there would appear to have been several periods of wetness. To the south the fertile belt of the Colorado separates the similar desert of Arizona and Sonora (Mexico), and there have always been in both deserts lake and other areas of permanent water such as the famous 'Death's Head Valley' and the 'Salton Sea' in California.

Comparisons with Old World deserts are impossible, for here are more than seven hundred species of plants. Many are supposedly desert-adapted, but caution is advised, since marsh and bog plants, owing to an absence of nitrogen, may show similar changes Some of the peculiar races are doubtless evolutions of northern plants, but there has probably been extensive immigration from the high, more ancient desert-lands of Sonora.

Insects are a function of plant-growth, so that there must be several thousand species, mostly living in inconspicuous habitats; the most visible are treated of in an interesting chapter. Snails and higher animals are well considered, the whole leading to a naturalist's account of the mammals, which are represented by thirty-six genera, including beavers which have given up the dam-making habit. The preservation of the bighorn sheep, of which about 600 are left, is immediately important, since experience has shown that the area occupied by a wild race of sheep which has been destroyed cannot be readily repeopled by sheep from other areas.

The Californian deserts are laboratories, conveniently situated for study; the experimental research is that of Nature, the lines those of past times, and hence peculiarly suited to the study of the changes which are due to natural evolution.

(2) Dr. Pickwell in his turn provides 64 full-plate photographic illustrations of these same deserts. His text for the most part is explanatory of these, to which is often added original observations on the biology of some of the plants and animals pictured. Unfortunately, many of the reproductions appear rather black-and-white so that frequently where detail is needed in the plants, it cannot be found. My own experience in similar landscape photography in the tropics leads me to suggest that for plants and forests a side light with consequent low-toned shadows is desirable, my practice being to close the camera for the six hours of midday. A concluding chapter summarizes the desert features and problems, subjects upon which experimental researches are urgently required, especially in respect to the water requirements of animals.

J. S. GARDINER.

INSTRUMENTS IN SCIENCE AND INDUSTRY*

By Robert S. Whipple

I FEEL that it is a great honour to be chosen as president of Section A of the British Association, particularly because on looking through the names of my distinguished predecessors I find that I am the first professional maker of scientific instruments to occupy this chair. My immediate predecessor, Dr. C. G. Darwin, who now occupies the important position of director of the National Physical Laboratory, gave us at Cambridge a brilliant dissertation on the use of mathematics in solving physical problems, and the need of the mathematical outlook when facing a series of facts requiring solution. He would, I am sure, be one of the first to insist that the mathematician requires physical facts to enable him to develop a physical theory, and that the probable soundness of the theory will depend largely upon the accuracy of the data discussed. In the majority of cases this accuracy depends on the qualities of the apparatus employed in the observations, assuming that the observer is fully qualified and capable of obtaining the best results from it. I believe that all such observers now demand far more from their apparatus than was formerly possible, but few realize the amount of thought and labour involved in raising the accuracy obtainable from one to one-tenth of one per cent.

The help that instruments have given to the advancement of science is a fascinating theme, and at the same time a wide one. Among the earliest and most striking examples we find that Kepler was able to state his laws of planetary motion as a result of the observations made with Tycho Brahe's carefully constructed instruments. Tycho (1546–1601) first introduced (though he did not discover) the method of transversal division of the arc, which is now familiar to us as the basis of the diagonal scale. It was he who first pointed out the importance of symmetry in an instrument. The ingenious naked-eye sights developed by him were a remarkable improvement on the simple sights previously used. According to Dreyer, his determinations of the right ascensions and declinations of his nine standard stars show a probable error of less than thirty seconds of arc—an almost incredible achievement.

I propose to consider a few well-known instruments and to use them as examples to indicate how the development of a particular subject has grown largely with the perfection of the instruments used to investigate it. It is in every way a reciprocal process. By means of an instrument certain evidence is obtained; this evidence does not go far enough and the instrument must be improved to enable further facts to be found. If, for example, the biologist requires to examine small bodies beyond the range of his microscope, he appeals to the physicist to help him, and the appeal is not in vain. Most probably, as a result of the work on his colleague's problem, the physicist develops a technique which will be of service to him or to a fellow-physicist.

The Microscope

The first example I shall take is the microscope, an instrument which is used in every observational science and, in some form or another, in nearly every industry. The early story of the microscope has been often told, and yet it may be of interest to recall the most important stages in its development. The first instruments consisted of single lenses, actually small globules of glass, which, when the surfaces were suitably ground, yielded in the hands of skilled observers surprisingly good results. The outstanding example is the Dutch naturalist Leeuwenhoek, who during the period 1674–1723, using a microscope of this type, discovered the protozoa and bacteria, and made many other biological observations of supreme importance.

Hooke, who was Leeuwenhoek's correspondent, was working in microscopical problems at the same time, and in the "Micrographia" (1665) described his own microscope—the first compound microscope. The optical system of this instrument consisted of a converging lens, called the object-glass, the field lens, and a third lens, the eye lens. Although it has been stated frequently that Hooke first introduced the field lens to enlarge the field of view, there is little doubt that this invention was due to Monconys, who published a short description of a compound microscope made to his design in 1660. This scarcely detracts from the credit due to Hooke, whose publication became so generally known, and whose optical system was universally adopted and remained practically unchanged for more than a hundred years.

Hevelius, in 1673, described in his "Machine Coelestis" a screw-focusing adjustment that he had fitted to an instrument of the Hooke type which was the forerunner of the modern mechanism adopted (or invented independently) by John Marshall (1663–1725), one of the great opticians at the close of the seventeenth century. Marshall should be remembered by the fact that he was the first to introduce the method of grinding a number of lenses simultaneously, by cementing a number of pieces of glass on to the surface of a large convex spherical block, and working them with a concave spherical tool. This is still the method employed for polishing lenses in quantity. In the modern spectacle lens factory as many as a hundred and fifty are sometimes polished in one block.

---

* From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association delivered on August 31.

Although many variations in the design and mechanical construction of the microscope were made during the eighteenth century and the early years of the nineteenth, yet there is no invention of fundamental importance to record until the construction of the achromatic objective. This was first successfully completed by the French optician Chevalier about 1825, and in England by Tulley working about the same time to the designs of Joseph J. Lister, nearly sixty years after the construction of a successful achromatic telescope objective.

Abbe carried the corrections of the aberrations to a far higher degree of perfection, notably by using glasses of new types which at his suggestion had been worked out by Schott, to produce, about 1886, the so-called apochromatic objective in which the colour correction was greatly improved.

It is difficult to see how the resolving power of the microscope is to be further increased using light from the visible region of the spectrum. The biologist, and particularly the medical man, is anxious to study organisms the structure of which is too fine to be resolved by any object glass when using ordinary white light, the alternative to which is the employment of rays of shorter wavelength, namely, the ultra-violet. Glass lenses are opaque to these short wave-lengths, and therefore lenses made of fused quartz must be used. J. E. Barnard, who has developed a very successful technique in connexion with ultra-violet microscopy, has shown that it is possible to study and photograph living bacteria, which are normally transparent to light from the visible region of the spectrum, without staining and therefore killing them. The use of such short wave-lengths has necessitated the construction of extremely rigid mountings in the microscope body and complete absence of play in the moving parts of the instrument. As showing the perfection of the technique obtained with ultra-violet microscopy, it may be mentioned that it is possible to take a series of photographs of an object in successive parallel planes separated by distances of the order of 0·0002 mm.

The use of short-wave radiations has proved so successful in the case of the ultra-violet microscope that a technique has been developed which offers great possibilities for the use of still shorter radiations. As is well known, a beam of cathode rays can be brought to a focus by passing the beam through a magnetic or electrostatic field, in a manner very similar to that in which light is brought to a focus by a convex lens. In the same way, an electron image of a surface may be formed owing to the fact that the electrons will be scattered by an amount depending on the density (or mass concentration) of the surface on which they impinge. By forming the image on a fluorescent screen it can be rendered visible, or if projected on to a sensitized plate, photographically recorded.

In an instrument designed by Von Borries and Ruska, an electron stream is passed through two specially designed electromagnets (or magnetic lenses), mounted one above the other, which act as equivalents to the objective and eye-piece of an optical microscope. If an object is placed between the poles of the lower magnet, some of the electrons will be scattered by the material of the object and others will be diverted by the magnetic flux so as to form an image of the object in a plane below the magnet. That an image can be formed in this way depends upon the fact that the scattering is proportional to the mass concentration at different parts of the object. The scattering will be greater from the thicker parts than from the thinner ones, and thus the dark parts of the image will correspond to the thick parts of the object, and *vice versa*. Magnifications of about twenty times those obtained with the optical microscope can be obtained. Excellent photographs have been taken of bacteria and bacilli at magnifications of 10,000 and 20,000 diameters.

Sorby, in 1864, was the first to investigate the structure of metals and alloys by the microscope, and although it was a considerable time before his work was appreciated, there is now no metallurgical laboratory worthy of the name that does not possess a microscope by means of which the molecular structure of an alloy can be examined and photographically recorded.

THE TELESCOPE

Although the discovery of the telescope antedated that of the microscope, in its service to mankind it ranks as second to it. The credit of the invention of the telescope must go to a Dutchman, Lipperahey; yet it was Galileo who first produced an instrument worthy of the name. He ground and polished his own lenses, and in 1610, with a telescope magnifying thirty-three diameters, discovered the satellites of Jupiter. Amongst his many astronomical observations he discovered the phases of Venus, and estimated the height of the lunar mountains from the length of their shadows.

Newton pointed out that the focal length of the refracting telescope could not be reduced owing to the refrangibility of light of different colours, and that it was not possible to focus for all the colours simultaneously and thus obtain a sharp image. He measured and calculated the distance between the foci of the red and violet and showed that it was about 1-50th the diameter of the lens. It was to overcome this difficulty that the glasses were made small and of long focal length. It is almost unbelievable that James Bradley, in 1722, measured the diameter of Venus with a telescope having a focal length of 212 ft., the supporting mast being about 45 ft. long.

In 1663, James Gregory suggested the construction of a reflecting telescope, and in 1668 Newton constructed the first practical instrument, having made his own alloy for the mirror and having devised methods for grinding and polishing it. A sentence in his "Optiks" (Bk. I, Pt. 1, Prop. VI, p. 75) shows how serious the position had become: "Seeing therefore the improvement of Telescopes of given length by Refractions is desperate; I contrived heretofore a Perspective by reflexion, using instead of an Object Glass a concave Metal."

The manufacture of satisfactory reflectors was very difficult, and it was not until an instrument maker, James Short of Edinburgh, about 1730, produced instruments with parabolic figuring, that the reflector came into general use. His instruments, even now, may be regarded as examples of first-class workmanship.

Sir William Herschel began making specula in 1774 and constructed a large number of reflecting telescopes, the most famous being his instrument at Slough of 4 ft. aperture and 40 ft. focal length; this was completed in 1789. Unfortunately, the weight (25 cwt.) of the large speculum rendered it liable to distortion, and it is of interest to note that all Herschel's discoveries were made with smaller instruments. More than fifty years later a reflector of 6 ft. aperture and 54 ft. focal length was erected by Lord Rosse at Parsonstown. All these instruments were fitted with metal mirrors which had an unfortunate tendency to tarnish, and re-polishing was apt to spoil the figuring of the mirror. In the modern instrument the metal mirror is replaced by glass which can be re-silvered at intervals. During the last few years aluminium has taken the place of silver as the reflecting surface, the aluminium being deposited on the glass surface under vacuum. The aluminium film does not tarnish, is more robust than silver and has a higher coefficient of reflection for short wave-lengths, and is thus more efficient photographically.

Owing to the increasing demand for telescopes of higher magnification, and of increased light-gathering power, the size of the mirrors used in the modern instruments is steadily increasing. The Mount Wilson Observatory has a telescope with a mirror 100 in. in diameter, and it is a matter of common knowledge that magnificent photographs of nebulæ, etc., have been obtained with it. At the present time an instrument having a mirror 200 in. in diameter is being constructed for the Mount Palomar Observatory. The manufacture of the borosilicate glass (pyrex) block for this mirror, which weighs twenty tons, has been a feat of considerable skill, and if it is successfully ground and polished, as appears likely, it will be a great engineering triumph. We have become so accustomed to success in mounting and operating these large telescopes, that we are apt to forget that this is the heaviest and certainly the most impressive side of instrument construction work.

For the large telescope the reflector has established itself as the most satisfactory instrument, whereas for the smaller telescope, and for the everyday purposes of life, the refractor is still the more efficient. In 1733, Chester Moor Hall found that by combining lenses made from glasses having different refractive indexes he was able to correct for the unequal refrangibility of light of different wave-lengths, and succeeded in making lenses which produced images free from colour. The same discovery was made independently by John Dolland, who, in 1758, produced an achromatic telescope in which the object glass consisted of a convex lens of crown glass combined with a concave lens of flint glass. The invention of the achromatic lens must be considered as one of the milestones in the development of scientific instruments.

THE SPECTROSCOPE

Perhaps there is no instrument which in recent times has aided pure science so much, and is now beginning to help industry, as the spectroscope. Fraunhofer constructed the first spectroscope in 1817, and made the first measurements of the lines of the solar spectrum. He was also the first to observe the spectrum of the electric spark. In 1842, Becquerel and Draper independently photographed the solar spectrum on daguerreotype plates, thus laying the foundation for the modern science of spectroscopy.

In 1859, Kirchhoff showed that the luminous vapour of a metal has the property of absorbing the same kind of light as it emits at the same temperature. Kirchhoff recognized the fundamental importance of his discovery, entitling it "spectrum analysis"; but it is largely due to Hartley (1882) and later to Twyman, who designed simple and efficient instruments, that spectroscopic analysis has become a quantitative method of chemical analysis. The spectrograph is now one of the most important tools in the metallurgical and chemical laboratory. In the manufacture of steel it is proving an invaluable check on the quality of the materials, the spectrogram obtained from the sample under test being compared with that taken from a standard. The speed of analysis may be judged from the statement that it is possible for one man to analyse twelve samples of nickel-chromium-molybdenum steel spectrochemically for the elements silicon, manganese, nickel, chromium, molybdenum, vanadium, aluminium and copper in less than one day. The spectroscope has also become a tool in common use in the steel warehouse, the storekeeper being able by its means to detect any mixing of the batches of steels.

In the laboratories of the works producing non-ferrous materials the spectroscope is proving equally efficient. For example, the failure of lead pipes from causes other than frost has been considerable, and has been traced to impurities in the lead. A spectroscopic examination of the pipe that has failed shows in a few minutes the undesirable impurities present, and, if the examination is carried further, the quantities of those impurities.

Our knowledge of the constitution of the celestial bodies is almost entirely due to the spectroscope. By its means it has been possible to discover what elements are present in the vapour surrounding them. This was strikingly shown by the discovery by Lockyer, in 1868, of an unknown gas (helium) in the bright-line spectrum of the sun's atmosphere, which was identified by Ramsay twenty-seven years later in the terrestrial atmosphere. The photographing of the sun's disk in a limited band of wave-lengths has led to the development of a special form of recording spectroscope, the photo-spectro-heliograph. In this instrument the slit of a spectroscope is slowly traversed across the sun's image, the selected radiation falling upon a photographic plate. Thus a picture of the sun is built up from a series of photographs taken in the selected wave-lengths. For example, if the wave-length selected is one of calcium, a picture of the disk is obtained showing the distribution of calcium over the sun's surface. The major part of the knowledge obtained about the double stars and also the determination of the velocity of stars in the line of sight has been obtained from spectroscopic observations. The theory of the expanding universe may be said to rest on spectroscopic observations.

SURVEYING INSTRUMENTS

The distinction between the telescope suitably mounted to survey the heavens and that used to measure distances upon the earth's surface is a faint one. The transit instrument is in general only a larger form of theodolite. The early surveyors (and here we may go back to early Egyptian times) made plans by means of rods and plummets; but it was not until the invention of the astrolabe and the use of a divided circle fitted with sights that accurate surveying was attempted. The first mention of the word 'theodolite' occurs in a book "Pantometria" (1571) by an Englishman, Thomas Digges. (It is a matter of interest that Digges has some claim to be called the inventor of the telescope). The early the odolites, like the astronomical instruments, were fitted with pinhole sights: in the case of the latter instruments, an important controversy arose between Hooke and Hevelius (1679) concerning the relative advantages of telescopic and open sights. Although Hevelius was not convinced, the telescopic sight was almost invariably used after that date. Mention should be made that William Gascoigne invented the filar micrometer and fitted it to a telescope in 1640: this invention greatly increased the accuracy of instruments to which it was attached. Bradley's observation in 1722 shows that he used a form of filar micrometer with considerable success.

As the demands of the astronomer (and later of the surveyor) increased, so the need for improved divided circles became more urgent. The accurate dividing of circles has always been one of the more difficult tasks of the instrument maker, and it is almost entirely due to the English manufacturer that the art of dividing has reached its present high position.

In 1766 Jesse Ramsden made his first circular dividing engine, but as it was not sufficiently accurate for dividing the scales of nautical instruments, he completed a second machine nine years later. It was with this machine that he divided the circles of the 3-ft. theodolites used in the principal triangulation of Great Britain and Ireland, 1792–1862. They were divided to 10 minutes and read to one second of arc by three micrometer microscopes.

In 1826, William Simms invented the self-acting mechanism by means of which the dividing machine became completely automatic, thus saving an immense amount of time, and reducing the risk of error in the dividing of a circle. A similar but larger machine, built by G. W. Watts in 1905, is capable of dividing a circle 4 ft. 6 in. in diameter to 30 seconds of arc with an error not exceeding ± 1 second.

Linear scales are automatically divided by somewhat similar machines in which are fitted a temperature compensation device for variation in the temperature of the machine and a compensation device for correcting for any variations in the pitch of the master screw. In this connexion the scientific man and the instrument maker are alike indebted to the late Dr. C. Guillaume for the invention of 'invar', a nickel-steel alloy having a remarkably small temperature coefficient of expansion, and hence an almost ideal material from which to manufacture standard scale and measuring tapes. In the case of linear scales, the position of the lines in a good metre scale can be guaranteed to an accuracy of 0·002 mm

THE THERMIONIC VALVE

An address of this nature would be incomplete if no mention were made of the thermionic valve. Its advent has led not only to the birth of a wide range of new instruments otherwise impracticable, but also to the simplification of many measuring techniques. The thermionic voltmeter was one of the first, if not the first, measuring instrument employing directly a valve, and uses to the full its most valuable characteristics as a measuring device. These characteristics may be briefly summed up as rectification, amplification, rapidity of response, and high impedance. Although these are the prime considerations, others, such as high overload capacity, are advantageous. The rectifying action combined with amplification enables alternating currents and voltages as small as 10^{-4} ampere and 10^{-4} volt to be measured, using a robust moving-coil instrument as a direct reading indicator. The low electrical inertia and high input impedance have, when using suitable diode valves, enabled voltages and frequencies up to 100 megacycles to be measured with reasonable accuracy by robust commercial instruments.

MANUFACTURE OF SCIENTIFIC INSTRUMENTS

Looking back over forty years' experience in the use of scientific instruments, many of those years being spent in their manufacture and development, I am much impressed with the steadily growing demands for higher accuracy. The development of the high-speed steam engine, and later the motor-car, brought about an insistent demand for accurate tools and gauges. This in its turn necessitated better design in the tools and more accurate measuring instruments. The manufacture of interchangeable components in large quantities has still further increased the demand for accuracy. The introduction of the new alloy steels with the special technique required in their heat treatment created a demand for precision thermometry.

The attitude of the manufacturer towards the scientific instrument has completely altered. He was once sceptical as to its usefulness; he is rarely so nowadays. In the majority of large works the general control over the instruments is now in the hands of a technically trained man, and that in itself relieves the instrument maker of much anxiety. Another fact that impresses one is the great difference between the methods of manufacture during the same period. Forty or fifty years ago, instruments were made in small batches, often by individual workmen. In London they were frequently made for some well-known firm by small chamber men who put the name of that firm upon them. As a result of this procedure, the so-called manufacturer very often had not an adequate knowledge of his products: this practice has almost entirely disappeared, to the benefit of customer and maker.

The increased demand for instruments has led to manufacture in the modern sense of the word. An instrument is carefully designed in the drawing office in consultation with the technical expert. The methods by which the instrument is to be made are considered. If the quantities are large, and if a preliminary model has been approved, then the possibility of the use of die castings, hot pressings or plastic mouldings must be considered, and the importance of interchangeability of components emphasized.

In preparing the design of an instrument it must never be forgotten that a good design helps production. It always pays to spend time in the drawing office rather than in the workshop. The application of geometric design, the early exponents of which were Maxwell and Horace Darwin, often reduces the cost of manufacture and makes a better instrument. I think that the experimentalist, in making up his own instrument, should consider whether he can obtain the same result by a simply designed geometric piece of apparatus, rather than the more elaborate design to which he may be attracted.

The demand for instruments is ever growing. As new problems arise, both in science and in industry, the requirements become more stringent. The instrument maker constantly receives incentives to progress from the scientific worker, to whom he owes not only suggestions but also many of his new materials. It is, I suppose, a truism that if knowledge is to progress it is essential that theory and practice advance together. Nowhere is this more true than in the development of scientific instruments.

THE ASSESSMENT OF PHYSICAL FITNESS*

BY PROF. DAVID BURNS

TESTS which have been used to assess fitness fall into three classes: (1) somatometric; (2) physiological; (3) psychological.

SOMATOMETRIC TESTS

The search for a relationship between the configuration of the body and physical fitness has been pursued since the time of Hippocrates. Such a relationship is elusive, and because of the complexity of body build and the scarcity of strictly comparable measurements, most of the findings lack validity.

It was natural, at first, to consider stature as an index of robustness. The tall man with a long reach was better able to hold his own in hand-to-hand fighting. Even to-day, height is taken into account in selecting recruits for the services and the police. The tall applicant, too, has generally a better chance of getting engaged in commerce and industry than his shorter competitor. Length, especially length of leg, is not merely an indication of genetic constitution but also of a late incidence of maturity. Chest girth in relation to size of body, at first sight, appears to have at least a probable relationship to fitness, but Gould (1864), who carried out a thorough statistical survey of the manhood of the American nation during the progress of the Civil War, had grave doubts as to the validity of chest measurements for this purpose. Hutchinson showed clearly that the circumference of the chest is no measure of vital capacity, endurance or even of muscular strength, nor is there any evidence that it bears any relationship to the state of general health.

Criteria of Fitness. Since the introduction by McLaren of systematic somatometric measurements as part of the routine of physical education, there has arisen a host of indexes, of which perhaps the best known are Von Pirquet's Pelidisi and Franzen's A.C.H. indexes.

In general, chests may be divided into three types: the wine-glass—wide shoulders and narrow hips; the test-tube—both measurements small; and the barrel with broad shoulders and wide hips. Persons of the test-tube type are often abdominal breathers, that is, they obtain their tidal air by contracting the diaphragm and displacing the viscera into a relaxed abdominal wall. Experiment shows that they have a larger effective vital capacity than the others and are generally more amenable to training. On the other hand, all three types are normal and are equally fitted, so far as bodily relations go, for the battle of life. One cannot mark down any type as fundamentally healthier than the others. The test-tube type is more prone to tuberculosis but less prone to rheumatism, diabetes and arterio-sclerosis than the barrel.

None of these indexes is valid as a measure of fitness, even when due allowance is made for race, type of body build, sex or occupation.

PHYSIOLOGICAL TESTS

Fitness is functional. The body must be tested at work. The measurement of vital capacity is generally classed as physiological although it is not strictly functional. This measurement, a common routine practice, has no real significance. The amount of air that a person can contain in his lungs is a measure of chest capacity and of the tone of the respiratory musculature, but the person with an extra large vital capacity has no advantage over one who has quite a small capacity provided that he has sufficient.

There is a prevalent error that so-called deep-breathing exercises where the shoulders are forced back and the chest brought forwards and upwards increase vital capacity. Actually, by fixing the pectoral muscles and stretching the abdominal wall, these procedures prevent full inspiration and expiration and increase the volume of air left in the lungs (residual air). Chest breathers have about the same vital capacity, whether taken at ease or on the stretch, while 'deep breathing' may reduce the vital capacity of abdominal breathers by about 30 per cent. The value of deep-breathing exercise lies in its effect on the filling of the heart and so on the maintenance of cardiac efficiency.

One is on surer ground when using the various breath-holding tests either *per se* or against pressure. The former is a measure of the alkali reserve of the blood and of the determination of the subject not to give in. The 40-mm. test brings out both these qualities and, in addition, is a severe test of muscular strength and control.

Bainbridge and Dawson quote the results of experiments which show clearly that fit and/or skilled men carry out physical work with but a slight increase in lactic acid, while the unfit, under the same conditions, have a higher blood-lactic acid content. That is, the reserve of alkali in the blood of the fit is large enough to cope with all or most of the acid released as a result of muscular exercise. Recruits have on the average 5 per cent less available base than the soldiers. Dawson states that three months' systematic physical education can raise the amount of available base by about 10 per cent.

---

* From the presidential address to Section I (Physiology) of the British Association, Dundee.

Similar 'fitnesses' associated with other groups of muscles can be tested by various dynamometers. Martin introduced a new procedure into this type of test. Instead of measuring the strength of a subject's active pull on a dynamometer, he applied the pulling force to groups of muscles and recorded the force necessary to break down the subject's active resistance to the movement of the muscle-group under test. The summation of a series of selected groups of muscles thus gives an indication of the total muscular strength of that individual as well as of his determination to resist. It gives no measure of his skill or of his economy of movement. It may be asked: Is muscular strength plus determination an adequate measure of general fitness?

Limiting Factor of Efficiency. It is well known that the limiting factor, the factor which determines whether muscular strength can be exerted to its full extent, the factor which overrides the will to do, is vaso-cardiac efficiency. Goodall recognized this when he published his efficiency tests. If, after a measured amount of exercise, the pulse rate and blood pressure come back to normal in a specified time, depending on the severity of the exertion, then the subject of the test is fit.

With a healthy heart, cardiac efficiency ultimately depends on the venous filling. A pump without a well may be a thing of beauty, the last word in mechanical efficiency, but its usefulness is non-existent. About 85 per cent of the total volume of the blood is in the capillaries and veins under normal conditions. Under these conditions, all capillaries are not patent at any one time. The splanchnic viscera, and particularly the liver and the spleen with their rich venous supply, are capable of retaining much larger quantities of blood than they do. If, for any reason, more capillaries open up at the same time and the splanchnic reservoir becomes filled with blood, the amount freely circulating, the amount necessary to fill the receiving chambers of the heart, becomes inadequate. The controlling factor in the distribution of blood, in maintaining an effective circulation, lies mainly in the tone of muscle—cardiac, visceral and, last but by no means least, ordinary skeletal muscle.

The venous return is also aided by the rhythmic alterations of intra-thoracic pressure with the phases of the respiratory act. It is, however, only in abdominal breathing that the respiratory act aids the return of blood to the heart. These alternating pushes and pulls, produced by muscular action dependent on the tone of the diaphragm and muscles of the abdominal wall, have a minor effect on venous return in comparison with the constant tonic push of muscle in general. During exercise, more capillaries in muscle become patent and, if muscle is in good tone, more blood is put under tissue pressure. On the other hand, if tone is at a low level, blood filling the capillaries is not pressed out, congestion appears and the heart fails through lack of blood. The fit person whose heart is able so to increase its output per unit of time that adequate blood is supplied to active tissues to meet their increased needs, must have a higher value of muscle tone than the unfit. Experiment shows that healthy young men have a tone in their relaxed left biceps muscle which is capable of withstanding a pressure of 60–90 mm. of water, while patients in bed have an intra-muscular pressure of about 50 mm. of water.

Intra-muscular pressure is markedly increased when muscle contracts, so that, as the fibres in muscle shorten intermittently during exercise, the blood is expelled from the venules in the muscles intermittently. This pulsation plays an important part in maintaining the tone of the vessel walls. The hæmostasis produced by immobile standing, shown by swelling of the legs in unfit persons, may be prevented by almost imperceptible voluntary twitches of the calf muscles or even by movements of the toes. Standing rigidly at attention is a severe test of the efficiency of the mechanisms responsible for the venous return to the heart.

Muscular tone is dependent on many factors—adequate blood supply, absence of excess of fatty upholstery, a regular arrival of motor impulses to the muscle controlled from higher centres and a cooling mechanism nicely co-ordinated to the needs of the moment. It is easy to demonstrate that faulty heat loss lowers tone. The avenue by which heat is lost is apparently unimportant, but, unless under the artificial conditions of the laboratory, where even loss by radiation can be made the effective sole method of losing heat, the evaporation of moisture from the skin is the usual limiting factor. Several investigators have shown that the phenomenon known as 'second-wind', by which a runner experiences a sudden relief from the agony of breathlessness and the leaden drag of weary muscles, is accompanied by sweating. When this occurs, alveolar carbon dioxide falls, the urgency of breathlessness fades, the head clears and the muscles act with renewed vigour.

Measures of Fitness. Three means of measuring fitness are thus indicated, and they are interrelated: (*a*) Tests of recuperative efficiency. The ability of the cardio-respiratory mechanism to return to normal functioning within a limited time after exertion. (*b*) The ease of heat loss under specified conditions. (*c*) The value of muscle tone.

(*a*) Tests such as Goodall's, Crampton's, Foster's, McCurdy's and Schneider's, which depend on arbitrary scoring for rise of pulse rate, blood-pressure and respiration rate after exercise, and scoring for the length of time for a return to pre-exercise levels, have a very low coefficient of reliability. Schneider's is the best, with $r = 0{\cdot}4$. McCloy prefers to measure alterations in diastolic pressure and pulse rate on standing erect after lying supine. For this r was between 0·8 and 0·9 in a limited study of healthy and convalescent golfers.

Turner's test, which depends on the cardio-vascular reactions during standing absolutely still for 15 minutes, has a coefficient of reliability of above 0·9 for adults but yields anomalous results with boys. In Schneider and Crampton's studies of pre-adolescent boys, the boy proved least fit by all other tests was the sole survivor at the end of 15 minutes' standing (with a pulse pressure of 8 mm. mercury !). The others had either given in or had fainted.

The rate at which the oxygen debt is repaid may be used as an index of physical solvency. The fit subject either pays cash to close the transaction or demands short credit. The percentage of the total debt liquidated during 3 minutes after the cessation of exercise is, in the case of the unfit, about 30, while the same subject, in condition, may have discharged more than 60 per cent of his debt. The drawback to the employment of tests of recuperative power is the possibility of overstraining the vaso-cardiac mechanism in the unsound.

(*b*) No large series of experiments has yet been planned to gauge the reliability of this test of efficiency.

(*c*) The value of muscle tone may be determined in various ways. Coffey, Barnum and Henderson used the knee-jerk as an index of tonus. Even when absolutely uniform strokes of the hammer are applied to the patellar tendon of a co-operating subject, variable degrees of the extent of kick are obtained with successive stimuli. It is a useful method to demonstrate the gross alterations for which these workers used it, but, principally because it requires a trained subject for accurate results, it is not of general utility. The direct reading of intra-muscular pressure is awkward and somewhat unpleasant for the subject. Several attempts have been made to link creatinine excretion with muscle tone.

Noël Paton, in his presidential address to Section I at Bournemouth in 1919, put forward the suggestion that the maintenance of muscle tone (and hence of physical fitness) depended in part on the presence in tissue-fluid of small quantities of guanidine or its methyl derivative. He showed unequivocally that muscle, either of warm- or cold-blooded animals, increased in tone when minute amounts of the salts of this base were administered. Since then much work has been done to elucidate this problem. Sullivan was able to estimate the urinary guanidines in cases of progressive muscular dystrophy before and during treatment. As the cases improved, under glycortal medication, simple guanidines disappeared from the urine. More recently, Minot has successfully treated patients suffering from this disease by oral administration of guanidine hydrochloride; and Dewar, working in my laboratory, has confirmed this (using the tasteless carbonate). Unfortunately, exhaustive search has failed to find a reliable method for the estimation of urinary or blood guanidine, and so, as a test of tone, the determination of the simple guanidines is, at present, unavailable.

The sympathetic control of muscle tone has been the subject of many investigations and much controversy. There is a wealth of indisputable evidence that the anatomical sympathetic system plays, at best, a minor part in the direct maintenance of muscle tone, and no one now holds the views of Hunter or of Royle. On the other hand, the work of the Orbeli school, amply confirmed by later experimenters from other laboratories, points to the influence of adrenergic nerves on the neuromuscular mechanism. This influence is shown more clearly when the action of the vasoconstrictor fibres is removed by poisoning with ergotoxine. This may be taken to mean that the main function of the sympathetic in the maintenance of muscular tone lies in ensuring effective vasodilatation of the muscle capillaries brought about through the so-called 'nutrition reflex'. The fit man, with good muscle tone, soon stops the drain on the blood supply to skin and viscera, while the unfit keeps the pallor of skin for some time and may even show signs of acute digestive upset. One may, therefore, test fitness by estimating the degree (amount × time) of the deprivation of the skin of moving blood.

The responsiveness of the sympathetic arm of the reflex arc depends on the functioning of the cortices of the suprarenal glands. This pair of ductless glands with a long ancestral history is absolutely necessary for life and is affected by any undue strain on the reserves of strength. The will to endure, to keep going on, is mental, but the power to force an unwilling body to obey the order of the mind, to exert its last ounce and not die in the last ditch, depends, in the end, on the adequacy of the secretory mechanism of the cortices suprarenales. Animals with grafts of cortical tissues and no medullæ act as normals. Injection of cortical extract to completely adrenalectomized rats restores voluntary activity to an extent depending on the amount of cortin given. Hypertrophy of cortical tissues follows exercise in the rat. "Possibly", says Dill, "one of the effects of training is to increase the secretory activity of the adrenal cortex."

The sequelæ of severe muscular exercise under conditions where cooling is inadequate differ only in degree from those of cortical insufficiency, that is, loss of muscle tone, increase of blood potassium and lowering of blood sodium both absolutely and relatively. The loss of tone may be due to imbalance between the metallic ions as well as to exhaustion of cortical supplies, as it may be mirrored in normal subjects by administration of salts of potassium.

PSYCHOLOGICAL TESTS

The fit man carries on his work and his play without an unpleasant degree of fatigue, and so his industrial output may be taken as a measure of his fitness. The amount of work done or the goodness of the work done depends not only on the physical state of the worker but also on the state of his mind. It is well known that work which is in itself pleasant or leads to pleasure as a more or less remote result is carried out with an efficiency lacking in more formal performances or in forced work. L. Hill, Gillespie and many others have shown that the initial cardiac acceleration followed by peripheral and splanchnic vasoconstriction leading to an increased venous return to the heart with consequent cardiac retardation and increased output is mainly psychical in origin. If the work is uninteresting or the movements passive, these preparatory circulatory changes do not take place and the organism as a whole is thus less fitted to do work. Investigations involving treadmills, stationary running, bicycle ergometers, etc., may thus fail to reveal accurately the efficiency of a subject because of the more or less complete lack of interest of the work once the novelty has worn off. The performance becomes a routine and the efficiency consistent but low. On the cessation of the mental effort, the tone of muscle falls, the peripheral and visceral vasoconstriction passes off and output falls. One of the conclusions, drawn from the results of many exhaustive investigations made in the United States and in Great Britain, is that good sociological conditions are of paramount importance if good work is to be expected. Even apparently trivial improvements in amenities lead to increased output. For example, the average output of relays per hour in the Western Electric factory at Chicago of 55·7 when lunch was provided by the management, rose to 66·4 when the employees supplied their own lunch. This rate was maintained over two periods of 31 weeks (of the observation period) and was a record (Whitehead quoted by Dill). Hitler realized this principle, in theory at least, when he instituted his 'Strength through Joy' movement.

Value of 'Stunt' Tests. Cathcart places great value on the ability to react rapidly and accurately to changes in the environment. Efficiency in this can be tested by presenting the subject with exercises which demand new co-ordinations as well as motor activity with a performance both easy and graceful. This type of test, as outlined by Brace, McCloy and others, has a coefficient of validity of more than 0·8.

EXERCISE AND FITNESS

What, then, can be said of the effect of exercise in maintaining fitness? The Committee of the Health Section of the League of Nations is rather despondent on this matter. It says, "Up to the present, methods and systems of physical education have not produced any clearly demonstrable effect on the health of the masses, doubtless because the present state of our knowledge is not as yet sufficient to enable us to base them on accurate scientific data" (1938).

Properly designed exercises, carefully controlled, can be used to correct faults of carriage, to eliminate uneconomic muscular actions and fit the mildly dysplastic to take their place without shame among the euplastic. The danger of such exercise lies in any attempt to create an 'ideal' posture, etc., which has no physiological foundation.

Exercise carried on without strain or undue fatigue keeps the body in tone; and some exercise is considered beneficial to those engaged in sedentary occupations especially, as it increases the venous return to the heart and prevents stagnation in the blood reservoirs and lower limbs. The group of experts of the Commission on Physical Training were therefore enjoined "to determine the minimum amount of physical training required to ensure the normal health of the individual".

Exercise designed to 'build muscles' beyond the needs of that particular person merely leads to increased food intake, and when, because of age or lack of opportunity, the amount of exercise is decreased, fibrous and fatty degeneration and infiltration takes place. While it may be 'better to have lov'd and lost', it is certainly not better to have exercised and stopped.

Probably the main beneficial result of keep-fit classes and similar movements is the inculcation of a spirit of independence, personal confidence and pleasure in performance. Although "the healthy body works in silence" (Carrel), the fit person has a keen sense of the enjoyment to be obtained from suitable exercise. The physiological foundation of the exhilaration resulting from exercise—an exhilaration not entirely due to a decreasing handicap at golf or competitive improvement at other games—would be a suitable and profitable study for ambitious politicians and others.

While it is true that one cannot assess a man's efficiency until his whole life's story has been unrolled (and then it is too late to do anything about it), one should be able to establish norms related to age and sex. The recent Military Service Act provides an occasion for the audit of the nation's young manhood, and, provided suitable tests are applied by properly trained examiners, a beginning will have been made to the collection of facts and figures from which much may be learned.

There is no doubt as to the improvement in mental and physical fitness that results from wise physical training, co-operative effort and good feeding such as that obtained in military camps of the best type. Such training may go far towards reconditioning some of the youth of Great Britain. The American Department of Labour, in a report (1935) on two years' experience of civilian conservation camps, says, "Thousands of actual case records reflect the fact that the C.C.C. men have returned to their homes definitely benefited physically and mentally; their outlook toward the future is brighter, their sense of self-reliance and their ability to adjust themselves to economic conditions is stronger." To this tribute to wise and varied physical, mental and moral education one may add the results of a short experiment in effectively reconditioning a selected number of rejected recruits for the British Army: "My predecessor started a depot for training a limited number of men who were below standard and, as a result, . . . 576 of the 600 . . . have reached the full standard of fitness" (Right Hon. L. Hore-Belisha, Devonport, 1937).

While not in any way detracting from the importance of work of this type on men during late adolescence and early maturity, one may ask why the audit is not made earlier in the course of our national business of turning out citizens—taken early before the debit balance of wasted lives becomes so large that strenuous measures have to be taken to safeguard our interests. No factory the products of which were good, bad and indifferent would exist long before the shareholders were demanding an inquiry and a change of directorship. Our national strength lies in our men and women and not in the machines that they tend or the battleships that they man. To be really great a State must have citizens fit in body and also in mind. "The health of the intelligence and of the affective sense, moral discipline and spiritual development are just as necessary as the health of the body and the prevention of infectious diseases" (Carrel).

To ensure this would cost money, but so does radium. The chief use of this rare element is to prolong the life of the aged; should we not be equally ready to foot a bill which would make young lives more fit to bear hopefully and without undue strain the heavy burden their ancestry has laid on them ?

OBITUARIES

Mr. H. P. Hollis

ASTRONOMICAL circles will miss the familiar figure of H. P. Hollis, who died on August 7 at the age of eighty-one years. Hollis was born on January 9, 1858, and was educated at Westminster, from which he went to Jesus College, Cambridge. He took his degree in 1880 and in the following year was appointed to the post of assistant at the Royal Observatory, Greenwich, where he remained for forty years, retiring in 1920. His work at first was connected with the regular astronomical observations with the transit and altazimuth instruments; but later he took part in the measurement and reduction of solar photographs. Among his various other activities must be mentioned his work in the determination of the difference of longitude between Greenwich and Paris. The reductions of the observations made in 1892 and also in 1901 were carried out under his directions. In 1896 he was promoted to a higher grade and took charge of the work of the Astrographic Chart and Catalogue. A record of his twenty-four years in this department is found in the two volumes which give the positions of the stars as measured on the photographs and also the photographic reproduction of the chart plates, as well as in the two other volumes supplementing these results.

Outside his professional duties at the Royal Observatory, Hollis took a keen interest in astronomy and was always pleased to assist the amateur in his difficulties. For some years he contributed very useful information to the tyro by his letters to the *English Mechanic*. He was an original member of the British Astronomical Association founded in 1890, and was president during 1908–9. In addition to serving on the Council at various times, he represented the Association on the Geophysical Committee of the Royal Astronomical Society, and contributed a number of valuable papers to the *Journal* of the Association.

In 1884 Hollis was elected a fellow of the Royal Astronomical Society, and served on the Council from 1909 until 1911. A number of papers appeared under his name in the *Monthly Notices* and the *Memoirs*; the last of these was in the *Monthly Notices* 79, 36 (1918), in which he discussed the magnitudes of Nova Aquilæ, deduced from the photographs which had been taken at the Royal Observatory, Greenwich. He edited the *Observatory* magazine from 1893 until 1912, and for many years was astronomical correspondent to *The Times*, to which he contributed the well-known article, "Stars of the Month". In 1910 his work, "Chats on Astronomy", was published. This was written in a popular style and was specially useful to beginners interested in astronomy.

Hollis maintained his interest in astronomy to the end, in spite of his physical disability. He seldom missed any astronomical meetings, and his mental faculties seemed unimpaired.

In 1882 he married Clara Susanna Clark, who predeceased him in 1932. Two sons and a daughter survive him.

Prof. L. Lévy-Bruhl

We regret to record the death of Prof. L. Lévy-Bruhl, the distinguished French philosopher and ethnologist, which took place in Paris on March 12 last at the age of eighty-one years.

Lucien Lévy-Bruhl was born on April 10, 1857. For long he had held a foremost place in the development in France of philosophical and sociological studies. He was appointed professor of philosophy in the Sorbonne in 1899 and occupied that chair until 1927, when on his retirement he was appointed honorary professor. He was elected a member of the Academy in 1917. He edited the *Revue philosophique* for many years. During 1927–30 he was president of the Institut française d'Anthropologie, of which he was one of the founders and a constant and enthusiastic attendant at its meetings so far as the calls of a busy life allowed. He had travelled widely, and had made the voyage round the world. He delivered courses of lectures in the universities of many countries outside France, including Egypt and both North and South America.

Although Prof. Lévy-Bruhl was the author of a number of profound works on philosophical topics, he was best known to a wide public in both France and England for his studies of primitive and 'savage' mentality, several of which appeared in English translation, while in France they served to introduce the psychological aspects of social anthropology to a wider circle than is usually attracted by scientific studies. In this field his principal or best known works are "Fonctions mentales dans les Sociétés inférieures" (1910), "Mentalité primitive" (1922), and "Surnaturel et la Nature" (1930). In these and others of a kindred character he developed his theories of primitive mentality as belonging to a mystic and prelogical stage of thought in a graceful and lucid style and with the support of a full documentation of facts.

Mr. Clifford Chaffer, O.B.E.

MR. CLIFFORD CHAFFER, superintendent of the Admiralty Research Laboratory, died suddenly on June 26 at his home at Weybridge, Surrey, at the early age of fifty-four years.

Mr. Chaffer was born on October 25, 1884, at Morley, Yorkshire, and, after going to the Wheelwright Grammar School, Dewsbury, became a scholar of Peterhouse, Cambridge, where he remained from 1903 until 1907. He was 18th wrangler in 1906 and took the National Science Tripos in 1907. On leaving the University he held mathematical masterships for a number of years.

In 1916 Mr. Chaffer was appointed a temporary Instructor Lieutenant in the Royal Navy, and after service at sea he was posted to the Admiralty Compass Department. On demobilization in 1920 he accepted an appointment on the civil staff of the Compass Department where he continued to serve until 1936 when he was transferred to the headquarters staff of the Department of Scientific Research and Experiment at the Admiralty.

He was appointed to the Admiralty Research Laboratory as superintendent in 1937 and in this position his clear judgment, power of recognizing the essential features of the problems with which he was called upon to deal, and his ability to inspire the staffs with his personal keenness and single-minded devotion to duty were of the greatest value in a time of unusual stress.

Baron Joji Sakurai

DR. MARIE STOPES writes: "All that Prof. Donnan says in the first paragraph (NATURE, Aug. 5, p. 234) of his obituary notice of Japan's greatest scientist I should like to endorse from personal experience while an honorary member of the professor's common room in the Imperial University, Tokyo. However, no obituary would be complete without mention of his spiritual and literary sensibilities. These were partly revealed by his interest and proficiency in the profound medieval religious plays 'The Nō' which he and I translated together into English and published under the title 'Plays of Old Japan'. The then Japanese Ambassador, Baron Kato, wrote that they 'placed Western students of Japanese art and literature under a debt of gratitude'. Prof. Sakurai, who was a most faithful friend, was in Great Britain for the Coronation of King George VI, and I had the privilege of viewing it with him. He was one of the few scientists who made one revere him".

We regret to announce the death of Prof. E. Westermarck, formerly professor of sociology in the University of London, aged seventy-seven years.

NEWS AND VIEWS

Sir Richard Gregory and the British Association

SIR RICHARD GREGORY, who has been elected president for the coming year of the British Association, has been connected intimately with its activities for the past forty-three years. Both on the Council and upon sectional committees, his wide knowledge of men and their achievements, his tact and his infinite capacity for work have made his services of special value to the welfare of the Association and the progress of science. At the creation of Section L (Educational Science) in 1901, Sir Richard was one of the secretaries, and he has remained in the closest touch with the Section since that date, serving as president in 1922. No one has done more to keep the Section alive to the more pressing problems of education, and he brought to it the men and women most competent to advise on the special topics of the year's programme. He has also taken a vital part in the work of the committees of sections appointed to inquire into special problems. These committees often comprise a long list of distinguished names, but experience shows that the real work of gathering information and drafting the report falls upon comparatively few. Sir Richard was invariably one of these few. In the past thirty-eight years, he has served upon more than twenty such committees either as chairman, secretary or ordinary member, and it must be remembered that these committees run for several years and report annually.

DURING the early years, Section L was much concerned with the place of a training in scientific method in the curricula of schools of all grades, and devoted itself mainly to scholastic problems. During this period, Sir Richard's services were invaluable. Among the more important reports for which he was in large measure responsible were those on practical and scientific studies and the position of science in the school certificate examination, with which was associated a report upon the influence of examinations on curricula and teaching methods. The first of all these reports, on the teaching of elementary mathematics, has affected profoundly the methods of mathematical teaching in schools of all grades. In later years Section L has been more concerned with the social, industrial and cultural relations of science in school education, and here again Sir Richard's wide knowledge of movements and their leaders has enabled the Section to bring to its assistance those most able and willing to help. He himself gave much time to the reports upon the mental and physical factors in education, to the many aspects of adult education, the effects of the free-place system in secondary schools and to training for overseas life. At the Nottingham meeting Sir Richard induced Mr. H. G. Wells to give his stimulating and provocative address on the informative content of education, which gave rise to a valuable report. Sir Richard was also chairman of the Conference of Delegates of Corresponding Societies in 1921.

No mention has been made thus far of Sir Richard Gregory's connexion during the past forty-five years with NATURE, from the editorial chair of which he retired at the end of last year. But it will be easily recognized that much of his work for Section L was intimately bound up with his wider interests. His zeal for the promotion of scientific research, its popularization and its application to everyday life was well shown when he offered a platform in NATURE early last year for the expression of opinions on the desirability of providing for more direct contact between men of science and public affairs, a movement which came to fruition in the establishment at the Cambridge meeting of the British Association of the new Division for the Social and International Relations of Science, with Sir Richard as its first chairman. During the many years when Sir Richard directed the policy of NATURE, he demonstrated time and again his belief in the mission of science as an instrument for the promotion of social, intellectual and industrial progress, and his election as president of the British Association sets a seal of approval on the action of the Association in forming the new Division. The Association may be assured that its objects, as set forth by its founders, and in particular, two of them, namely, "to obtain a greater degree of national attention to the objects of science, and a removal of those disadvantages which impede its progress", are safe in the hands of its new president.

Recruiting Men with Technical Qualifications

THE Ministry of Labour announces that technical committees associated with University Recruiting Boards have been set up to deal with offers of service from men less than twenty-five years of age with qualifications in engineering, chemistry, metallurgy, physics, the biological sciences and mathematics, in order that they may be allocated to an appropriate form of national service. The committees will sit in all cities with universities or university colleges in Great Britain and Northern Ireland, and applications, which should be made in the first instance to a local office of the Ministry of Labour, will be referred to the technical committees and the University Recruiting Boards. This offer is open to men who are starting on their final year of a degree course, or already hold a university degree in any of the following subjects: engineering, chemistry, metallurgy, physics, the biological sciences (including agriculture) and mathematics (including statistics); and to men who are starting on their final year of study or already hold a Higher National Diploma or Higher National Certificate in mechanical or electrical engineering, or the associateship of the Institute of Chemistry.

War Agricultural Committee

THE Minister of Agriculture and Fisheries has appointed a War Agricultural Executive Committee for each county in England and Wales and has made an Order (The Cultivation of Lands Order, 1939) authorizing these committees to exercise on his behalf certain powers conferred on him by the Defence Regulations for the purpose of increasing home food production in time of war. In a Circular Letter to the committees, the Minister states that they will be given as free a hand as possible to proceed as a matter of urgency with all possible steps to increase the production of foodstuffs in their areas. Their immediate task is to see that additional land is brought under the plough with all speed. The aim is to obtain for next year's harvest an increase of about 1½ million acres in the tillage area in England and Wales compared with the acreage in June last. Each county has been allotted its share of this total, and the committees have been urged to see that every effort is made to complete their allotted tasks—and, if possible, to exceed them. The committees have already been holding informal meetings and have made good progress with their preparatory work.

Roman Temple at Albury, Surrey

ROMANO-BRITISH studies are greatly indebted to the Surrey Archæological Society for the work of excavation and conservation which has been carried out on the site of the Roman temple on Farley Heath, Albury, Surrey, by A. W. G. Lowther and R. G. Goodchild on behalf of the Society. The complete plan of the building has now been traced, and marked out by stones from the original structure, bedded in concrete. The site has been known for a long time. It attracted the attention of Elias Ashmole; and in 1670 and 1847 it was despoiled of much of its stone. Little, however, was known of its structure or its relation to surrounding buildings, if any. Recent excavation has shown, it is reported in *The Times* of August 18, that the temple consisted of a simple cella, or shrine, measuring 18 ft. internally, and surrounded by a corridor, or veranda, 8 ft. wide. It has been too much damaged for any details of the architecture to be known, but red tesserae and red wall plaster hint at the character of the internal decoration. It stood within a polygonal wall, approximately 240 ft. in diameter, which probably was intended to demarcate the sacred enclosure. An inner enclosing wall has been found on the north side. Few smaller antiquities have been found in the recent excavations, the most important being a fragment of a terra-cotta "votive lantern", similar to those found at Ashstead, Surrey, and Verulamium. The ground had been too thoroughly turned over by previous diggers to make it probable that many of the smaller class of objects would be found. Further, the excavations of 1848 had provided a rich spoil—more than 1,000 coins, mostly Roman, but including some rare British in gold and silver, and numerous enamelled brooches, while a thin strip of bronze, crudely embossed with human and animal figures, has since been identified as a pagan priest's ritual sceptre. The foundations of the temple were of local ironstone and chalk from the North Downs, but the superstructure was of Bargate sandstone. Wealden clay had been used for the tiles, baked, in all probability, in the tile-kiln discovered in 1936 in Wykehurst Farm, Cranleigh, four miles away.

Archæological Explorations in the United States

A DETERMINATION to limit public expenditure and opposition to the President in the United States of America have recently eliminated most of the intellectual activities which had been subsidized out of Federal funds in the desire to stimulate prosperity by State aid. Archæological investigations in the field, however, so long as they worked within the States, have survived attack owing to the fact that they provide occupation for a considerable number of the unemployed. This consideration does not affect expeditions working abroad and in the Old World, and these have had to be curtailed on the ground of economy. Nearly one hundred archæological expeditions, it is reported by Science Service of Washington, D.C., have taken the field in the course of the present summer; and of these, thirty-two in twenty-two States are financed as part of the W.P.A. programme, the Government supplying the labour—2,500 men and women in all—for excavation work under the direction of representatives of museums, universities and scientific institutions sponsoring the respective expeditions. Two investigations in particular have been made possible by the advantageous conditions. Of these, one is a combined effort on the part of the Universities of Montana, Wyoming, and other of the south-western States to find evidence of the line of advance of the earliest immigrants into America through the Siberia-Alaska gateway towards the south-west. The other will make a rapid and intensive examination of the mounds and other relics of early occupation in the vast region in the States of Tennessee, Alabama and Texas, which is marked for inundation when the dams of the Tennessee Scheme of water supply are built. It is hoped that it may be possible to trace the relation of the cultures of the Mississippi Valley to those of the south before it is too late, and the evidence disappears for ever.

Excavations at Caerleon

FURTHER excavations on the site of the Roman fortress of Caerleon-on-Usk have been necessitated by building development on two acres at the north-east angle. Evidence for the defences here, it is reported by Lady Fox, who directed the excavation on behalf of the Caerleon Excavation Committee (*The Times*, Aug. 5), comprised the primary clay bank and ditch of the occupation by the Second Augustan Legion in A.D. 75, and the foundations of the stone walls and one of the internal turrets set up about A.D. 100, when the internal early timber buildings were reconstructed in stone. The construction of the rampart roadway, which provided access throughout the circuit of the fortress behind the ramparts, was examined. A block of barracks, set in pairs, back to back, and providing accommodation for soldiers, with more spacious quarters for the centurions, was found to be in plan similar to those excavated in the south-west corner of the fortress in 1926–9. A coin of Nerva confirmed the date of their erection. Occupation by the Second Legion on this occasion appears to have been short; but in the third century the barracks were thoroughly renovated at a date indicated by the stamp "Leg. II Aug. Anto." as A.D. 212–222. Relics of the latest occupation, not necessarily of a military character, were found in the centurions' quarters, where a tile hearth had been built over a destroyed partition wall, and the moulded base of a column, upside down and partly sunk in the floor, appears to have served as a gaming-table, as several counters were found around it. The associated layers contained fourth century coins and pottery of a late type. In all, 70 coins were found and 90 legionary stamped tiles. Pottery was not abundant, but the most interesting find was a hoard of five gold coins, ranging from two of Nero, A.D. 55 and 61 to Titus and Domitian, A.D. 74 and 73, which was found concealed in a barrack floor, and possibly represents the savings of a soldier, which was left behind when the legion was ordered north.

Health Activities of the Rockefeller Foundation

THE annual report for 1937 of the International Health Division of the Rockefeller Foundation, recently published, gives an account of the projects carried out under the auspices of the Health Division by members of its staff. Virus agents of yellow fever, influenza and other diseases, and certain proteins, including visual purple, have been studied by the use of an analytical ultracentrifuge. By means of a cultured yellow fever virus, a vaccine has been produced with which some 60,000 persons have been inoculated, mostly in Brazil, the results of which show that a practicable safe method of large-scale immunization against yellow fever is now available. Studies on the epidemiology of the jungle form of yellow fever have also been pursued. Tuberculosis, particularly in Jamaica, hookworm disease in Egypt and the United States, and malaria and its mosquito vectors in various countries, are other subjects that have been investigated. In addition to research work, the Foundation renders financial aid to State and local health services and to health education in all parts of the world. The report, which is very readable, includes several plates illustrating the work carried out.

The International Seismological Summary

THE International Seismological Summary for July, August and September 1933 has just come to hand, containing details of the calculations of the initial times and epicentres of 169 earthquakes. Sixty-eight of these epicentres are new and 101 are repetitions from old epicentres, showing the tendency of earthquakes to recur from the same epicentre. Included in the 169 earthquake shocks are 15 which had a focal depth below normal, the deepest being that of August 29, 1933, with epicentre 11·0° S., 69·5° W. (in Bolivia near its junction with Peru and Brazil) and focus 0·085 of the earth's radius below normal. Twelve of these deep focus shocks had their epicentres between 45·4° N., and 20·5° S. latitude, and between 131·5° E. and 170·0° E. longitude, thus showing the deep-seated instability of this region of the earth which has Japan in its north-west corner.

Milk for Mothers and Children

A SCHEME was prepared a short time ago by the Milk Marketing Board and approved by the Minister of Agriculture and Fisheries for the supply of cheap milk to local authorities, and was outlined in a circular issued by the Ministry of Health (Circular 1840. H.M. Stationery Office. *3d.* net). The aim of the scheme is to enable expectant and nursing mothers and children under five, who cannot afford the full retail price for the milk they need, to obtain a pint of milk per head per day either free or for not more than twopence according to family circumstances. Those wishing to receive milk under the scheme will have first to apply to the local authority and they will then be told whether they are eligible to receive the supply. When authorized, they will ask an approved dairyman to deliver at their home the milk to which they are entitled.

Announcements

THE remainder of the meetings of the British Association which began in Dundee on August 30 were cancelled on September 1. Most of the members present left Dundee on that day.

THE French Academy of Medicine has awarded the Grand Prix Prince Albert I de Monaco to Jules Lefèvre, for his work on biology during the last fifty years.

ON the occasion of the jubilee of the Paris Pasteur Institute the scientific and executive committees of the Institute have awarded the gold Pasteur Medal to Dr. H. Plotz, of New York, and Prof. A. Saenz, of Montevideo, for their contributions to science.

IT is announced in *Aesculape* of May that three new chairs for the history of medicine have been founded in Italy, namely, at Florence, Turin and Sienna, while corresponding chairs in Rumania have been abolished.

DR. W. JUNK writes from The Hague to point out a mistake in Dr. W. T. Calman's review of the British Museum reprint of Linnæus's "Systema Naturae" (NATURE, August 12, p. 269). The tenth edition was not, as there stated, the last published during Linnæus's lifetime. The twelfth edition began publication in 1766, twelve years before the death of the author.

ALL the poisonous snakes and insects in the Zoological Gardens of the Zoological Society of London have recently been destroyed. Several of the more valuable animals have been sent to Whipsnade. The Zoo is again open to the public.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 486.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Forces Associated with Heat Flow in Helium II

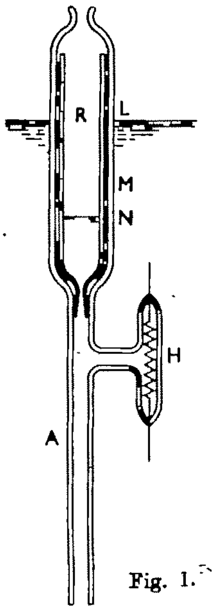


Fig. 1.

IT was discovered some time ago[1] that when heat flowed in helium II down a narrow capillary or through a tube filled with powder, liquid was forced up the tube in the opposite direction. It was considered at the time that the phenomenon, which has been called the 'fountain effect', was associated in some way with the surface of the capillary or of the powder particles. Recent experiments by Daunt and Mendelssohn[2], who have proved the thermodynamic reversibility of the effect, have tended to confirm the idea that it is a surface phenomenon. The thermodynamic aspects of the effect have been treated in a recent paper by H. London[3].

It has now been observed that when heat flows downwards through capillaries of the order of 1 mm. in diameter, the liquid no longer rises above the bath-level, as it does in the fountain effect, but sinks below it. The depression in level has been interpreted as being due to a force which acts on the liquid in the centre of the capillary and which carries the liquid along in the direction of the heat flow. Thus the force associated with the flow of heat in helium II has two components, one a surface effect in which the liquid is forced against the direction of the heat flow, and the other a volume effect in which the liquid in the centre of the channel is forced in the direction of the heat flow. The two effects were observed simultaneously in the apparatus shown in Fig. 1. The reservoir *R* contained a co-axial tube which was drawn to a fine funnel at the bottom so that it fitted into a 1·45 mm. diameter capillary. The funnel opening was about 1 mm. in diameter, which left an annulus of roughly 0·2 mm. width between the mouth of the funnel and the capillary wall. Heat was supplied electrically in the coil *H*, and flowed down the capillary *A* to the bath. The annular reservoir was thus arranged to collect the surface component of the force, the 'fountain effect', whilst the inside reservoir indicated the volume effect, that is, the liquid which is forced down the centre of the capillary. When heat was flowing down the capillary, which was 15 cm. long, the bath-level

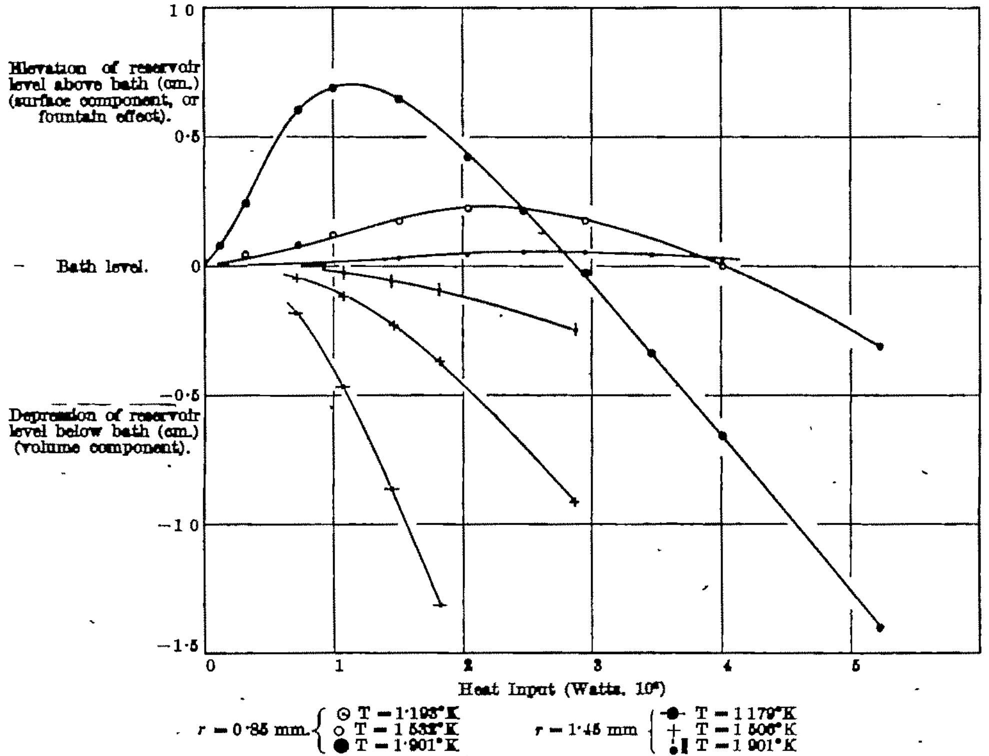


Fig. 2.

and the annular and inner reservoir levels assumed the relative positions L, M and N.

Fig. 2 shows the difference in level between the bath and the inner reservoir at different temperatures as a function of the heat input for two capillary diameters. The figure shows that in a capillary of 1·45 mm. diameter the surface effect is completely swamped by the volume effect, whilst in a capillary of 0·85 mm. diameter inversions take place. In the latter case the surface effect predominates for small heat flow whilst the volume effect predominates for large heat flow. The surface and volume components, therefore, do not appear to be symmetrical with respect to the bath level when considered as a function of temperature. In consequence, one does not find an intermediate capillary diameter which shows no net effect at all temperatures in helium II.

Although previous measurements made on a powder-filled tube indicate that the surface component is approximately a linear function of the heat flow, the nature of the present curves suggests that the surface component becomes saturated at high heat inputs. This would allow the volume component to predominate in a capillary where the total amount of surface is small. Further evidence of the saturation of the surface component was obtained from measurements on a powder-filled tube from which all but a few mm.[4] of the powder had been removed. Since both surface and volume components increase in magnitude for given heat input down to the lowest temperatures available, it would be interesting to find out the behaviour of the effects at still lower temperatures.

If both the surface components, as determined from previous measurements, and the present results (largely volume component) are plotted for constant heat input and as a function of the temperature, it is found that they both tend to constant values and not to zero as the temperature approaches the λ-point. The surface effect, however, when plotted as a function of temperature difference, does approach zero at the λ-point[4]. Incomplete measurements on the volume effect indicate that it also behaves in the same way.

The experiments described above help to confirm the ideas previously advanced[1,2] with regard to the fountain effect, namely, that it is associated with the surface of the channel. Although the surface component can be understood from F. London's[5] hypothesis of helium II, based on consideration of Bose-Einstein condensation phenomena, the volume effect presents a further complexity. Much more research will be necessary before a clear theoretical picture of helium II can be produced.

J. F. ALLEN.
J. REEKIE.

Royal Society Mond Laboratory,
Cambridge. July 24.

---

[1] Allen, J. F., and Jones, H., NATURE, 141, 243 (1938).

[2] Daunt, J. G., and Mendelssohn, K., NATURE, 143, 719 (1939).

[3] London, H., *Proc. Roy. Soc.*, A, 171, 484 (1939).

[4] Allen, J. F., and Reekie, J., *Proc. Camb. Phil. Soc.*, 35, 114 (1939).

[5] London, F., *Amer. J. Phys. Chem.*, 43, 49 (1939).

The Electric Quadrupole Moment of the Deuteron and the Field Theory of Nuclear Forces

THE discovery by Rabi and his collaborators[1] that the deuteron in its ground state possesses an electric quadrupole moment is of considerable theoretical importance, since it clearly shows that the forces acting between a proton and a neutron must to a quite appreciable extent depend on the spatial orientations of the spins of the heavy particles. It is well known that the vector meson theory of nuclear forces formally provides such a directional coupling, though of so strongly singular a type that it can only be given a definite meaning by taking recourse to some arbitrary cutting-off prescription. Now, Bethe[2] has recently examined the question how such a cutting-off should be performed, in a theory giving rise to charge-independent nuclear forces, in order to obtain the correct positions of the ground-level and the excited ^1S-level of the deuteron. He was led to the conclusion that, while the way in which the cutting-off is performed is of small influence on the results, the value to be assumed for the cutting-off radius depends critically on the combination of charged and neutral meson fields adopted: if one uses the symmetrical combination of meson fields suggested by Kemmer[3], the cutting-off radius should be chosen larger than the range of the nuclear forces, and a reasonable value of this radius can only be obtained if the meson field is assumed to be purely neutral. This last assumption amounts of course to giving up the remarkable connexions suggested by the symmetrical theory between the problem of nuclear forces and those of cosmic ray phenomena, beta decay and especially the magnetic moments of proton and neutron.

In view of this unsatisfactory feature of the vector meson theory, we should like to point out that the question of the quadrupole moment of the deuteron, as well as the whole problem of the consistency of the meson theory of nuclear forces in its present provisional form, takes a quite different aspect when, as already suggested in a recent note[4], pseudoscalar meson fields are introduced besides the vector fields in such a way as to cancel all strongly singular terms in the static interaction energy of the heavy particles. In such a theory, which necessarily involves the choice of Kemmer's symmetrical combination of charged and neutral fields to account for the charge-independence of the nuclear forces, no question of any cutting-off arises, provided of course the physical interpretation of the formalism is restricted in a way analogous to the so-called correspondence treatment of quantum electrodynamics. At first sight, however, it would seem as though the disappearance of the singular static interaction terms, which just contain the directional coupling of the vector meson theory, would leave no room for such an effect as the quadrupole moment of the deuteron. But it is most readily shown by the method of canonical transformation described in our previous note, that the interaction energy between the heavy particles involves, besides the static interactions hitherto discussed, further significant interaction terms, which represent a directional coupling of the character just required for the occurrence of a quadrupole moment in the ground state of the deuteron.

The non-static interaction terms just mentioned, which contain a factor of the order of magnitude of the ratio of the velocities of the heavy particles to the velocity of light, are also quadratic with respect to the fundamental constants determining the strength of the sources of the meson fields; in fact, if the constants referring to the four-vector and six-vector source densities of the vector meson fields, and to the pseudoscalar and pseudovector source densities of the pseudoscalar meson fields, are denoted by g_1, g_2, f_1, f_2 respectively, these interaction terms are proportional to the products g_1g_2 and f_1f_2. A straightforward calculation then shows that the resulting quadrupole moment of the deuteron contains the factor $g_1g_2 + f_1f_2$. The constants referring to the pseudoscalar meson fields are only restricted by the conditions that $|f_2| = |g_2|$ and that $|f_1|$ should not be very much larger than $|g_1|$ or $|g_2|$; the adjustment of the theory to the known energy spectrum of the deuteron fixes the order of magnitude, but not the signs, of g_1 and g_2. Thus, in contrast to the vector meson theory, in which the two cases studied by Bethe correspond to definite values of the quadrupole moment, of opposite signs and very different magnitudes, the theory discussed in the present note would be able to account for any sign and for a wide range of magnitudes of the effect in question. It does not seem possible at present to derive from the measurements an entirely reliable estimate of the effect, owing to the insufficient knowledge of the electronic wave-functions of the hydrogen molecule, which enter in such a derivation. Anyhow, the order of magnitude following from our theory, if we make, for example, the simplest assumption $f_1 = 0$, agrees reasonably well with the provisional empirical value given by Rabi and his collaborators.

A fuller account of the problems discussed in this note and in the previous one will appear in the *Proceedings of the Copenhagen Academy*.

C. MØLLER.
L. ROSENFELD.

Institut for teoretisk Fysik,
Copenhagen.
July 31

---

* This circumstance was pointed out to one of us in the course of valuable discussions on the subject with Prof. Rabi and Prof. Bethe.

[1] Kellogg, Rabi, Ramsey and Zacharias, *Phys. Rev.*, **55**, 318 (1939).

[2] Bethe, H., *Phys. Rev.*, **55**, 1130 (1939).

[3] Kemmer, N., *Proc. Camb. Phil. Soc.*, **34**, 354 (1938).

[4] Møller, C., and Rosenfeld, L., NATURE, **143**, 241 (1939)

Effect of Temperature on the Intensity of X-ray Reflections from Copper

IN a recent letter in NATURE[1], Prof. E. A. Owen and Mr. R. W. Williams have given results for the effect of temperature on the intensity of X-ray reflections from copper. They find that throughout the range of temperature from 290° to 840° A., the decline of intensity with temperature is greater than predicted by the usual Debye-Waller formula, $\exp. -2M$, where M has the well-known expression involving the characteristic temperature Θ which occurs in the Debye theory of specific heats, and that their results agree closely with a temperature factor of the form $\exp. -3M$.

The fact that deviations from the Debye-Waller formula occur at the higher temperatures is not surprising, but so large a deviation near room temperature would not be expected. An alternative explanation of the results would be that the value of Θ to be used in the expression for M is not identical with that given by specific heat data. Since M is approximately proportional to $1/\Theta^2$, it follows that instead of changing the numerical factor from 2 to 3, we may take

$$\Theta\ (\text{X-ray}) = \Theta\ (\text{sp. heat}) \times \sqrt{2/3} = 315° \times 0{\cdot}816 = 257°.$$

To test this result we have examined the intensities of reflections from copper at room temperature and liquid air temperature, using two methods to arrive at the temperature factor. (1) Using a mixture of copper and aluminium powders, we have measured the change in the copper intensities in terms of the aluminium intensities, the latter having previously been determined. (2) The second method is to use the relative intensities from the copper powder at the two temperatures and, with cubic metals, these data alone are sufficient to give the temperature factor. Method (1) is probably the more accurate but involves a second substance; method (2) is less accurate but eliminates any comparison substance.

Our results by the two methods are: (1) $\Theta =$ 310° Abs. (2) $\Theta = 297°$ Abs. The uncertainties in these figures are of the order of 4 per cent; that is, about ± 12°. Comparing these with the specific heat value, 315° Abs., we see that while there is a tendency for the X-ray value to be smaller than the specific heat value, there is no marked discrepancy.

Note added after writing the above letter. Prof. Owen and Mr. Williams have kindly informed us of their more recent work on gold, which has yielded results in close agreement with theory (see following letter). This result, considered in conjunction with our own measurements on copper at low temperatures, indicates that no abnormalities are to be expected for copper at higher temperatures, and we think that the suggestion which they make regarding the tarnishing of the copper is quite likely to prove correct.

G. W. BRINDLEY
(Mackinnon Student, Royal Society).
G. H. ATKINSON.

Physics Laboratories,
University of Leeds.

---

[1] Owen, E. A., and Williams, R. W., NATURE, **142**, 915 (1938).

Effect of Temperature on the Intensity of X-ray Reflections from Gold

IN a previous letter[1] we referred to some measurements that we carried out on the effect of temperature on the intensity of reflection of X-rays from copper, from which it was concluded that over the range of temperature from about 20° C. to 570° C., the intensity decreased with rise in temperature more nearly in accordance with the temperature factor $\exp.(-3M)$ instead of the factor $\exp.(-2M)$.

Looked at from another point of view, the characteristic temperature of copper, assuming the $\exp.(-2M)$ factor, works out to be 261° K., which is well removed from the accepted value of 315° K. The main difficulty with the measurements was to keep the surface of the copper untarnished, and to meet the difficulty the material was exposed to X-rays when it was maintained at a given temperature in an evacuated chamber.

Similar measurements have now been completed with gold, the surface of which can more easily be kept clean when maintained at high temperature. The results obtained with gold agree more closely with the $\exp.(-2M)$ factor, the characteristic temperature working out to be 161 ± 9° K. when the temperature of the material is 445° K. This is in close agreement with the characteristic temperature of 166° K. calculated by Debye from the elastic constants of gold and not far removed from the experimental values of 170° and 175° deduced respectively from specific heats at low temperatures and from electrical conductivity measurements. At higher temperatures the characteristic temperature of gold on the basis of the $\exp.(-2M)$ factor turns out to be somewhat lower.

It would be well, therefore, not to accept the results obtained with copper at temperatures above room temperature until further measurements have been made under more rigorous conditions.

E. A. OWEN.
R. WILSON WILLIAMS.
Physics Department,
University College of North Wales,
Bangor.

---

[1] NATURE, 142, 915 (1938).

Observations with Electromagnetic Microbarographs

Two electromagnetic microbarographs designed by H. Benioff to respond to pressure variations in the frequency range from five cycles per second to one cycle in thirty seconds approximately, and with sufficient sensitivity to record the natural unrest of the atmosphere, have been in operation at the Seismological Laboratory in Pasadena for approximately two years. These instruments were operated either at the same point with different characteristics, or at points separated by distances from several to more than 100 metres, with identical characteristics. In the short-period galvanometer combination the response is approximately proportional to the rate of change of pressure. For periods of 1 second, the sensitivity is such that 1 mm. deflection of the galvanometer corresponds to a pressure change of 1 dyne per $cm.^2$ approximately. The instruments respond to waves as well as to current variations. Discrimination between these two types of movements is made on the basis of their difference in velocity of propagation, the waves being propagated with the velocity of sound, while current variations are propagated with much smaller velocity.

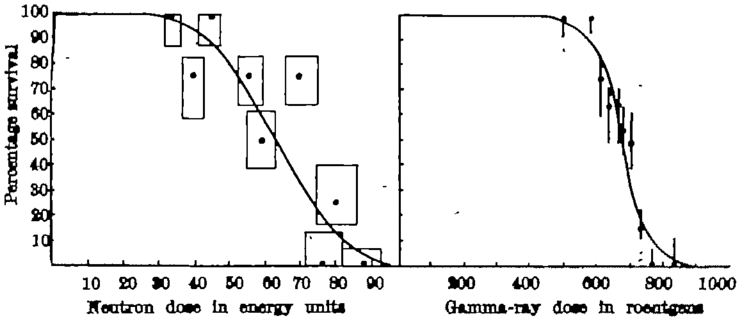
The waves are produced either by natural causes such as earthquakes, surf, other unknown sources or artificial causes (aeroplanes, automobiles, dynamite blasts, gunfire). Waves produced by battleship target practice have been used by Gutenberg to calculate sound velocities and temperatures in the stratosphere. His results agree with those obtained in Central Europe and Novaya Zemlya. The natural waves have predominant periods of 4 sec. and 20 sec. to several hundred seconds, and are largest in winter. They have exhibited no correlation with microseisms.

Air currents produce irregular disturbances throughout the whole range of recorded frequencies. They are due either to ordinary wind or to convection currents resulting from heating of the ground by solar radiation, and ordinarily the two types are not distinguishable from each other in appearance on the records. Both types of movements can be recorded indoors, although under these conditions they are modified in amplitude and in frequency characteristics. They are absent on calm, overcast or foggy days. On clear, calm days convection currents are small in winter, when they are occasionally recorded here from approximately 10 a.m. to 3 p.m. In April and November they occur from approximately 10 a.m. to 4 p.m., and during June and July they appear from 7 a.m. to 7 p.m. Strong currents of either type produce strains in the ground rock as recorded by the strain seismograph. Sudden changes in the characteristics of short-period movements sometimes accompany the passage of a cold front.

H. BENIOFF.
B. GUTENBERG.
Balch Graduate School of the
Geological Sciences,
California Institute of Technology,
Pasadena, California.

Comparison of the Lethal Effect of Fast Neutrons and Gamma-Rays on the Growing Tips of Broad Bean Roots

THE growing tips of broad bean roots have been irradiated by D-D neutrons (~ 2·9 Mev.) and by gamma-rays by techniques already described[1,2]. The duration of irradiation and the variation of intensity along the length of the root was approximately the same for both radiations. The neutrons were unaccompanied by gamma-radiation, and stray X-rays were excluded by 5 mm. of lead surrounding the specimens. The dose was measured and converted into energy units in the manner already described[1,2].



SURVIVAL OF BEAN ROOTS EXPOSED TO NEUTRON AND GAMMA-RAY ENERGY MEASURED IN COMPARABLE UNITS.

The mortality curves for gamma-rays and neutrons are shown in the accompanying figure. The apparent difference in shape between the two curves is not considered to be established in view of the magnitude of the probable errors represented by the rectangles. Individual points on the neutron curve represent the result of irradiating batches of from four to twelve beans. The probable errors of these points were estimated as follows. The probability of observing a certain mortality q in an experiment with N beans, for which the true probability of death corresponding to the dose is p, is :

$$Lt_{x\to\infty}\ {}^{Px}C_{qN} \times {}^{(1-P)x}C_{(1-q)N}/{}^{x}C_{N},$$

which, for q constant, is proportional to

$$P^{qN}\ (1-P)^{(1-q)N},$$

Plotting this probability against p, and halving the area on each side of the maximum, we obtain the range of values of p within which it is a 50 per cent chance that the true value of p corresponding to the dose, lies.

It is evident that 50 per cent mortality is produced by 63 ± 6 energy units of neutrons, which may be compared directly with the value of 690 ± 35 roentgens of gamma-rays, since the unit of energy has been defined as the increment of energy per unit volume of water exposed to 1 roentgen of gamma-radiation. Neutron energy thus appears to be about ten times as efficient as gamma-ray energy in its lethal effect on bean roots.

We gratefully acknowledge the financial assistance of the British Empire Cancer Campaign, and the loan of radium by the Medical Research Council.

Note added in proof. We are advised by a statistician, "It is not correct to say there is a 50 per cent chance that the true value of p corresponding to the dose lies in the range found in the manner described above. This cannot be done without the use of 'inverse probability', which is not justifiable in such cases as this". However, we have treated the data in the manner described on p. 243 of "Biological Effects of Radiation", Vol. 1, Duggar, with the same conclusion regarding the 50 per cent mortality dose.

L. H. GRAY.
J. READ.
J. C. MOTTRAM.

The Mount Vernon Hospital
and the Radium Institute,
Northwood, Middlesex.
July 29.

[1] Mottram, J. C., *Brit. J. Radiol.*, 8, 32 (1935).

[2] Spear, Gray and Read, NATURE, 142, 1074 (1938).

[3] Gray and Read, NATURE, 144, 439 (1939).

Formula for the Change of Velocity of Sound with Temperature

THERE appears to be no simple expression which satisfactorily represents the velocity of sound in air over normal ranges of temperature.

The formula

$$v = 331 \cdot 5 + 0 \cdot 56\, t,$$

in which v is the velocity in metres per second at a temperature t° C., is accurate to three significant figures between − 40° and 100° C. Thus, at 100° C., the expression gives 387·5, which is correct to 0·1 per cent, and at − 40°, 309, which is the value obtained from the Greely and Parry Antarctic measurements.

A. E. BATH.

Northern Polytechnic,
London, N.7.

Action of Copper Salts on Emulsions Stabilized by Sodium Oleate

DURING experiments on the effect of addition of electrolytes on emulsions of xylene in water stabilized by sodium oleate, we noticed that the xylene thrown out by copper salts was a clear, bright green or blue colour. The same colour was obtained if benzene, even the purest benzene, was used instead of xylene. On adding a quantity of copper salt equivalent to the sodium oleate present in the emulsion, benzene began to separate immediately and a certain amount of inverted emulsion was also formed, which, however, broke after some time. The separated water contained copper. On evaporation of the benzene a dark green, waxy solid was obtained, which on analysis gave a ratio of copper to oleate of 1 : 3·4 and contained some sodium. Dilute solutions of this solid in benzene were blue, more concentrated ones a bright emerald green.

Copper oleate prepared by the interaction of equivalent quantities of copper sulphate and sodium oleate in aqueous solution was, when first precipitated, insoluble in benzene. After allowing it to stand for some time it could be filtered off and obtained as a much paler green, waxy solid, which on analysis gave a ratio of copper to oleate of 1 : 2·05. After it had been kept for some time this solid would dissolve in benzene, presumably because it had lost some water, to give a solution identical in appearance with that obtained when breaking emulsions. Freezing point measurements, however, showed that these solutions were not identical. Copper oleate prepared in aqueous solution caused no depression of the freezing point of benzene (compare the work of Bhatnagar, Kapur and Hussain[1] on magnesium and zinc oleates) whilst the substance obtained on breaking an emulsion did depress the freezing point. Freshly precipitated copper oleate can be made immediately soluble in benzene by the addition of sodium oleate or oleic acid.

Now when our emulsion was completely broken, all the oleate was dissolved in the benzene, but not all of it as ordinary copper oleate, the ratio of copper to oleate being 1 : 3·4. Therefore one might expect that it would not be necessary to add a quantity of copper salt fully equivalent to the sodium oleate present in order to break the emulsion, but only 2/3·4 or 59 per cent of this amount. This expectation was not fulfilled—addition of this quantity of copper salt threw out only about one third of the benzene. We therefore conclude that the copper ion experiences some resistance to penetration to the oleate at the benzene-water interface, perhaps due to strongly attached sodium ions of the inner portion of the diffuse section of the double layer forming a practically continuous protective sheath of bound water around the benzene droplet.

The power of cations to overcome this resistance should be greater the less they are held back by their affinity for the aqueous phase, which affinity is indicated by their position in the lyotropic series. In our experiments on the partial breaking of emulsions by a number of electrolytes, we have found that the order of effectiveness of a number of cations did follow this series; for example, calcium chloride was less effective than strontium chloride, which was less effective than barium chloride, and zinc sulphate was less effective than magnesium sulphate.

A. R. MARTIN.
R. N. HERMANN.

Sir John Cass Institute,
Jewry Street, Aldgate,
London, E.C.3.
August 1.

[1] Bhatnagar, Kapur, and Hussain, *Proc. Ind. Acad. Sci.*, 9, A, 143 (1939).

Cholinesterase and Electrolytes

WE have found some effects of electrolytes on the activity of cholinesterase, which may explain the well-known effects of these electrolytes on irritability.

A purified preparation of cholinesterase from horse serum free from electrolytes was used in these experiments. 1 mgm. of the dry enzyme preparation hydrolysed about 100 mgm. of acetylcholine per hour. The esterase activity was measured manometrically.

Calcium and magnesium ions act as activators and potassium ions as inhibitors of cholinesterase. The effects of added calcium, magnesium and potassium depend on the concentration of the substrate; they are more pronounced at low concentrations of acetylcholine. At a concentration of 0·5 per cent of acetylcholine, the activity of the esterase is increased about 30 per cent by calcium or magnesium and decreased about 15 per cent by potassium. At a concentration of 0·025 per cent of acetylcholine, the increase in enzyme activity by calcium and magnesium amounts to 100–150 per cent, the inhibition by potassium to about 40 per cent. The inhibition by potassium ions is abolished by calcium or magnesium. In a balanced medium, such as Tyrode solution, a decrease in calcium or magnesium has the same effect on esterase activity as an increase in potassium ions. All these effects are brought about by physiological concentrations of the electrolytes. The following table illustrates these facts.

HYDROLYSIS OF ACETYLCHOLINE.

0·05 c.c. purified cholinesterase preparation from horse serum; 0·5 mgm. acetylcholine; 2 c.c. 0·025 mol. sodium bicarbonate; 5 per cent carbon dioxide in nitrogen; 37° C.

Cations added (In form of chlorides).	Acetylcholine hydrolysed in 3 minutes
—	124 γ
0·24 mgm % Mg	174 γ
2·4 „ Mg	240 γ
0·44 „ Ca	180 γ
2·2 „ Ca	288 γ
400 „ K	73 γ
400 „ K + 0·72 mgm.% Mg	129 γ
400 „ K + 0·55 „ Ca	133 γ

The adjuvant actions of potassium on parasympathetic effects and the depressant actions of calcium (and magnesium) on such effects may be explained by the effects of these electrolytes on cholinesterase. Potassium, by inhibiting the esterase activity, would delay the destruction of acetylcholine and thus augment parasympathomimetic effects; calcium and magnesium, on the other hand, by activating the esterase, would accelerate the hydrolysis of acetylcholine, and thus antagonize such effects.

In the same way, the hyper-irritability in the various forms of tetany known to be associated with a low calcium or magnesium level, may possibly be due to a delayed destruction of the acetylcholine liberated by a motor nerve impulse at the nerve endings. The vasodilatation, observed in magnesium deficiency, may similarly be due to delayed destruction of acetylcholine liberated by impulses in cholinergic vasodilator nerves.

BRUNO MENDEL.
DOROTHY MUNDELL.
FRIDA STRELITZ.

Department of Medical Research,
Banting Institute,
University of Toronto.
July 6.

Can Rusts Fix Nitrogen?

Caldwell *et al.*[1] and Murphy[2] have shown that in wheat and oat plants infected with *Puccinia triticina* and *P. coronata* respectively, the amount of nitrogen, and of some other substances present, is greater than in uninfected plants. Gretschushnikoff[3] found that the rust he studied excreted urea and ammonia, which, he suggested, were removed by the host, since no correlation was found between the severity of the infection and the amount of ammonia and urea in the extracts of the rusted leaves. These facts suggest that rusts may fix atmospheric nitrogen just as some other fungi are believed to do.

Work begun in Cambridge in 1937 and continued in Portugal has suggested that the problem is worth investigating in some detail. The results of two experiments are given below. Six samples each of fifty plants of Jenkin wheat were grown on sand until the plants were showing the second leaf, and after cutting off the roots and grain the plants were washed in distilled water. Samples 1 and 2 were taken at the beginning of the experiment; samples 3 and 4 were placed with their cut ends in water and kept rust free; samples 5 and 6 were placed in water and inoculated with *P. graminis tritici*, race 27. Sample 4 was accidentally destroyed before the close of the experiment. Samples 3, 5 and 6 were collected twelve days after the experiment was begun. The plants when collected were dried and then analysed. The results of the analyses are given in the accompanying table.

	Rust-free	Dry weight in gm.	Absolute nitrogen per gm.
Initial control	1	1·2549	0·06604
	2	1·2858	0·06038
Final control	3	1·6790	0·06230
	Inoculated		
	5	1·5615	0·07285
	6	1·4406	0·07980

In the second experiment, seedlings of Spratt Archer barley were used. The seedlings were prepared in the way described above; fifty plants were dried for analysis when the experiment was begun. Two samples of 225 plants each were placed with their cut ends in modified Crone's nitrogen-free solution. One sample was kept rust free, the other was infected with *Puccinia anomala* race 12. Fifty seedlings were taken every three days from each sample and dried at once. After twelve days the experiment was discontinued and the samples analysed. The results of the analyses are given below:

		Dry weight in gm.	Absolute nitrogen in gm.
	Initial control	0·7206	0·03012
	Rust-free		
No. of days the seedlings were kept in the solution	3	0·8853	0·0326
	6	0·9908	0·03073
	9	1·0067	0·0326
	12	1·8007	0·02996
	Inoculated		
No. of days the seedlings were kept in the solution	3	0·9156	0·033015
	6	1·1150	0·03458
	9	0·9922	0·03542
	12	0·8836	0·04809

The results of other experiments not given here agree in essentials with those quoted above, although in some experiments with *P. glumarum* the apparent increase in nitrogen content was not so marked. Irregular results were found with other rusts, particularly if the leaves remained wilted for long periods after inoculation. Nevertheless the experiments point to an increase in the amount of nitrogen in the rust-infected plants.

I realize the difficulties involved in demonstrating nitrogen fixation by an obligate parasite, yet I feel that the above results are sufficiently suggestive to warrant their being brought to the notice of other workers.

BRANQUINHO D'OLIVEIRA.

Estação Agronomica Nacional,
Belem, Lisbon.
July 5.

---

[1] Caldwell, Graybill, Sullivan and Compton, *J. Agric. Res.*, 48, 1049–1071 (1934).

[2] Murphy, H. C., *Phytopath.*, 26, 220–234 (1936).

[3] Gretschushnikoff, A. I., *C.R. Acad. Sci. U.R.S.S.*, N.S., 2, 335–340 (1936); (Ref. in *Rev. Appl. Mycol.*, 15, 710; 1936).

Nomenclature of Nudibranchiate Mollusca

WANTON changes in the nomenclature of animals are so injurious to zoology by confusing its literature, and so heavily handicap the study of systematic problems, that I seek the publicity of NATURE for the exposure of a particularly flagrant case. This is the synonymic List of British Nudibranchiate Mollusca by Iredale and O'Donoghue[1], the nomenclature of which was adopted in the last edition of the "Plymouth Marine Fauna" of the Marine Biological Association (1931). My attention was directed to it by noticing that some extraordinary names for these animals were being used by recent workers at Plymouth, who naturally followed the guidance of the Association's official "Fauna".

The revolutionary nature of the scheme may be seen from the fact that in it familiar names like *Doris*, *Triopa*, *Tritonia* and *Doto* have completely disappeared, and that no less than 40 out of the 71 species recorded bear names different from those in Alder and Hancock's "Monograph", as revised for the Ray Society by the late Sir Charles Eliot in 1910. No reasons were given in the "Fauna" for the rejection of Eliot's nomenclature, and no opinion was expressed as to the validity of the new scheme. As an old student of the group, familiar with the careful workmanship both of Alder and Hancock and of Eliot, I have thought it desirable to subject Iredale and O'Donoghue's paper to a critical examination, and submit herewith a few examples of their treatment.

(1) *Doris* (*Archidoris*) *tuberculata*, Cuvier, 1804.—Our largest and most familiar species of *Doris* has been known exclusively by this name for nearly a century. Iredale and O'Donoghue assert, but without evidence, that it is not Cuvier's species. Their statement traverses the unanimous testimony of Alder and Hancock, Bergh, Eliot, Fischer, Cuénot and Vayssière, in fact of every expert investigator. Their change of its name to *A. britannica* (Johnston, 1838) is baseless.

(2) *Doris* (*Jorunna*) *johnstoni*, A. and H., is another well-known species which has been universally known under this name since Alder and Hancock first accurately defined it in their monograph. Iredale and O'Donoghue change the specific name to *tomentosa*, Cuvier, 1804, on the ground that Fischer (1869, 1870) "pointed out this synonymy" and that Cuénot (1903) "confirmed" it. The facts are that Fischer claimed that *tomentosa*, Cuvier, was distinct from *johnstoni*, while Cuénot said that the synonymy of *johnstoni* with *tomentosa* was at most a "possibility" which could not be established, since Cuvier's description was "*absolument insuffisante*"! Fischer had made a superficial examination of some specimens labelled *D. tomentosa*, Cuv., in the Paris Museum, but the single authentic type was not among them.

Moreover, Iredale and O'Donoghue omit the fact that Bergh conclusively identified as *D. johnstoni* some specimens in the Leyden Museum which Cuvier himself had authenticated as *D. stellata*, Gmel. (Bergh, *Verh. z. b. Ges. Wien*, 1893)—a species of antiquarian interest only, but from which Cuvier had expressly distinguished his own *tomentosa*. Thus, if we assume that *tomentosa* really was identical with *johnstoni*, Cuvier could not recognize his own species when it was before him. Enough has been said to show that the only indisputable name for Alder and Hancock's species remains *Doris* (*Jorunna*) *johnstoni* A. and H.

(3) *Doris verrucosa*, Linn. (Cuv.). This, the type-species of the Linnean genus *Doris*, had remained unrecognized until Cuvier's "Mémoire sur le genre Doris" (1804). Iredale and O'Donoghue dismiss Cuvier's identification with the assertion that Linnæus's species was "based on a specimen described by Rumph and figured by Séba, which is indeterminable", thus begging an important question and brushing aside essential facts. It is generally admitted that Linnæus's first attempt, in the tenth edition of the "Systema" (1758), to define the sea-slug *Doris* was both erroneous and confused. Cuvier pointed out that Linnæus's citations from Rumph and Séba indicated an "Oscabrion", that is, a Chitonid (Séba's plate suggests a *Cryptochiton* with reflected mantle), but the generic diagnosis included statements about appendages of which there was no indication either in Rumph or Séba ("*Tentacula ad os circiter octo*"). This suggested to Cuvier that, in addition to Séba's figure, Linnæus had a true *Doris* before him, though wrongly orientated, and Bergh, long afterwards, reached the same conclusion. Anyhow, after Bohadsch had cleared up the anatomical errors (1761), Linnæus corrected his diagnosis in the twelfth edition, changed *os* to *anum*, distinguished the true tentacles as "retractile within foramina", and nevertheless retained *verrucosa*, along with three new species of indubitable *Doris*, as members of the revised genus. Cuvier had found some specimens in the old "Cabinet d'Histoire Naturelle" which in fact combined the verrucosity of Séba's figure with the revised generic characters. He accordingly claimed the species, which he described and figured, as in all probability Linnæus's hitherto unrecognized type, and it has since happily proved to be the commonest Mediterranean species.

Cuvier's identification was in every sense legitimate and has been admitted without exception by every subsequent investigator. It was tantamount to a fixation of the type for all time. Accordingly the old genus *Doris* stands, in spite of its original ambiguity, and includes five British species at least, as detailed in Eliot's Revision.

These few examples, out of many similar, show that Iredale and O'Donoghue draw no distinction between proved conclusions and mere opinions. Until the changes of nomenclature introduced by them have been confirmed independently, I would advise serious investigators to record their discoveries under the more stable and historic names of Eliot's authorized Revision.

WALTER GARSTANG.

18 Apsley Road,
Oxford.

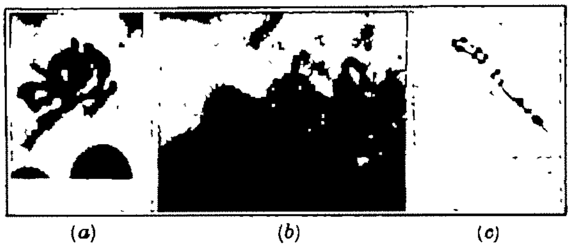
---

[1] *Proc. Malac. Soc.*, 15 (1923).

Chromosome Structure as Observed in Root Tips

THERE are some features of the structure of the somatic chromosome which can be observed without any special technique. These are the primary and the secondary constrictions (the last including the SAT- and the NO-SAT-constrictions) and also the heterochromatin and the euchromatin.

Recently, Darlington and La Cour[1], by means of a special technique, have observed a "new differentiation" in the chromosome which appears as a decrease in its thickness owing, they suggest, to these parts of the chromosome "being coiled in a finer thread of smaller diameter than the rest of the thread".



METAPHASES OF ROOT TIPS OF *Trillium ovatum*, PURSH; (c) IS AN ENLARGEMENT OF THE PART BETWEEN THE ARROWS IN (b).

The connexion of the satellites to the chromosomes has been referred to in the literature as 'SAT-thread', although in some cases (Heitz[2] and Resende[3]) this connexion appears more as a band than as a thread. From the comparison of my figure[3] of a SAT-band in *Dioon spinulosum* with the photographs of Darlington and La Cour of *Paris polyphilla*, one can see that there is no difference at all between them. As these authors did not observe the nucleoli, however, it is very likely that they failed to recognize such differentiations as SAT-constrictions. Similar aspects were observed by me in the proximal satellites of *Trillium ovatum* (see *a*) and other plants[4]. In all these cases, as in *Dioon*, the nucleoli have been observed and there can be no doubt that we were dealing with true SAT-differentiations.

In a metaphase preparation of *Trillium ovatum*, in which this SAT-band was particularly extended, one could clearly see that this zone is deprived of kalymma and that the chromonemata there showed a differentiation identical with that observed hitherto only in meiosis (cf. Belling[5]). Exactly as Belling[5] observed in a pachynema of *Lilium pardalinum*, I found in somatic metaphases (root tips) of *Trillium ovatum* (see *b*) groups of four chromomeres linked together by fine (?) fibrils. The observation of such a differentiation in mitosis shows the identity of the somatic chromonemata with those of meiosis.

The present observations are a confirmation of the hypothesis put forward by Heitz[6] on the constitution of the chromosome, but, of course, only with regard to the number of the chromonemata. It is now demonstrated that the chromonema is split longitudinally, as suggested before by several authors (cf. Geitler[7] and Straub[8]). The facts referred to also show that the longitudinal splitting of the chromonema is already present at metaphase.

FLÁVIO RESENDE.

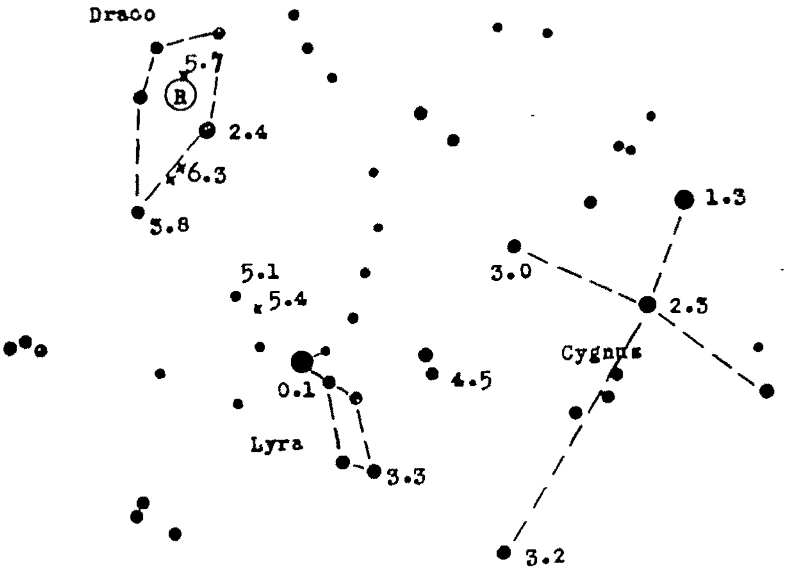
Institut für allgemeine Botanik,
Hamburg, 36. June 24.

---

[1] Darlington, C. D., and La Cour, L., *Ann. Bot.*, N.S. 2 (1938)
[2] Heitz, E., *Planta*, 8 (1931), figs. 14 and 23.
[3] Resende, F., *Planta*, 26 (1937), fig. 26K, see arrow.
[4] Resende, F., *Z. Zellforsch.* In the Press
[5] Belling, J., after Geitler, Berlin (1938).
[6] Heitz, E., *Z. Abstammungslehre*, 70 (1935)
[7] Geitler, L., *Z. Zellforsch.*, 28 (1938)
[8] Straub, J., *Z. Bot.*, 33 (1938).

Giacobinid Meteors in 1939 and 1940?

ON October 9, 1938, when the earth passed through the region occupied eighty days earlier by the faint, short-period comet Giacobini-Zinner, the strongest meteor shower of the century appeared for a few hours. The best available orbit for the comet indicates that it will again pass near the earth's orbit on February 23, 1940; thus in 1939 the earth will precede the comet to the nodal point by 136 days and in 1940 follow it by 229 days. It therefore appears probable that some recurrence of the shower, but of a quite unpredictable intensity, may be anticipated on October 9 or 10 in either or both of these years[1]. Observations from widely separated localities are of great value in the investigation of the internal structure of meteoric swarms, hence a request is made for reports from anyone detecting the shower. The radiant will be in the head of the constellation Draco, north and west of the bright star Vega. In 1939 the moon, aged twenty-five days, will not interfere; but in 1940, aged eight days, it will illuminate the evening sky.



Continued investigation of the Giacobinid system, in which both meteor showers and the comet may be observed, should greatly increase our knowledge of the structure of comets and the process by which they disintegrate into meteor swarms. In the study of the structure of meteor swarms, certain types of data are of especial importance and unless they are obtained and recorded with the more general observations of a meteor shower, the studies are likely to be of little value. For this reason the following observing programme is suggested for a single observer assisted by a recorder. If additional observers are available, the several types of observation may be delegated.

(1) Determine as closely as possible the position and size of the radiant area, and, if possible, fix the position of the radiant area when it is at several appreciably different zenith distances.

(2) Have each observer record the magnitude, or identity, of the faintest star that he can see. If the transparency changes appreciably during the observations, record the stellar limit frequently.

(3) Choose some specific region of the sky, for example, the polar region, or the zenith, and count

the number of meteors seen during intervals of five minutes.

(4) At least once each hour count, over intervals of not less than five minutes, the number of meteors of each magnitude. A continuous record of the magnitudes of all meteors seen, from which any time-variations of the magnitude distribution may be found, would be extremely valuable.

(5) If low-power binoculars or a comet-seeker are available, determine and record the number of meteors of various magnitudes seen through such optical instruments.

(6) Utilize whatever photographic equipment is available for securing both trails and spectra of the meteors. For detailed suggestions see papers by Dr. P. M. Millman[2].

(7) When reporting the observations, give all the data that are obtained and descriptions of the field of view, time system, telescopes, etc., employed. At a later date superfluous information may be disregarded, but omitted data cannot be recreated.

For convenience in identifying the radiant, its approximate position is indicated by R in the accompanying chart. The location and visual magnitudes of a few easily identified, faint stars are also indicated (crosses) to aid in fixing the limit of visibility and in determining the magnitudes of faint meteors.

FLETCHER WATSON.

Harvard Observatory,
Cambridge, Massachusetts.
July 21.

---

[1] *Pop. Astro*, 47, 308 (1939).

[2] *Pop. Astro.*, 41, 298 (1933); *J. Astro. Soc. Can.*, 31, 295 (1937); "Amateur Telescope Making, Advanced", p. 544 (New York: Scientific American Press, 1937).

Points from Foregoing Letters

J. F. Allen and J. Reekie state that the force associated with heat flow in He II has been found to possess two components. When heat flows in a tube containing He II, the liquid which is close to the surface of the capillary is forced to flow in the direction opposite to that of the flow of heat. This is the so-called fountain effect. In the centre of the capillary, however, liquid is forced by the flow of heat to move in the same direction as the heat flow. There is evidence that the fountain effect, that is the surface component, becomes saturated when the heat current is sufficiently high.

According to C. Møller and L. Rosenfeld, recent developments of the vector meson theory lead to the view that the meson field is neutral. They state that the quadruple moment of the deuteron, and indeed the consistency of the whole meson theory of nuclear forces, is much clarified by introducing pseudoscalar meson fields as well as the vector fields.

G. W. Brindley and G. H. Atkinson point out that the characteristic temperature of copper obtained from X-ray measurements at low temperatures agrees with the specific heat value, in contradiction to the previously reported result of Owen and Williams obtained from X-ray measurements at high temperatures.

E. A. Owen and R. Wilson Williams find that the characteristic temperature of gold deduced from X-ray measurements agrees with the value obtained by other methods. They suggest that the results which they previously recorded for copper at high temperatures need further investigation under more rigorous conditions.

H. Benioff and B. Gutenberg describe results obtained with electromagnetic microbarographs designed by the former. They respond to the range of frequencies 5 cycles per sec. and to 2 cycles per minute, and are capable of recording the natural movements of the atmosphere. Wave movements, produced by earthquakes, surf or artificial sources, and also air currents can be detected.

The lethal effects of neutrons and γ-rays on broad bean roots are compared by L. H. Gray, J. Read and J. C. Mottram. Using earlier results, it was found that the biological effect produced by a given amount of absorbed γ-ray energy was produced by about one tenth of this amount of absorbed neutron energy.

A. R. Martin and R. N. Hermann find that when a quantity of copper salt equivalent to the sodium oleate present is added to an emulsion of benzene in water, the solid obtained on evaporating the benzene thrown out is different from the product of the interaction of sodium oleate and copper salts in aqueous solution. They make suggestions about the nature of the double layer round the oil droplets in emulsions.

B. Mendel, D. Mundell and F. Strelitz find that calcium and magnesium ions activate and potassium ions inhibit cholinesterase. These effects are brought about by physiological concentrations of the electrolytes and become more pronounced the lower the concentration of acetylcholine.

B. d'Oliveira describes some experiments in which it is shown that the leaves of cereal seedlings experimentally inoculated with some rusts (Puccinia) present an increase of the total amount of nitrogen. The question is put whether rusts are able to fix nitrogen directly from the air.

W. Garstang criticizes the nomenclature of British Nudibranchiate Mollusca which was adopted in the last edition (1931) of the "Plymouth Marine Fauna" of the Marine Biological Association from Iredale and O'Donoghue's Synonymic List of 1923. He gives examples of the unreliability of this list, and advises a return to the nomenclature of Eliot's Revision of Alder and Hancock's Monograph (Ray Society, 1910).

F. Resende submits photomicrographs which he claims support the view that the chromonema is split longitudinally at metaphase.

The possibilities that meteor showers, associated with comet Giacobini-Zinner, will appear on October 9–10, 1939 and 1940 are discussed by F. Watson, and the most valuable types of observations are detailed.

RESEARCH ITEMS

Early Copper

EXPERIMENTS in smelting copper from ores have been carried out by H. H. Coghlan with the view of throwing light on the supposed accidental discovery of copper smelting by primitive man (*Man*, July 1939). Primitive conditions were simulated so far as possible, to show whether copper could be produced in a 'hole in the ground' or camp fire. The green carbonate malachite was selected as the most probable material from which the earliest smelted copper was produced. A cone of charcoal was built up in a hole in the ground about three feet in diameter, and surrounded by a ring of stones. The ore was well embedded in the centre of the cone. A bright red heat was obtained, which could not have been increased without a forced draught. The fire was kept at full heat for some hours, and then allowed to die down slowly. The malachite had only been reduced to black oxide of copper, and no metallic copper was produced. Failure is attributed to excess of air, and later experiments proved that low temperature was not the cause of failure. The theory of accidental discovery precludes the use of bellows to produce a forced draught, as this is a method which belongs to a sophisticated copper-smelting technique. An alternative theory is put forward that accidental discovery may have resulted from the employment of a pottery kiln, especially in view of the fact that the use of pottery preceded the discovery of copper. A test was made in a simple kiln, such as that which had been in use at Ereed in the Alt Valley, where the baking chamber was simply a dome of brick or burnt clay. The kiln following this model was covered with charcoal, and the fire kept at a good red heat for some hours. Metallic copper was produced, at first as sponge copper, and afterwards with a closer packing, as a compact and close-grained bead. The malachite may have been introduced into the primitive pottery kiln by accident or in the form of a paint or slip, or made up as a glaze.

Tree Ritual in Southern Rhodesia

A NUMBER of examples of tree ritual among the Bantu tribes of Southern Rhodesia have been collected by F. Posselt (*Man*, August, 1939). In the Marandellas District, Central Mashonaland, a tree on a ridge, a prominent landmark, was known to the natives as "the tree without a name", so-called because it was the only one of its kind. Before British occupation in 1890, religious rites were performed around it, particularly by the Barozwi. The assembly danced around it and made offerings of black cloth and beads. The tree was believed to be the abode of a great tribal spirit; and the rites were intended to propitiate, and ensure the prosperity of the community, as well as a bountiful season. The sacred grove of the *miti michena*, "the white trees", was the scene of a ritual murder of human sacrifice in 1923. This grove, in the Darwin District, Northern Mashonaland, is the centre of the Karuwa cult of the Rainmaker, whose wife was obliged to live within the enclosure to which no male, except the officiating priest, was admitted. Contact with any male defiled the spirit's wife and was regarded as a rape, with the result that the angered spirit visited the land with a prolonged drought, refusing to be reconciled until the offending male had been immolated. The chief's son in the instance mentioned was burnt to break the drought which had followed his trespass. Among the Vazezuru and the Kalanga, offerings of beer and porridge are made to the ancestors under a large tree. Among the Amandebele and others, the use of any timber or fuel of the *citamuzi*, the "tree of discord", is forbidden. It is used at funerals as a symbol of farewell greeting.

Mollusca of the John Murray Expedition

Two recent monographs deal with the Opisthobranchs and Pteropods ("A Systematic and Anatomical Account of the Opisthobranchia" by N. B. Eales, British Museum (Natural History). The John Murray Expedition 1933–34 Scientific Reports, 5, No. 4. Pteropoda by H. G. Stubbings, 5, No. 2; 1938). Dr. Eales's work on the Opisthobranchs is most excellent and is a valuable addition to our knowledge of the group, although the specimens available are somewhat scrappy and possibly not altogether representative of the region. She has studied specially the nervous and reproductive systems with the alimentary system in less detail. This will go far in elucidating the relationships of the various genera, especially so because they are illustrated with very carefully drawn figures. Notes on the feeding of two species, *Hydatina* (*Aplustrum*) *velum* and *Hexabranchus sanguineus*, are interesting. In the Hydatina the alimentary canal is remarkably long and the thin-walled crop fills the greater part of the body cavity. In the crop was found a cirratulid worm, 80 mm. long and 4 mm. wide, more than four times as long as the Hydatina itself. Bergh noted a similar worm in this species which must select its food. In *Hexabranchus sanguineus* the crop was full of Foraminifera, worm tubes and pieces of gastropods and echinoderms which fully account for the very much worn radula. A comparison of the chief types represented provides a series exhibiting progressive concentration of the nervous system, the least specialized being *Bulla ampulla*, the most specialized *Hexabranchus sanguineus*. The collection of Pteropods is small. All are known forms and none occur in large numbers. Mr. Stubbings has attempted to show the vertical distribution of certain species and his notes are interesting and suggestive.

Hawaiian Bivalves

THE recent work by William Healy Dall, Paul Bartsch and Harald Alfred Rehder entitled "A Manual of the Recent and Fossil Marine Pelecypod Mollusks of the Hawaiian Islands" (*Bull. Bernice P. Bishop Museum*, 153; 1938) is a comprehensive account of Hawaiian Pelecypoda, including a very large number of species. It is purely conchological, dealing only with the shells and not the animals, but will be indispensable as a work of reference. The main part is based on the valuable collection of Mr. D. Thaanum presented to the United States National Museum, but added to this are specimens from collections, chiefly from deeper waters, made by the U.S. Bureau of Fisheries steamer *Albatross* in Hawaiian waters, and smaller collections made by individual workers.

Paul Bartsch, in his introduction, is inclined to attribute the Pelecypod fauna of the Hawaiian Islands mainly to drift. The fauna is composed, with few exceptions, "of just such species and such only, as might use this type of transportation". The work is illustrated by fifty-eight good photographic plates.

Powdery Mildew of the Rose

THE fungus *Sphaerotheca pannosa* var. *rosae* causes the powdery mildew disease of roses, and is the most serious parasite of this national flower. Control of the malady, however, has often been difficult, owing to lack of exact knowledge of the factors which affect the development and distribution of the disease. Karla Longrée has recently investigated this question (Cornell Univ. Agr. Exp. Sta. Memoir 223, Ithaca, N.Y., U.S.A., April 1939). The effect of external conditions upon the propagation of the fungus appears sufficiently limited to account for the sporadic nature of the malady. Optimum temperatures for spore germination, for example, fall rapidly from 27·5° to 21° C. during the first few days after liberation. Sporulation only takes place between 9° and 27·5° C., and spores quickly lose their viability. Relative humidity of the atmosphere, however, provides an even greater obstacle to spore germination, which was only good between the narrow limits of 97 and 99 per cent humidity. Young rose leaves, however, appear to have a layer of air with such a high relative humidity, close to the surface, particularly on the underside, and so are prone to attack by the fungus. Many other details of the effect of climatic environment upon the fungus are given in the paper, which should provide a valuable basis for the more efficient control of the malady.

The Daruma Volcano, Japan

HISASHI KUNO has recently made a study of this volcano (*Bull. Earthq. Res. Inst., Tokyo*, 16 (4), 763–771 ; 1938) and finds that it may best be classed as a shield volcano of the Hawaiian type similar to the Prospect Peak and Mount Harkness volcanoes of the Lassen Volcanic National Park as have been described by Howel Williams. It has a breached central crater and a gently sloping flank, having been built up chiefly by repeated gentle outpourings of lavas with scarcely any violent explosive eruption. Each lava was accompanied by large blocks formed by the breaking down of the already consolidated scoriaceous crusts. The composition of these lavas did not change much from one effusion to another, being mostly hypersthene-augite-andesite, becoming only slightly richer in olivine towards the later stage of activity. Augite-olivine-basaltic andesite and olivine-basalt were also erupted occasionally during the later stage. A comparison of the extent to which the volcano has been dissected, with that of the other north Izu volcanoes, suggests that it is of older Pleistocene age or slightly older, though no decisive conclusion can be drawn.

The Atomic Weight of Hydrogen

ON the basis of a protium-deuterium (H/D) ratio in normal water of 5000, the International Committee on Atomic Weights in 1938 changed the accepted atomic weight of hydrogen from 1·0078 to 1·0081. No reference to the source of this ratio was given and the higher ratios 6900 and 6500 found by Gabbard and Dole and by Hall and Jones respectively, were not mentioned. J. A. Swartout and M. Dole (*J. Amer. Chem. Soc.*, 61, 2025 ; 1939) have confirmed the ratio 6900 by a new exchange reaction $H_2+HOD \rightleftharpoons HD+HOH$ and also reinvestigated the density of water made from atmospheric oxygen as compared with normal water, as the published data vary from 6·0 to 8·6 parts per million excess density as compared with normal water. Lake Michigan water was used and water made from the oxygen of this water and pure protium had a density 15·5 p.p.m. smaller than normal Lake Michigan water, giving a ratio H/D = 6970. Water containing normal Atlantic Ocean oxygen and pure protium was 15·7 p.p.m. lighter than normal Atlantic Ocean water, giving a ratio H/D = 6900. Deuterium-free hydrogen was burned with atmospheric oxygen and the density of the water produced compared with that of water containing normal Lake Michigan oxygen and pure protium, and the atmospheric oxygen water was 6·6 p.p.m. heavier, which corresponds with a greater atomic weight of oxygen in air of 0·000119 ± 0·00002 atomic weight units. The chemical atomic weight of hydrogen calculated from the new H/D ratio is found to be 1·0080 instead of the value of 1·0081 recently adopted by the International Committee.

Fluctuation Voltages

IT has been known for a long time that there is a spontaneous oscillating potential difference between the ends of an isolated resistance. This is generally attributed to thermal agitation of the free electrons. It is known to have an effective value which is proportional to the resistance and to its absolute temperature. In a paper by F. C. Williams (*J. Inst. Elec. Eng.*, Aug.), various methods are given of representing the voltage, current, etc., of the thermal fluctuations both in simple and in complex networks. The oscillations are augmented if the resistance, whether an open or a closed circuit, carries a current which has passed through a thermionic valve. The two components of oscillation are called thermal and thermionic fluctuation voltages respectively. All electrical communications suffer from them, as they always form an inevitable background which ruins intelligibility when the strength of the signal is less than some definite amount, which is independent of subsequent amplification and magnifies both alike. It is important to be able to predict the fluctuation voltage inherent in any assembly of circuits and thermionic valves. Although there has been considerable research in this direction the exact mechanism of these effects has not yet been discovered, and it is very laborious to estimate their probable magnitude in complex circuits. The author recently described a method of representing the phenomena which enables the fluctuation generated in any specified network to be computed by the ordinary processes of circuit analysis, by ignoring the physical mechanism which produces the effects. The author states that extensive experiments have completely vindicated this method of representation. In this representation the distribution of potential developed along the length of a resistance is simulated, for simplicity, by a concentrated generator producing a specified E.M.F. and supposed inseparable from the resistance ; an analogous representation is adopted for thermionic fluctuations. This method, which is useful in technological applications, is called 'voltage representation'. An alternative method, which is termed 'current representation', is sometimes more convenient. Both methods are described in this paper.

HEALTH AND SAFETY IN INDUSTRY

THE annual report of the Chief Inspector of Factories for 1938 gives an encouraging picture of the way in which health and safety in industry in Great Britain are being improved. Although the report deals only with the first six months during which the Factory Act of 1937 was in force, it indicates that great progress has been made in applying the new code and raising the standard of all factories and workshops to the level of the best. Indeed, a striking feature of the coming into operation of the Act, the report points out, has been the co-operation of employers, whose inquiries have been directed to the best manner of doing this or that, rather than to the necessity of doing it. Accordingly, the factory inspector is now regarded more as an expert adviser on problems of health and safety and less as an official with punitive powers.

In regard to safety, the new Act marked an extension of safety regulations to diminish accidents. The report shows that in 1938 the number of reportable accidents was 7 per cent less than in 1937, while fatal accidents were reduced by 6 per cent. While, however, these figures remain at the high level of 180, 103 and 944 respectively, there is still plenty of room for improvement in this respect, and the fall in accidents must be attributed to some extent to the reduction of the number of people in employment in consequence of the trade depression. In this connexion, the chief inspector pointed out that the decrease was especially marked among the fatal accidents on factory premises, and considered that the new safety requirements are already beginning to take effect. It should, of course, be remembered that the relative value of the accident figures for 1938 is affected by the wider requirements in the new Act for reporting accidents.

An important factor in the prevention of accidents is the work of the Safety Committees and safety officers throughout the country, particularly in the larger factories. In such work, scientific workers have an important part to play. Success in this matter depends largely on their technical knowledge and interest, and their skill in enlisting the co-operation of fellow-workers who may not possess such expert knowledge. Moreover, significantly enough, the report points out, special difficulty is often experienced in small factories, for example, in the elimination of fire risk through effective protection of circuits from persistent earth leakage, because neither the instruments required nor the ability to use them are available.

If, therefore, the report contains welcome evidence that the management side is increasingly alive to its responsibilities in this matter, it once more endorses the far-sightedness of the policy of such professional associations as the British Association of Chemists in attempting to secure that certain specified operations are carried out under the direct supervision of properly qualified persons. This is indeed essential in the development of new processes, and the value of such a safeguard tends to increase as the pressure due to national defence requirements increases. From the point of view of safety, no less than health, the reduction of hours of work is a wise and beneficial measure.

Once again an important section of the report is concerned with accidents to young workers. A most serious problem in factories to-day is indeed to protect young workers from the alarming proportion of accidents occurring in the age group 14–18, which are often due to carelessless, ignorance or lack of discipline. The education authorities are now endeavouring to prepare boys and girls for the risks of their future employment by giving such training as they can to the young people while they are still attending colleges or schools. Progress in this matter obviously depends on close co-operation with employers themselves. The report points out that the firms which are most successful in reducing accidents to young workers are those which regard their employees both from the personal point of view and that of their future value as skilled workers. Moreover, if the number of accidents is to be reduced as far as possible, the training and supervision of the young entrants into industry must be extended beyond their instruction with regard to the use of machinery, for most of the injuries due to accidents come from other causes.

At the present time there is a further factor in the shortage of young workers, which may tend to increase this already alarming incidence of accidents among young workers. Due to this shortage there may be greater danger that boys and girls may be placed in positions for which they are not most suitable. If it is a counsel of perfection at the present time to select boys and girls who are the most suitable mentally and physically for the work which has to be done, at least greater care could be taken to prevent those specially prone to accidents from being placed in the more hazardous posts. Moreover, the fact that accidents tend to occur to particular boys and girls whom the management consider to be among the smartest and most intelligent in the works is a further demonstration of the need of close guidance and supervision if only to maintain discipline, to remedy lack of experience, for example, as to the type of clothing worn, and prevent dangerous experiments on the part of young workers due to their inquisitiveness and eagerness to try out ideas of their own.

While, therefore, the evidence presented in this report shows that the great developments in organized attempts to reduce accidents in recent years are gradually achieving their object, there can be no reasonable room for doubt that great efforts still continue to be required in this field, and notably in attention to the young workers. The field of research open to the Industrial Health Research Board remains a wide one, and it is significant that special attention is directed to this matter in the programme recently formulated by the Scientific Advisory Committee of the Trades Union Congress. At its first meeting this committee agreed that the subjects upon which the committee might be consulted in regard to their effect on labour and social conditions should include the position of research in relation to industrial and occupational diseases with a view to prevention rather than cure, and also researches into industrial fatigue and nerve strain, including systems of labour measurement in relation to shorter working hours, holidays and minimum periods for rest and recreation. Two sub-committees have been formed to give their attention to these subjects and a third sub-committee to deal with the effects of new industries, new materials, new uses of new processes, upon the distribution, displacement and character of labour with particular reference to plastics, textiles and non-textile products.

In view of the increasing responsibilities which scientific workers must assume for control and management in industry, the report of the Chief Inspector of Factories is a timely reminder to them of their opportunities and responsibilities in this important field.

FISHERY RESEARCH IN SCOTLAND

THE passing of the Fishery Board for Scotland, under the Reorganisation of Offices (Scotland) Act, means the removal of a landmark from the field of fishery research. As the Development Commissioners observe in their latest annual report, the Board was the first department of Government in the United Kingdom to possess a permanent scientific organization, and its scientific staff was responsible for many of the earlier classical discoveries in marine research, while in more recent years it has made important contributions to the development of fishery science.

Since its inception, the Board has had its headquarters in Edinburgh, one of the homes of the modern science of oceanography. From Edinburgh, Edward Forbes conducted much of his pioneer work of shallow-water dredging and Dr. Bruce his polar researches, and the city is for ever to be associated with the famous *Challenger* expedition and the names of those deep-sea explorers, Sir Wyville Thomson and Sir John Murray. The last-named was scientific member of the Fishery Board and the chief British delegate at the International Congress held at Stockholm in 1899—a congress which led to the formation of the International Council for the Exploration of the Sea.

It would probably amaze some of these pioneer fishery investigators to see how far governmental interest in research, land and marine, has progressed since their time. There are many to-day who, like Forbes, would prefer to see scientific research conducted without the trammels of officialdom; but finance is a hard taskmaster and has a way of assuming the direction and control of policy. Certainly, without Government funds the conduct of marine research would, in view of the costly equipment and staff required, be a difficult undertaking for private enterprise.

It was in 1882, following a report by a Select Committee of the House of Commons, which was impressed by the progress of fishery research in the United States, that the Fishery Board for Scotland was empowered to carry on scientific researches. The funds provided were on a modest scale, but the Board was enabled in 1886 to acquire a small steam research vessel, the *Garland*, which was employed mainly in investigating the effects of trawling on the inshore fisheries. With the great development of trawling, this question had become one of much public and political interest, especially in Scotland, where the inshore fisheries are of considerable importance. The investigations are described in Prof. W. C. McIntosh's "Resources of the Sea", in which the author did not support the Board in the policy of restriction of trawling on which it decided.

In 1895 the Board was reconstituted, and "a person of skill in the branches of science concerned with the habits and food of fishes" was thenceforward included as one of its members. The role was filled in turn by such distinguished men of science as Prof. Cossar Ewart, Prof. W. C. McIntosh and Sir John Murray, and since 1898 the scientific member of the Board has been Sir D'Arcy W. Thompson, who has taken so long and honourable a part not only in fishery science but also in many other fields of culture and education.

The establishment in 1902 of the International Council for the Exploration of the Sea gave a great fillip to marine research, and the share of the programme of international research assigned to Great Britain was entrusted, so far as the northern half of the North Sea was concerned, to the Fishery Board for Scotland acting as agent for the Treasury. The work in the southern half of the North Sea was undertaken originally by the Marine Biological Association and afterwards, in 1910, by the Board (now Ministry) of Agriculture and Fisheries.

A new research vessel, the *Goldseeker*, was provided for the Fishery Board in 1902, and she was replaced in 1920, by means of a grant from the Development Fund, by the research vessel *Explorer*, which is still in commission.

Laboratories were set up at Dunbar, Granton and Tarbert (Loch Fyne) and finally at Aberdeen, where the Board's scientific staff is now stationed. The Board has been fortunate in securing the services of a succession of scientific superintendents of outstanding ability, of whom Fulton and Bowman may be specially mentioned. Apart from his varied contributions to fishery science, Fulton found time to write the "Sovereignty of the Sea", a valuable historical survey of questions of maritime jurisdiction, while Bowman laid the foundation for the forecasts which have now become possible of the stocks of haddock in the sea.

The statistical records of the Board are of the greatest value. Sir D'Arcy Thompson is personally responsible for a series of statistical reports on the fisheries of the North Sea, which are indispensable to any proper study and appreciation of fishery problems.

In conclusion, it is fitting to mention the contributions made by the Board to salmon and freshwater fishery research. The names of Archer, Young, Calderwood and Menzies, in turn inspectors of salmon fisheries, stand high as authorities in this branch of science.

H. J. C.

SCIENCE NEWS A CENTURY AGO

Propagation of Heat in Liquids

ON September 14, 1839, the *Athenæum* said: "The experiment of M. Despretz concerning the propagation of heat in liquids has been attended with the most satisfactory results. From these it appears that a liquid column being heated at the upper part, the heat is propagated according to the same laws as those belonging to solid bodies; that the temperature decreases from the axis to the surface, and from the surface to the wall of the side. The depth to which solar heat penetrates in a given time may be easily calculated by these data in large lakes and isolated seas". The French physicist César Mansuète Despretz, well-known for his studies of heat, was born in 1792 and died on March 15, 1863.

Scientific Gossip

ON the same page in the *Athenæum* as the above note appeared, was a column of 'Weekly Gossip' in which it was said: "The prevailing quiet at home has induced us to hunt over the foreign papers and journals, in the hope that something might be thence gleaned, but all seem subject to the same summer influences. It may be well, however, to remind our scientific friends that . . . the Italian savants are to assemble at Pisa in October; that the French Geologists meet in the same month; and that the German Naturalists meet this year at Pyrmont. An account appears in the *Nördische Blätter* of an immense landslip at Federowka, a village situated on the Volga . . . The motion of the ground continued with more or less violence, for nearly three days, and seventy houses were either wholly or partially destroyed. . . . On one side of the village rise high hills, the upper strata of which are of limestone, but the lower of various kinds of clay, while on the opposite side it is washed by the Volga, which is here hemmed into a narrow bed; and the waters thus confined are supposed to have forced a passage between the stony and alluvial beds.

Proposed Society for Practical Mechanics and Chemistry

THE *Mechanic and Chemist* of September 14, 1839, published a note from "Tyro Chemicus" saying: "The increasing desire which the middle classes evince for information in every department of science, particularly those branches in which mechanics and chemistry form a part, shows the immediate necessity of all students in the above branches of science combining together and forming themselves into a society in which practical mechanics and chemistry are exclusively studied, and affording them benefits which the Mechanics' Institution and other similar institutions have denied them; for although they may be called mechanics' institutions, etc., yet no person will attempt to deny that practical mechanics is in most of them totally excluded. . . ." The same remark applied to practical chemistry, and the Editor of the *Mechanic and Chemist* in recommending the proposal said: "Another important advantage derived from a society of this description is the reciprocal instruction resulting from the intercourse of the numbers. Many difficulties may arise to a practical man which would sooner and more satisfactorily be disposed of by a jury of workmen, than by all the erudition of the Royal Society".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

AGRICULTURAL CHEMIST at the School of Agriculture, Houghall, Durham—The Director of Agriculture, 23 Old Elvet, Durham (September 14).

TEACHER OF MINING SUBJECTS in the Whitwood Mining and Technical Institute—The Secretary to the Managers, Education Offices, Castleford, Yorks (September 15).

RESEARCH ASSISTANT IN PHYSICS—The Registrar, University, Leeds 2 (September 20).

PROFESSOR OF CHEMISTRY—The Registrar, Indian Institute of Science, Bangalore, India (October 31).

PROFESSOR OF BIOCHEMISTRY—The Registrar, Indian Institute of Science, Bangalore, India—(October 31).

ASSISTANT for the Department of the Advisory Economist—The Secretary and Bursar, Seale-Hayne Agricultural College, Newton Abbot, Devon.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Sir John Cass Technical Institute. Calendar, Session 1939–1940. Pp. 146. (London: Sir John Cass Technical Institute.) [228

The Absolute Colorimetric Analysis of Metals by the use of the Pulfrich Photometer: Directions for Absolute Colorimetric Analyses of Iron, Steel and Light Alloys. Pp. 103. (London: Carl Zeiss, Ltd.) [228

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. Vol. 238, No. 789: The Specific Heat of Gases at High Temperatures. By R. W. Fenning and A. C. Whiffin. Pp. 149–228+1 plate. 9s. Vol. 238, No. 790: Self-Consistent Field, including Exchange and Superposition of Configurations, with some Results for Oxygen. By D. R. Hartree, W. Hartree and Bertha Swirles. Pp. 229–248. 2s. 6d. Series B: Biological Sciences. Vol. 230, No. 565: Reproduction in the Spotted Hyena, *Crocuta crocuta* (Erxleben). By L. Harrison Matthews. Pp. 78+14 plates. 24s. Vol. 230, No. 566: The Protobranchiate Mollusca, a Functional Interpretation of their Structure and Evolution. By Dr. C. M. Yonge. Pp. 79–147+plate 15. 12s. Vol. 230, No. 567: The Distribution of Anthocyanins in Flowers, Fruits and Leaves. By William John Cooper Lawrence, James Robert Price, Mrs. Gertrude Maud Robinson and Robert Robinson. Pp. 149–178. Vol. 230, No. 568: Evidence on Spiral Structure and Chromosome Pairing in *Osmunda regalis* L. By Dr. Irene Manton. Pp. 179–216+plates 16–19. 11s. (London: Cambridge University Press.) [228

Air Ministry. Production of Civil Aeroplanes: Report of a Committee appointed by the Secretary of State for Air. (Cmd. 6038.) Pp. 18. (London: H.M. Stationery Office.) 4d. net. [248

Economic Advisory Council: Committee on Nutrition in the Colonial Empire. First Report, Part 1: Nutrition in the Colonial Empire. (Cmd. 6050.) Pp. 310. 8s. net. First Report, Part 2: Summary of Information regarding Nutrition in the Colonial Empire. (Cmd. 6051.) Pp. iv+146. 2s. 6d. net. (London: H.M. Stationery Office.) [248

Other Countries

Report on Some Problems of Personnel in the Faculty of Arts and Sciences. By a Special Committee appointed by the President of Harvard University. Pp. xxiv+166. (Cambridge, Mass.: Harvard University.) [228

University of California Publications in American Archæology and Ethnology. Vol. 35, No. 7: Contributions to Alsea Ethnography. By Philip Drucker. Pp. iii+81–102. 25 cents; 1s. 3d. net. Vol. 36, No. 5: Ethnographic Notes on the Washo. By Robert H. Lowie. Pp. iii+301–352. 50 cents; 2s. 6d. net. Vol. 36, No. 6: Pomo Geography. By Fred B. Kniffen. Pp. iv+353–400+plates 5–7. 50 cents; 2s. 6d. net. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) [238

Anthropological Records. Vol. 1, No. 5: Culture Element Distributions, 9: Gulf of Georgia Salish. By H. G. Barnett. Pp. iv+221–296. 75 cents; 4s. net. Vol. 1, No. 6: Culture Element Distributions, 10: Northwest California. By Harold E. Driver. Pp. vi+297–434. 1.25 dollars; 6s. 6d. net. Vol. 2, No. 3: The Northern Paiute Bands. By Omer C. Stewart. Pp. iv+127–150. 25 cents; 1s. 3d. net. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) [228

Catalogues, etc.

Zeiss Nachrichten. 2 Folge, Heft 9, Januar 1939. Pp. 307–354. (Jena and London: Carl Zeiss.)

Priced Catalogue of B.D.H. Laboratory Chemicals and Testing Outfits. Pp. vi+232. (London: The British Drug Houses, Ltd.)

Philips Technical Review. Vol. 4, No. 7, July 1939. Pp. 181–212. (London: Philips Lamps, Ltd.).

Bollettino delle Opere scientifiche—Medicina. Pp. 50. (Bologna: Libreria L. Cappelli.)

Precision Instruments by Kipp and Zonen. (Kip. 3.) Pp. 4. (London: W. Edwards and Co.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, SEPTEMBER 16, 1939 No. 3646

THE FUTURE OF CIVILIZATION

THE supreme need for concentrating national effort upon the successful prosecution of the war, and securing the overthrow of the forces which threaten good faith and understanding among the nations, should not be allowed to blind us to the necessity of preparing the foundations upon which a just and enduring peace can be based. It is, indeed, to defend the moral and spiritual realities upon which civilization itself depends that we have been driven to enter this conflict. To keep those moral issues clearly defined is essential if we are to sustain the sacrifices and effort which the task to which we have addressed ourselves will demand. We should not forget that it is possible to win a war and lose the peace.

There is, indeed, no reason for those who recognize that the future of civilization depends upon effective co-operation between governments and nations either to be dismayed even at the present moment or to relax their efforts to achieve co-operation. They must, indeed, seek rather to be ready to seize the opportunity for constructive statesmanship, when it has been won from the aggressor and respect for the rights of others re-established. Apart from the moral issues upon which the conflict has been joined there is, indeed, welcome evidence to be found of the success of efforts in this direction in certain fields.

Among such evidence may be cited the encouraging report of the special committee which was recently appointed by the Council of the League of Nations to consider how best international co-operation could be developed in economic and social affairs. The pre-occupation of public interest with the League's efforts to abolish war, and disappointment over its failure to create an effective system of collective security, have led to failure to appreciate its success in other directions. Even those who are aware that most of the League's activity has been concerned with social and economic problems have little idea of the varied character of this activity, and how beneficial have been its results.

The report of this special committee should redress the balance. The progress of civilization is dependent to a growing extent on economic and human values, and in such diverse problems as the prevention of unemployment or of wide fluctuations in economic activity, the provision of better housing, or the suppression and cure of disease, purely national action cannot find a complete solution. The mechanism of international co-operation which has been built up by the League is rendering invaluable service to the world as a whole in meeting these needs. Moreover, the way in which the world is becoming closer knit, in spite of political severance, and the growing similarity of the form of economic structure in different countries and of the difficulties for which they must find solutions, are powerful factors even at the present time in stimulating the expansion and development of the League's work in such fields, and in the scientific approach to such questions as nutrition, housing and health on an international scale.

International discussion offers a further advantage in affording a safeguard against the effect on governments of sectional influences at the expense of the general welfare. The growing material and intellectual demands which men make on life, the consciousness that a better use of the scientific and productive resources of the world could improve their living conditions out of all knowledge, the impatience for some real and concerted effort to raise the standard of living near to what it might become, are yet further factors reinforcing the tendency towards international co-operation. Indeed, it may well be expected that the very sacrifices and renunciation which citizens in Great Britain have so willingly made of the advantages which modern science had placed in their hands, whether in the domain of communications and transport, lighting, entertainments, which within a couple of decades or so we had come to take for granted, will stimulate a further and more determined effort after the war both to extend such advantages and by international co-operation to make them secure from interruption again.

The picture which this report gives of the variety and success of the League's work in the checking of epidemics, the control of disease, the suppression of the traffic in opium and other narcotics, and in women and children, or the regulation of international communications or the pooling of experience and investigations in such problems as nutrition or the causes of economic depressions, is not altogether unfamiliar to many scientific workers. The present report, however, gives a concise summary of the real advantages of the League's organization and the way in which it is able to make a uniquely economic contribution. Its resources enable it to collect and sift evidence drawn from all over the world, to obtain the services of the best experts and arrange meetings between them, and to provide the essential links between experts and those responsible for policy, as well as opportunities for statesmen to meet and discuss their policy, and machinery for the conclusion of international agreements. As Mr. Cordell Hull recently wrote to the Secretary-General: "The League of Nations has been responsible for the development of mutual exchange and discussion of ideas and methods to a greater extent and in more fields of humanitarian and scientific endeavour than any other organization in history."

Considerations such as these have led the Special Committee, of which the Right Hon. S. M. Bruce was chairman, to its proposals for extending the work of the League in this field and increasing its efficiency. It recommends that a Central Committee for Social and Economic Questions should be created to supervise the work and co-ordinate the efforts of the many different agencies engaged in it. This committee would direct and supervise the work of the League committees dealing with social and economic questions, and appoint the members of the standing technical committees so far as possible. It is further proposed that, to give States which are not members of the League the opportunity of the fullest co-operation in the work itself as well as in its direction, non-members of the League should be represented on the committee on the same footing as the member States, and that the committee should have power to co-opt non-official members experienced in economic and social affairs.

These proposals should facilitate a clearer separation between the political and non-political work of the League, and provide a permanent basis for the development of the economic and social work of the League. Apart from this development, such separation may be of value in retaining the structure of the organization if, after the war, it is expedient to make a fresh start to secure the goodwill and co-operation of Germany and other nations.

Nor is it only on the social and economic side that we have been reminded of the forces still working for international co-operation. Two papers prepared for presentation before the Division for the Social and International Relations of Science at the Dundee meeting of the British Association deal with the question of international intellectual co-operation. Prof. Gilbert Murray describes the purpose and organization of the Committee of Intellectual Co-operation and the various types of conference organized under its auspices or in association with other bodies, such as the International Labour Office. He refers, for example, to the study of science and social relations, such as the effect of scientific invention on industrial conditions, and the proposal of the International Labour Office to include men of science in its conferences.

Prof. Gunnar Dahlberg's paper is mainly concerned with the question of translation of scientific papers. Organization of the facilities of translation would, he considers, facilitate international co-operation for the smaller countries, and Prof. Dahlberg supports the idea of a world language in science. He also stresses the value of informal conferences on special problems between leading men of science from different countries.

If the possibilities of international conference on any scale are remote at the moment, the movements and tendencies in the field of intellectual co-operation, no less than in the economic and social sphere, should remind us of the hard thinking and preparation which are yet to be done if opportunities are to be seized as they present themselves.

We have entered on this struggle to prevent further encroachments on freedom of thought and speech and investigation; but freedom can be endangered even in such a cause as that for which we contend. If the fruits of victory are ultimately to be reaped, we must bring to the struggle not merely the full force of our moral and material resources, but also constructive and imaginative statesmanship ready to build on whatever remains from the present wreckage of our hopes. Science, at least, has given men a vision of the world that might be when man's moral and spiritual development is in keeping with his material advance. If that world is ever to be realized, scientific workers, amid the stress of the present emergency, must guard zealously their loyalty to truth, not less than their belief that science transcends national frontiers, and that mankind will only enter on its full heritage through international co-operation and understanding, and the mutual respect and good faith upon which alone such co-operation and understanding are possible.

AN ENCYCLOPÆDIA OF CHEMISTRY

Thorpe's Dictionary of Applied Chemistry
Vol. 3. Chemical Calculations—Diffusion. By Prof. J. F. Thorpe and Dr. M. A. Whiteley. Fourth edition. Pp. xxiv + 608. (London, New York and Toronto: Longmans, Green and Co., 1939.) 63*s*. net.

THE third volume of Thorpe's "Dictionary" opens with a short sermon by Dr. Johnson intended especially for adverse critics. To one who has not, perhaps, been too complimentary in the past, it is indeed gratifying to find that a few chance words have deserved so much attention, for the reviewer of an encyclopædic work such as the present, not being omniscient and having no collaborators, must needs confine himself to general aspects, although, on occasion, he may be permitted to indicate an error. He can but put forward what he believes to be the views of a section of readers and make suggestions which he considers will improve the later volumes.

It was mentioned that, to justify the issue of a new serial which might become a millstone around librarians' necks, matter of exceptional character would have to be provided, and this condition appeared scarcely satisfied by the first two volumes. Another ground for complaint was that, in spite of the title and the crying need for an up-to-date book on industrial processes, the general impression of these volumes was that of a text-book on organic chemistry.

It seems too much to hope that these remarks have borne fruit, but the fact remains that the third volume is something different. It is possible to turn over page after page without seeing an organic formula, and references dated 1936, 1937 and even 1938 abound, while, when preparing a list of the more important contributions, it is necessary to write "new" with almost monotonous regularity.

The volume opens with an excellent article on chemical calculations, a title which unfortunately does not indicate the scope of the contents. It includes triangular co-ordinates, nomograms and graphical methods of calculation in general, or, as the author puts it, "methods of saving time in calculating". It should be read by all chemists, and physicists too. Other general articles include "Chemical Warfare", beginning with the words: "Chemical warfare is prohibited by the Geneva Protocol of 1925," but none the less doubled in length since the issue of the supplement and containing a concise account of the subject with good bibliography; "Colloids", a brief but clear survey; "Colorimeters", a lucid treatise on modern instruments, their uses and the theory of colour measurement, which should be in the hands of all those who have to deal with the subject; "Condensers", in which the author has shown his ability to condense matter other than vapours by discussing in eight pages, largely occupied by illustrations, the history of commercial and laboratory condensers, types for special purposes, condensers used in industry, the corrosion of condenser tubes and the theory of condensation, the whole being interspersed with more than one hundred references; "Co-ordination Compounds", extended from the supplement and brought up to date to form a comprehensive review; "Corrosion and Protective Measures", occupying thirty-two pages, which must perhaps receive a prize for the admirable way in which it deals with the many aspects of this controversial but important subject; "Crystallisation", a good article with adequate diagrams, dealing with the principles underlying what was until recently an empirical process; and, finally, "Diffusion", in which the phenomenon is considered mainly from the laboratory aspect—in view of its importance in industry, a more comprehensive treatment would have been desirable, but perhaps there is to be an article on diffusional processes.

There is but one black spot, mentioned on a previous occasion, and that is the risk that these valuable articles may escape notice. The man in the street wanting information on mustard gas would think he must wait some years for M or G or P, while the chemist might look up "Chlor" but obtain no satisfaction. Even if an abbreviated index is not possible, a list of general articles to date would be of much service to the reader.

The longer articles dealing with individual substances or groups of substances have been mostly rewritten, in many cases by those engaged in actual manufacture, and a fair number of new diagrams has been introduced. A particularly pleasing example is "Benzol Recovery", while "Chloroform", although taken from the older edition and ruthlessly mutilated, is still able to remain a gem. It is difficult to say whether "Cinchona Alkaloids" or "Cyanides" is the outstanding contribution in this class. Each occupies some fifty pages and summarizes our present knowledge with a conciseness not likely to be found elsewhere. A new contribution, "Coal Tar", with explanatory diagrams, serves as a good introduction to modern distillation methods, while "Chlorine", partly rewritten and enlarged, contains among much other information a useful account of electrolytic cells. Space does not allow discussion of all the three hundred and ninety-five headings dealt with, and thus it must suffice only to mention "Cobalt" and "Copper" with their important alloys, "Citric Acid" and "Cider" among the natural products, and "Cyanine Dyes", "Diazo Compounds" and "Cocaine" with its derivatives, as illustrating some recent developments of organic chemistry. Finally, "Deuterium", practically unknown when the last edition was published, has now an extensive literature which has been collected and abstracted to give a very complete account of the properties of the element.

To summarize: volume 3 appears to be a great advance on its predecessors and to approach very nearly the ideals of its authors. May the high standard they have set up continue and may they find, with Dr. Johnson, that "useful diligence will at last prevail". H. E. W.

FIRST YEAR UNIVERSITY BOTANY

An Introduction to Botany
By Prof. Arthur W. Haupt. (McGraw-Hill Publications in the Botanical Sciences.) Pp. xii+396. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 18*s*.

An Introduction to Botany
with Special Reference to the Structure of the Flowering Plant. By Prof. J. H. Priestley and Lorna I. Scott. Pp. x+615. (London: Longmans, Green and Co., Ltd., 1938.) 17*s*. 6*d*. net.

A GOOD many university botany schools have now published their first-year teaching courses as text-books. They vary strikingly in subject, but this may make little ultimate difference as gaps can be made good in the next two years; it may also matter very little whether the wide survey method or intensive study on 'types' is used. The student's attitude to his work at the end of the year is what is of fundamental importance.

All teachers must have seen a freshman of promise, starting with a childlike thirst for knowledge, who in a year or two became dull, seemingly bent on acquiring the minimum of knowledge (and very likely failing in that). However little the teacher is to blame, it may well be that this disaster would have been prevented by other methods. Of great importance, too, is the student's attitude to his practical work, whether he makes a record of his observations which he is prepared to trust when, for example, it conflicts with book or lecture. Perhaps a student cannot greatly increase his inventiveness and power of logical thought; but these virtues can be put to sleep by wrong teaching.

While it is the nature of a text-book to supply facts, some writers show their preoccupation with education (as apart from instruction) more obviously than others.

(1) Here are two books, both good. Haupt's shows a very normal balance and excels in the simple way every subject is treated

There is no doubt that a student who wanted a book to supplement his lecture notes would like it; and if his botany ends with the year, it may be just right. It is an easy book because it is well arranged and well expressed, and sometimes because things are made to seem easier than they are; for example, in the section on transpiration the reader would certainly suppose that light causes stomata to open through increased sugar formed simply by their own photosynthesis. It may be well to save a muddle by withholding queer facts, but only if the reader is made to realize that he has not anything like the truth. It must be more difficult afterwards to teach the mechanism of a stoma where a slick and wrong notion is held than where there is none. On the other hand, it may be that the student will be so interested and encouraged by his ability to understand that he will surmount his difficulties none the worse.

(2) Priestley and Scott's book is unusual in balance; nine tenths is on the flowering plant, though the continuation of the title "with Special Reference to the Structure of the Flowering Plant" is barely just, for structure is only considered in relation to function. Tables of real data are included; they may not always prove their point, but they are exactly the sort of measurements students can make, and they are as ragged as an honest student's results. It may be said that this book is unique in fostering scientific honesty by glaring examples. Much of the subject matter is equally fresh, and the teaching reader is sure to find ideas to incorporate in his own course.

Difficulties are faced wherever they arise, but scarcely so admirable is the way some are met when there is no apparent need; there is, for example, some discussion of plastochrones and the significance of Fibonacci phyllotaxis. Causal explanations are given throughout, but sometimes on an inadequate basis. It is said that the modification of gorse leaves to spines "appears to be due to lack of sufficient water", and as evidence is given the statement that in wet seasons gorse shoots often revert to the flat seedling foliage. Gorse, however, develops fierce spines in western Ireland (where it is surely wet enough) and in gardens along with soft-leaved plants. It is, however, only just to say that this is an extreme example, and the risk to the student is the less since a causal explanation at once suggests an experimental test, or original observation.

T. M. H.

EXPERIMENTAL EMBRYOLOGY

Form and Causality in Early Development
By Prof. Albert M. Dalcq. Pp. vi+197. (Cambridge Biological Studies.) (Cambridge: At the University Press, 1938.) 12*s.* 6*d.* net.

THE fertility of its ideas and the widths of its interests have combined to make the Brussels School of Embryology under Prof. Dalcq a centre whose work and activities are of the greatest interest and importance to all biologists. It is therefore particularly valuable to have Prof. Dalcq's views succinctly set forth in this volume which he has written in English.

Few are the aspects of experimental embryology to which the author and his colleagues have not made original contributions, and the present work is, essentially, a synthesis of modern views based on experimental evidence of the time-honoured problem of the causality of form-production in ontogenetic development. Space is lacking in which to do justice to the many important problems raised in this book, such as the progressive development of the inductive power of the organizer, the potencies of the ascidian egg, or the nature of the phenomenon of regulation. But attention must be paid to what is, really, the point of chief interest and importance of the book, namely, the attempt to formulate an explanation of the repartition of the presumptive organ-forming regions of the chordate egg. This the author ascribes to the combined effects of processes associated with a gradient in the cortex of the egg having its high point at the site of normal formation of the dorsal lip of the blastopore, and a gradient in the yolk the repartition of which is under the influence of gravity. A dorsal lip invaginates at the normal site, or at a place nearest this site in contact with yolk, and sets up an organizing centre. By introducing the concept of threshold qualitative response values in the gradient field set up by the above-mentioned gradients, a formal explanation can be arrived at of the distribution of the presumptive notochord, mesoderm, neural plate, and other territories.

The concept is nothing if not bold, and extends in many ways the views which have now for some time been associated with the name of Child. If Prof. Dalcq's views can be substantiated, then indeed a capital step will have been taken. The author would be the last person to deny the necessity for further experimental evidence to establish his hypothesis beyond question; and there are difficulties. But already his hypothesis enables acceptable interpretations to be given of results which have seemed baffling, such as

Yamada's experiments on the differentiation of presumptive notochord into structures of 'sub-notochordal' rank; or Lopaschov's demonstration of the differentiating powers of massed organizers.

Another very important aspect of Prof. Dalcq's position is his derivation of gradient fields from pre-existing oocyte organization and not as a result of the action of directional external factors. This has an important bearing on the problem of preformation and epigenesis, and also points the way to a field of new work on gametic cytology. But enough will by now have been said to bring to the notice of all biologists the fundamental importance of Prof. Dalcq's work.

G. R. DE BEER.

FORESTRY IN INDIA

Manual of Indian Silviculture

Part 1: General Silviculture, by H. G. Champion; Part 2: Silvicultural Systems, by Sir Gerald Trevor. Pp. xv+374+33 plates. (London: Oxford University Press, 1938.) 30*s*. net.

SINCE the establishment of the Forest Research Institute at Dehra Dun in 1906, Indian sylvicultural knowledge has advanced rapidly. Two manuals of Indian sylviculture had been written at different times before then, but these have long been out of date. The appearance of the present work, therefore, is to be welcomed. Its joint authorship does not imply collaboration. The two portions of the book—(1) "General Silviculture", by Champion, and (2) "Silvicultural Systems", by Trevor—might equally well, and perhaps with advantage, have been published as separate works.

Champion's contribution, which occupies more than three-quarters of the whole, breaks much new ground, and its general arrangement is logical. The subject matter is dealt with in eight chapters: i, the locality factors of the forest; ii, growth and form of trees and crops; iii, tree and crop physiology; iv, forest composition and distribution; v, natural regeneration; vi, artificial regeneration; vii, afforestation; viii, tending. Each chapter is subdivided into well-defined sections and subsections which facilitate reference, and although the style is terse and sometimes even brief, a comprehensive list of references to literature appears at the end of each chapter. In this way much ground is covered within a reasonably small compass, while the reader is put in possession of the necessary references for further details. While general principles are expounded, the author is at pains to apply them strictly to Indian conditions.

Under locality factors, special attention is paid to the important question of the soil. Admittedly our knowledge of forest soils, particularly in the tropics, is as yet far from complete; nevertheless, this section should prove of much value to students of tropical sylviculture. A noteworthy feature of tropical forest soils is the absence of decayed leaf litter, owing to the rapid decomposition in warm climates; this may be observed even in rain forest with a yearly production of 100 tons of fresh organic matter per acre. Typical *p*H values are given for different forest soils in India, the most acid being red laterite (4·5) and the most alkaline black cotton soil (8·7–9·0) and alkali soil (9·6–10·4). In the irrigated areas of the Punjab, it has been found that soils with *p*H exceeding 8·5 cannot be satisfactorily planted with *Dalbergia sissoo*; up to 9·0 several of the indigenous trees can grow, but above 9·5 the soil is barren.

Among the many biological questions relating to forest trees and crops that are dealt with may be mentioned conditions of flowering and seeding, seed dispersal, the establishment of seedlings (including the phenomenon of 'dying back'), root competition, the inheritance of parental characters, and water and light relations. Part 1 ends with a useful discussion of artificial regeneration and tending, and stress is rightly laid on the importance of shifting cultivation as a basis for the formation of forest plantations.

Part 2, on sylvicultural systems, by Sir Gerald Trevor, following the arrangement and substance of Troup's "Silvicultural Systems", enumerates the various systems developed in Europe, and gives examples of the application of these systems to Indian forestry. It is of particular interest to note how the systems of Europe have been adapted successfully, with suitable modifications, to the varying conditions in India. Leaving out of account the management of bamboo forest, which does not concern European forestry, and the rough selection fellings employed as a provisional method of working, it may be said that, apart from local modifications, there is no Indian system described in the book that is radically different from one or other of the recognized systems of continental Europe. This is ample testimony to the soundness of the policy at one time in force of including in the training of probationers for the Indian Forest

Service a period of practical study in those European countries in which the standard sylvicultural systems are well exemplified. Some of these systems are now so well established in India that they furnish examples equal to anything to be found in Europe: this only serves to emphasize India's indebtedness to Europe, a fact that is sometimes overlooked.

The style of the book is attractive and the illustrations are good, though in some of the titles the omission of the locality to which they refer detracts somewhat from their interest.

THE HYDROLOGY OF THE UPPER WHITE NILE

The Nile Basin

Vol. 5: The Hydrology of the Lake Plateau and Bahr El Jebel. By Dr. H. E. Hurst and Dr. P. Phillips. (Ministry of Public Works, Egypt: Physical Department Paper No. 35.) Pp. x+251+103 plates. (Cairo: Ministry of Finance, 1938.) P.T. 100. 20*s*.

SINCE 1931 the Physical Department of the Egyptian Government has been issuing at intervals the volumes of a publication "The Nile Basin", written by Drs. H. E. Hurst and P. Phillips. The earlier volumes have contained descriptive matter and statistical records of hydrological observations of the Nile and its basin. The series has now been crowned by the volume under review, which summarizes and discusses the results of thirty years' river survey in the Sudan, upon which work Egypt has spent money both generously and fruitfully.

The excellent and numerous maps and diagrams that accompany the text have been reproduced by the Survey of Egypt, from which the Physical Department has sprung. One is reminded by this instance of co-operation of the principle advocated before the British Association in 1929 by Brigadier E. M. Jack, that the several survey branches of any country's administration should be as closely related as possible.

"The Nile Basin" is a book of a type of which unfortunately far too few examples get published. Mankind is comparatively well supplied with information as to the resources of the heavens and the earth itself but, as was noted by Galileo, knows little of the freshwater resources of the globe. So much is this the case that, when anything on the subject is reported in a British technical journal, the indexer usually is at a loss to classify it suitably and places it under some such heading as 'Water Supply', that is, distribution, whether the resources have been put to use or not. In this connexion, reference may be made to a recent Stationery Office publication, in which on an advertisement page the Surface Water Year-book of Great Britain, 1935–36, is placed under the heading of River Pollution and Fisheries.

The motives of modern Egyptian river-studies are the same as those for which the Roda gauge at Cairo has been read since A.D. 620, namely, irrigation and defence against floods. Without entangling the reader deeply in the problems of the Egyptian Irrigation Department, the authors frequently discuss their data with reference to those problems.

The task of surveying the Upper Nile is a formidable one, because of the tangle of lakes, channels and swamps in which the river-flow is gradually accumulated and through which it passes to Malakal. As the result of these physical conditions, any scheme for the conservation of the river-water in those regions in the interests of far-away Egyptian agriculture brings many factors into play. There is, however, a practical limit to the amount of survey that can be undertaken. Great care and skill have, therefore, to be exercised in extracting the maximum of accurate data for the testing of the schemes prepared.

In performing their task, the authors have, however, placed hydrologists as well as river-engineers in their debt, not only by furnishing well-arranged records of the river-system and its behaviour but also by discussing various problems and phenomena, such as the time of travel of changes of river-level and discharge; sunspots in relation to the water-levels of Lake Victoria; flow through and water-losses in swamps; the backwater effect of large rivers on one another; and gauge-discharge relationships as observed at various points on the Nile. Orthodox forms of statistical analysis have been used to an extent that is otherwise very rare in studies of this great river.

Dr. Phillips' death unfortunately occurred whilst this book was in draft form. Although hydrologists must deplore the premature loss of this valued worker, they can nevertheless rejoice as he surely would have done that this admirable record of the river-survey work of Dr. Hurst, his staff and the Egyptian Irrigation Department has now by publication been given a wider audience and endowed with permanency.

W. Allard.

SEVENTH INTERNATIONAL GENETICAL CONGRESS

THE chief qualifications demanded of those who undertake the organization of an international scientific congress in these days would seem to be an unwarrantable optimism and a complete disregard for current political events. At no time during the last two years has it ever been certain that the International Genetical Congress would meet, and now it is indeed surprising that it ever met.

It will be remembered that the Permanent International Committee appointed by the Sixth Congress at Ithaca in 1932 accepted the invitation of the Russian geneticists to hold the next Congress in Moscow in 1937. Difficulties arose, however, which made its postponement necessary. Late in 1937, the International Committee had reason to doubt that the Congress could be held in Moscow even in 1938, and found it necessary to seek invitations from other countries. The committee of the Genetical Society of Great Britain was informed that if we in this country were prepared to take over from the Russians, we should be rendering both the science and the International Committee a very great service. Being assured that it was quite impossible for the Congress to meet in Moscow in 1938, the Genetical Society of Great Britain offered, in October 1937, to stage it in Great Britain in 1939 This offer was eagerly accepted.

The committee of the Genetical Society formed itself into an organizing committee and decided that the Congress should meet in Edinburgh. F A. E. Crew was appointed general secretary. Since N. I. Vavilov would have been the president of this Congress had it been held in Moscow as was intended, and since we wished to indicate in the only manner available to us our great respect for him personally and our ardent desire for the active co-operation of the Russian geneticists in the affairs of the Congress, an invitation was sent to Vavilov asking him to continue in the presidency.

During 1938 and the first half of 1939, the programme of the Congress slowly took shape. At times the organizing committee had reason to think that its was a hopeless task; at others it was greatly encouraged by the eager co-operation extended to them by geneticists from all over the world. A programme built up of more than four hundred papers of quality was ultimately issued, whilst in London, Cambridge and Edinburgh preparations for the reception and entertainment of some four hundred foreign guests were completed. Yet all the while doubt lurked in the minds of all of us. It was obvious to all that the day was not far distant when the flickering lamps of science would be dimmed, and the only question that concerned us was when this day would dawn. Should we be permitted to carry this Congress to its successful conclusion before we were required to leave the forges of knowledge and use tools that we had made, for unworthy and damnable purposes?

On the morning of August 23 there gathered for the first meeting of the Congress some six hundred geneticists drawn from fifty-five different countries. There could be no grander measure of the devotion that men of science give to the science they serve than this. They met in days heavy with anxiety, to consolidate the ground won by them and their colleagues during the last seven years. The Congress had met, but it lacked a president, for, a fortnight previously, information was received that no one from the U.S.S.R. would be attending. This was a wound which at the time seemed mortal, for it had been hoped that not only would Russia supply a president but also that fifty or more papers of outstanding quality would be presented. However, the vitality of the Congress was such that it survived, and for two days into its rooms none of the loud murmurings of the outside world entered. Looking back on those days, they now seem to have been a dream of what the world itself might be were all men reasonable.

It is true that according to the records there were Americans, French, Germans, Poles, and all the rest of a great geographical and political variety, yet these were divided by no barrier of language or of prejudice. They formed one harmonious whole, moved by a common purpose, to advance a science, to serve mankind, to cultivate a fellowship. But the murmurings outside grew in intensity, and towards the end of the second day the air became disturbed, and everyone began to remember his private responsibilities and duties. The first group to be seriously affected was the German delegation (34 strong), which received advice that it would be desirable for them to think of returning home. This advice they resisted until it became quite certain that if they delayed longer they might encounter very serious difficulties in transportation; and so, most regretfully, and bearing with them the good wishes of their colleagues, they bade us farewell. At the same time, owing to mobilization of the Dutch army, the delegation from the Netherlands (17 strong) decided that it was desirable that they also should go. From that moment onwards the citizens of Edinburgh looked upon the Congress as a trustworthy barometer. Hourly inquiries as to whether or not the Italians, the French and the Poles were still with us were received, and Edinburgh was comforted when it could be told that the French and the Poles were remaining with us, and that the Italians had no intention of departing.

The programme, of course, was sadly crippled by this time, and for a while the organizing committee considered the question as to whether or not, in the circumstances, it would not be advisable to bring the Congress to an abrupt end. However, the Congress itself decided that it should continue. There was little else that we could do save to indicate, by continuing, that science was worth serving even in days like these, and that it, of all things, offered the most enduring good to all mankind. But the Congress was shortened, for Sunday was made a working day. A brave gesture this, for it will be remembered that Edinburgh is the capital of Scotland. As things turned out, this decision was more than justified, for the meetings continued to be very well attended right to the end, and daily the congressists sat down to mighty repasts. Looking back upon the sessions from this short distance, it would seem that not one of them was remarkable for the announcement of any startling discovery, but that they were immensely useful in that, during them, differences were bridged and new lines of advance were traced.

The organizing committee received repeated expressions of congratulation for the way in which the Congress affairs were conducted. Those who congratulated us seemed to be unaware of the obvious fact that the quality of a Congress is determined not so much by its organization as by the personalities of its adherents. On this occasion we were more than ordinarily fortunate. From a great many countries there came strong delegations bringing contributions of knowledge, of friendliness, of charm. It was they who made this congress successful. To the Germans, to the French, to the Italians and to the Poles we are indeed indebted. They came at great personal inconvenience to our aid, and they have left behind them most happy memories. The coming of an American contingent, 130 strong, made the success of the Congress inevitable. But it is too much to expect that the welcome they received would compensate them for the distress that they endured when the Congress ended, for then they found themselves stranded in Great Britain with no immediate hope of return to their own. Already at least seven of them have been exposed to the gravest danger, for these were passengers on the *Athenia* and their fate at the moment of writing is not known. Some forty others have still to make the dangerous passage.

At the first business meeting of the Congress, F. A. E. Crew was elected to the presidency rendered vacant by N. I. Vavilov's absence. A Permanent International Committee, consisting of C. L. Huskins (Canada), O. Winge (Denmark), Boris Ephrussi (France), Von Wettstein (Germany), F. A. E. Crew (Great Britain), A. Ghigi (Italy), M. J. Sirks (Netherlands), Otto L. Mohr (Norway), G. Dahlberg (Sweden), A. Ernst (Switzerland), M. Demerec (United States of America), was appointed. This committee later elected F. A. E. Crew as its chairman.

At the second meeting of the Congress it was agreed that, in the circumstances, it was quite impossible at this particular time for the International Committee seriously to consider invitations and to decide as to the time and place of the next congress. It was intimated that invitations had been received from Italy and America. The International Committee was given authority to designate the time and place of the next congress at some later date.

Following a motion brought forward by the International Committee, the Congress decided that it should not be regarded as essential or necessary for future congresses to publish *Proceedings*. This decision was reached because it was recognized that, in the past, a number of invitations to meet therein had not been received from several countries on account of the expenses that are associated with the publication of the *Proceedings*. It was recognized that complete autonomy must be given to the actual organizing committee of a particular congress as to whether or not *Proceedings* of that congress should be published.

The Congress considered the setting up of an international committee which would devise a scheme whereby animal and plant stocks of genetical importance could be maintained in times of emergency. The International Committee was asked to consider the matter and set up a committee for this purpose.

During the course of the Congress a group meeting was arranged for the discussion on the statistical requirements of the student of genetics. At the end of this meeting the following resolutions were passed:

(1) That the teaching of statistics should be carried out in conjunction with the teaching of practical genetics.

(2) That elementary statistical methods, in particular tests of significance and their validity, should be included in the ordinary mathematical courses given at secondary schools.

(3) That the General Secretary of the Seventh International Congress of Genetics be requested to transmit copies of resolution 2 to any educational bodies which he considers may be able to assist in its fulfilment.

(4) That the genetical societies of countries

represented at the Seventh International Congress of Genetics be requested to discuss the teaching of statistics in relation to genetics and to transmit their final resolutions to the next congress.

In connexion with the Congress, a meeting of mouse geneticists was held on August 24 to consider a set of nomenclature rules drawn up by a recently formed Committee on Mouse Genetics Nomenclature and to discuss details of a Mouse Genetics News Service. The director and staff of the Roscoe B. Jackson Memorial Laboratory in Bar Harbor, Maine, U.S.A., have offered facilities for the publication in mimeographed form of the *Mouse Genetics News*. It was suggested that a register of stocks and the various pure lines should be drawn up; this should end the confusion in the naming of pure lines used in various laboratories which has arisen during the last few years. Stock lists of all the laboratories concerned should be published from time to time. It was further suggested that notice should be given by a laboratory before any stocks are discontinued; it has happened several times in the past that valuable material has been irretrievably lost, because every laboratory has relied on other places for its maintenance. The News Service should also arrange for exchange of stocks, and it is hoped that its activities may be extended to rabbits and other rodents. The meeting also discussed the establishment of centres, preferably in the United States, for the maintenance and safe keeping of stocks, particularly of genes (pathological and otherwise) which are not purposely kept by the fancy. It was urged that this matter should receive the immediate consideration of the News Service, and that an appeal should be made to the Carnegie and Rockefeller Foundations for financial assistance. F. A. E. CREW.

MEASUREMENT IN PSYCHOLOGY*

BY R. J. BARTLETT

IN the opening paragraph of "Psychology Down the Ages", Prof. C. Spearman concludes a list of difficulties facing any who seek to define psychology, with the questions: "Do the data at its disposal include what can properly be called 'measurements'? Is it, or can it ever hope to be, or should it as much as try to be, a systematic science at all?" Dr. William Brown, in the realm of medical psychology, answers the first question in the negative. Forced into metaphysics, he writes: "Determinism, although a postulate for psychology, cannot be accepted as anything proved. In physical science there is empirical proof of it to a certain extent through measurement. By measurement we can prove to a certain extent, within certain limits of error, the conservation of mass, the conservation of energy. . . . But there is no measurement of that sort possible in psychology. . . . The observations of psychology are primarily qualitative, not quantitative." But the writer of "Essentials of Mental Measurement" could not leave it there. He added a footnote: "But mental measurement, in a derived form, is possible in the domain of mental tests and of the psycho-physical methods."

The conflict between philosophy and experimental psychology, thus exemplified, is of long standing. Malebranche argued that mental states could be distinguished qualitatively, but not quantitatively. Leibniz declared that mathematical treatment was impossible in psychology as it lacked continuous magnitudes. Kant said that psychology possessed no mathematical magnitudes for the reason that, "whereas the phenomena of matter possess two variables, space and time, those of mind have only the single one, time". For these and many later philosophers psychology possesses neither measurable phenomenon nor the means to measure. Still worse! Some physicists seem to have reached the same conclusion. For them measurement is impossible in psychology.

Notwithstanding criticism from philosophy and physics, the word measurement is deeply imbedded in the literature of psychology, and of late years its use has been greatly on the increase. Experimental psychology is little more than fifty years old. Galton's "Inquiries into Human Faculty" appeared in 1883, Wundt went to Leipzig in 1875, Weber died in 1878 and Fechner in 1887. Since then an ever-growing body of workers has been applying experimental method to psychological problems and developing its own methods of measurement and mathematical treatment of data obtained. Contemplating this work against the declaration that measurement is impossible in psychology, Prof. Spearman comments: "But the path of science is paved with achievements of the allegedly unachievable. And in point of fact, mathematical treatment is perhaps just the region where psychology has made its steadiest and most surprising advances." My task is to attempt a review of experimental psychology that will reveal the senses in which the word measurement is being used by psychologists.

---

* From the presidential address to Section J (Psychology) of the British Association, delivered in Dundee on September 1

Psycho-physical Measurements

When we turn to actual measurements being made in psychological laboratories, we find in use metre scales and foot rules, balances and weights, chronoscopes and stop watches, resistance boxes, galvanometers, photometers and any other measuring instrument that ancient wisdom or modern physics has made available and happens to be of service in the task in hand.

One general group of tasks consists in measuring the results of bodily activity carried out under controlled conditions. Take as an example the product of a person's behaviour when asked to draw lines on blank foolscap paper of length equal to half the width of the paper. In one experiment 2,048 such lines were drawn and measured. It is probable that no two lines were exactly the same length, and that measurement to 0·01 mm. would have proved this, while obscuring a law binding them together.

Choosing a coarser unit, we measure to the nearest millimetre and find 92 lines of 103 mm. length at the modal value of results scattered from 69 mm. to 135 mm. Relative to the material our unit is still fine, so by addition we find the numbers of lines that would have fallen into each group had we measured with units 2, 3, 4, 5 and 6 mm. respectively. With increase of the size of unit the numbers approximate more and more closely to a smooth curve. Further, as we take out the figures for measurement with a unit of 6 mm., we recognize in them an approximation to the terms of the binomial expansion $(1+1)^{11}$. Then, using the slightly smaller unit of 5⅞ mm., we obtain a very close approximation to the binomial point curve. For a particular case we have established the fact that by suitable choice of unit our experimental data fall into groups closely approximating to the binomial distribution of their number, 2048. This is but a particular case of a general law.

The Gaussian continuous function, commonly called the *normal curve* or *curve of error*, in the form

$$y = \frac{N}{\sigma\sqrt{2\pi}} e^{-x^2/2\sigma^2}$$

gives close approximations to the values of binomial distributions, and is usually taken to represent the law of distribution of the results of the bodily expression of mental intention. The frequency with which results of this nature are obtained in psychological experiments leads to the conclusion that an appreciable scatter is an essential feature of our data, and that, while the old-time physicist or chemist can rest satisfied with the mean of two determinations, we must make at least fifty before we can be reasonably sure of the values of our constants. Experimental psychology could have made little progress without accepting what Dr. Darwin, last year, in his presidential address to Section A, called "the fuzziness inherent in absolutely all facts of the world", when he was arguing "that the subject of probability ought to play an enormously greater part in our mathematical-physical education".

Kant reached the conclusion that mind had but one variable—time. Without accepting his conclusion, we can concur in the importance of the time factor in mental happenings, and appreciate the part played in psychology by the Wheatstone-Hipp chronoscope, stop watches and other instruments for measuring and recording time intervals. Starting from comparatively simple beginnings, reaction times of more and more complex mental activities were determined, and the chronoscope has become for the psychologist what the balance is for the chemist.

It would seem undeniable that intensity is a characteristic of sensory experience. When we attempt to evaluate this quantitative element in sensation we are met with difficulties. First comes the fact that the same material object may be perceived by sensations that vary greatly in intensity. The intensity of experienced sound of an express train is as a rule different for a passenger comfortably sitting in it and for a would-be passenger standing on the platform as it rushes through a station. The intensity of the noise of a ticking clock sinks below the threshold when we are engaged in an absorbing task, but the energy output of the clock remains reasonably constant. The same source of stimulation occasions different intensities of sensation according to the subjective attitude of the recipient of the energy falling upon the sensory organs. To secure consistent results it is necessary to control the conditions, and in experiments involving sensation-intensity this is done by arranging that the subject shall give undivided attention to the stimuli. The maximal intensity thus obtained is accepted as constant for the given stimulus.

Normally we do not discriminate the intensity of the sensation, nor are we interested in the particular sensation itself. Our interest may be in the pleasure tone of the whole sensation complex, as when enjoying music or a glorious bank of flowers, but, more often, our interest is in the properties of the external objects that occasion the experience. The lightning's flash, the trumpet's blare are ominous portents, rather than intense sensations. This preoccupation with the things of the external world has given us science but makes introspective analysis of experience difficult. It endows sound, light and matter with 'intensity' which we proceed to measure with acoumeters, photometers and a balance. For the psychologist, however, these measurements are only of interest so far as they may help to throw light on the problems of sensory experience.

Early in the life of experimental psychology the smallest change in the stimulus value that could be appreciated in sensation became the subject of inquiry and, for the determination of this difference threshold, difference limen, least perceptible difference or just noticeable difference, the psycho-physical methods were developed and gave to psychology a technique the wide serviceability of which does not even yet seem to be fully appreciated.

[Mr. Bartlett here discussed the Weber ratio]

PHYSIOLOGICAL INVESTIGATION

Another branch of experimental psychology busies itself with the physiological concomitants of emotional experience. On a smoked drum record of a subject's breathing, measurement can be made of frequency and amplitude, and changes therein can be compared with introspection records to find out their meaning. The inspiration-expiration ratio, with varying emotional states, shows marked variations from the average value, rising to as much as three times that value in 'amazement' and sinking to about half the value under the sense of guilt or shame awakened by conscious misrepresentation or wilful falsehood. These changes in the ratio of inspiration to expiration are accompanied by marked changes in frequency, amplitude and form, which result in characteristic curves that the eye can read and interpret without recourse to the millimetre scale and time record. The whole profile, rather than its analysis, is diagnostic.

INTELLIGENCE TESTS

An entirely different method of measurement had by 1920 reached the stage where it could not be ignored. Intelligence tests were being widely used, and the Board of Education set up a consultative committee to report "on psychological tests of educable capacity and their possible use in the public system of education". The report appeared in 1924, and the principal findings of the committee were: "That up to the present the only kinds of psychological tests of educable capacity that have been sufficiently developed to be of much service in schools for the purpose of diagnosing and assessing such capacity are tests of 'intelligence', standardized scholastic tests, and to a less extent vocational tests". Let us consider the first of these.

The foundations of the method are laid in Binet's happy thought of 'mental age' and Spearman's application of methods of correlation to psychological data. Prior to Binet's work, testing had been confined almost entirely to tests of sensory discrimination. Spearman proceeded to calculate correlation coefficients between the results of such tests and estimates of intellectual ability. Binet, "instead of measuring the intensity of simple faculties", set out by tests "manifold and heterogeneous . . . [to] measure acts of adaptation . . . to determine how many years an individual is advanced or retarded". His measure is a time measure based on the normal development of intellectual ability. Originally his "manifold and heterogeneous" tests were 54 in number, used for the diagnosis of mental deficiency. This number has steadily increased until, in the New Revision of the Stanford-Binet Scale, issued by Terman and Merrill in 1937, there are two sets of 129 tests each, covering mental ages from 2 years to 22 years 10 months and providing for Intelligence Quotient values up to 170 for children and up to 152 for adults.

By correlation methods, Spearman compared the results of tests of sensory discrimination and estimates of intellectual ability, inaugurating a new phase of mathematical activity in psychology, in which, again, the tasks led to new methods. The correlation between two sets of measurements or rankings is a measure of the extent to which the sets of figures agree, and this agreement would seem to be due to a common factor in the abilities measured. It follows that "when any pair of abilities are to any extent correlated with each other, to this extent *they can be regarded as depending upon a common factor*. . . Otherwise expressed, each of the abilities may be taken to involve two factors, the one common to both, the other specific to that ability alone". Extending this thought to more than two abilities, Spearman developed his theory of two factors, and evolved various criteria for establishing the existence of the relations that fit the theory, culminating with the tetrad equation, $r_{ap}r_{bq} - r_{bp}r_{aq} = 0$, and its probable error.

VOCATIONAL TESTS

The Educable Capacity Report of 1924 gave limited approval to vocational tests, but concluded that "the range of such tests [was] not yet sufficient for any recommendation". The Medical Research Council, through the Industrial Fatigue Research it may suffer a little by comparison with its predecessor, which dealt with a more determinate theme. Perhaps, too, it was unfortunate that the first volume, concerned largely with philosophical generalities, was issued in 1906, and the second volume some two years later; for the latter bore chief witness to the solidity of the inductive treatment on which the author relied. In "Early Beliefs and their Social Influence" (1932), various essays occur that throw further light on his views about ethics, as also about religion, towards which he adopted a frankly agnostic attitude.

His latest views on this subject are to be found in "Christianity and Morals" (1939), a considerable work full of interesting material.

It remains only to say something about Westermarck's studies of the social institutions of Morocco, which country from 1898 onwards he had resolved to make his special field of first-hand investigation. Such works as "Marriage Ceremonies in Morocco" (1914), wherein he deals largely with the magical side of marriage ritual, a subject which his "History" had passed by, or "Ritual and Belief in Morocco" (1926), not to mention various minor writings, display his infinite capacity for collecting facts, conjoined with the analytic power that can reduce an apparently chaotic material to a lucid order. Indeed, Westermarck the ethnographer would bear a most distinguished name were it not that Westermarck the ethnologist had to some extent eclipsed himself. Finland may well be proud of having produced such a man, to know whom was a liberal education.

R. R. MARETT.

Prof. M. B. Krol

THE death occurred on August 6 of Prof. Mikhail Borisovich Krol, the eminent neuropathologist and director of the clinic for nervous disorders of the All-Union Institute of Experimental Medicine and of the Second Moscow Medical Institute.

Prof. Krol was born in 1879. He graduated from the medical faculty of the University of Moscow in 1901 and at first worked as assistant in the clinic for disorders of the higher nervous activities for women in Moscow under the direction of Prof. Minor, and in a number of clinics and laboratories in western Europe. In 1921 he took an active part in the foundation of the Belorussian University and of the medical faculty in Minsk. In 1924 he occupied the chair for nervous disorders in the Belorussian University, and was elected dean of the University. In 1931 he was elected a member of the Belorussian Academy of Sciences, and in 1939 became a member-correspondent of the Academy of Sciences of the U.S.S.R.

In 1932, Prof. Krol was appointed director of the chair of nervous disorders in the Second Moscow Medical Institute and director of the clinic for nervous disorders of the Institute of Higher Nervous Activities, now the All-Union Institute of Experimental Medicine. During 1934–38 he was chief physician of the Kremlin Hospital in Moscow. In 1935 he headed the Soviet delegation to the second International Neurological Congress in London. From June 1938, Prof. Krol directed the clinical section of the Institute of Experimental Medicine. He was the author of more than a hundred scientific works in Russian and other languages, among which are several monographs of first importance. He was president of the Moscow and All-Union societies of neuropathologists and psychiatrists. He was vice-president of the Medical Council of the Soviet Union, and editor of the journal *Soviet Neuropathology and Psychiatry*.

NEWS AND VIEWS

A.R.P. for Animals

THE Royal Society for the Prevention of Cruelty to Animals has issued a very useful booklet on "Animals and Air Raids" containing the A.R.P. for animals drawn up by its veterinary experts, and the demand has been so great that a second edition was immediately required. In addition to the usual veterinary treatments for burns, injuries, and gas contamination, described in a manner convenient for animal-owners at a time when only a limited number of veterinary surgeons will be available, there are some well thought-out practical hints in these difficult problems. It is stated that there are in Greater London approximately 40,000 horses, 9,000 cattle, 6,000 sheep, 18,000 pigs, 400,000 dogs, 1,500,000 cats; that there are some 200,000 working horses in England and Wales and in addition 1,004,686 agricultural horses. For horses on the streets, a halter and 12-ft. lead is advised to control the horse while unharnessing and then securing it at a spot away from falling masonry; the nosebag should be put on to keep it calm. For small dogs and domestic animals, a gas-proof air-tight box with an opening covered by a blanket dipped in a saturated solution of chloride of lime or permanganate of potash is recommended, and a similar device against gas is recommended for adapting stables, shippons and byres.

THE Government anti-gas ointment No. 1 is among the treatments recommended for mustard gas contamination of animals, and anti-gas ointment No. 2 can be smeared on vulnerable parts of a horse, as the legs below the knee and hock joints, when it has to be led through streets that may still be contaminated. The former, a powerful irritant, is composed of equal parts of stabilized bleaching powder and vaseline, the latter of chloramine *T* in a vanishing-cream base, but it is not stable. Both ointments are only for brief treatment. Petrol swabs or chloride of lime paste with frequent washes of soapy water are also recommended for contact with mustard gas that has not done serious injury, and hot water, soap and soda scrubbing for lewisite contact if blisters have not developed. The difficulties of providing for cats and birds, or of devising a gas mask for any animal, are stated to be considerable. Research is continuing in this work.

Royal Botanic Gardens, Kew

IT has been reluctantly decided to close the Royal Botanic Gardens, Kew, for the present owing to the impossibility of providing adequate air raid shelters in the Gardens. It will be readily understood that should an air raid occur and the Gardens were at all crowded with visitors, grave risks might be incurred. Not only would there be difficulty in evacuating the public before the gates were closed, but there would also be the practical impossibility of their being able to find sufficient shelter outside or means of transport to their homes. Even were it possible to provide air raid shelters, owing to the large extent of the Gardens and the six different means of entrance, the public would scarcely be likely to discover the shelters, however well labelled, at a critical moment, unless a large staff of wardens was available. Since so many of the staff have had to be detailed for guarding the Herbarium and other vulnerable spots in the Gardens, as well as the employees, there is no one who could be detailed to look after a large body of visitors. Adequate steps, it is hoped, have been taken to safeguard the collections in the Herbarium, the museums, etc., and work is proceeding so far as possible on normal lines.

The Toll of Accidents

THE Inter-Departmental Committee on the Rehabilitation of Persons Injured by Accidents has issued its final report (H.M. Stationery Office. 3*s*. 6*d*. net). The report refers to the loss to the community resulting from injuries by all classes of accidents as being "enormous", and the cost must run into many millions of pounds annually. Fractures in particular are dealt with, and the Committee recommends in the first instance concentration on the provision of fracture services, and concludes that the treatment of fractures can be satisfactorily carried out only in specially organized hospital departments. Some 15 per cent of all fractures are due to road traffic, and 29 per cent to industrial, accidents, and the Committee recommends a revision of the Road Traffic Act whereby the limits imposed on the amounts recoverable for the treatment of road accidents may be abolished. The Committee considers that every hospital with a medical school should have an organized fracture service, and that a period of training in a fracture department should be an obligatory part of medical students' training. Questions of organization and finance of fracture services are considered, and under the Workmen's Compensation Acts it is recommended, with certain reservations, that so long as the patient requires treatment by the fracture service he should continue to receive compensation as for total incapacity.

New Laboratory for Virus Research

THE Squibb Biological Laboratories, New Brunswick, New Jersey, have established a new laboratory for the study of filterable virus diseases. Dr. Raymond C. Parker, biologist of the Rockefeller Institute for Medical Research, has been appointed head of the laboratory, which will operate as a unit of the Biological Division of E. R. Squibb and Sons. The new building is a continuation of a programme of expansion which began in 1938 with the dedication to pure science of the 750,000-dollar laboratory of the Squibb Institute for Medical Research. Among the common diseases caused by filterable viruses are smallpox, rabies, equine encephalitis, measles, chicken pox, poliomyelitis, and the common cold. No specific product for the prevention of four of these diseases—the common cold, poliomyelitis, chicken pox, and measles—is yet available.

THE new virus laboratory, which was opened during a tour of the Squibb Institute and the Biological Laboratories on September 6–7, is housed in a specially constructed building, and is equipped for work with chick embryos and tissue culture, two of the techniques for work in this field. The actual working quarters consist of a large general laboratory equipped with every facility for chemical and histological work, a general preparation room for washing, drying, packing, and storing the various materials that are used, two special culture and operating rooms provided with filtered ventilation, a spacious incubator room, an animal preparation room, a bleeding room, and ample animal quarters. The arrangement of the rooms is such that the air of the culture suite proper is protected at all times from the air of the general laboratory and office quarters on one side, and of the animal rooms on the other. It is also possible for visitors to observe every step of the work in progress without entering any of the various rooms of the culture suite.

Experimentation and Disease

THE thirteenth Stephen Paget Memorial Lecture was delivered at the annual general meeting of the Research Defence Society on June 13 by Sir Edward Mellanby, who took as his subject "The Experimental Method in the Conquest of Disease" (*The Fight against Disease*, 27, Nos. 2 and 3). After a tribute to the memory of Stephen Paget, Sir Edward referred to the exhibition in an anti-vivisection office window of models of dogs suffering from rickets (incidentally, models of his own experimental animals), and remarked that it is difficult now to find throughout Great Britain children suffering from the same kind of deformity. Sir Edward Mellanby then proceeded to give instances in which the experimental method had solved the nature and causation of various diseases. In the case of facial paralysis ('Bell's palsy'), in 1844 Bell surmised on anatomical grounds that this form of paralysis was caused by paralysis of the facial nerve, and demonstrated the truth of this surmise experimentally by cutting the facial nerve in an animal and producing the condition, thus solving an age-old problem. The experimental work on the elucidation of the nature of rickets and scurvy as being due to vitamin deficiency, on the discovery of drugs curative for streptococcal infections, such as puerperal fever and pneumonia, and on the nature of cancer, were described. Finally, Sir Edward pointed out both the importance and the limits of clinical observation, and discussed some of the criticisms and failures of the experimental method.

Early Cultural Relations in Central America

AMONG communications dealing with the archæology of Central America presented to the Twenty-seventh International Congress of Americanists, which met in Mexico City on August 5–15 (see NATURE, Aug. 19, p. 319), there were several, it would appear from a preliminary report issued by Science Service of Washington, which brought forward suggestions and advanced conclusions of considerable interest in reference to the cultural relations of, and cultural successions among, the early inhabitants of Mexico and the adjacent regions. Dr. Alfonso Caso, president of the Congress, for example, in describing the results of his excavations on Monte Alban, not only argued for the common origin of the culture of that site with that of the not far distant ruined city of Mitla on the evidence of architectural affinities, but also put forward the conclusion that three stages of development are to be distinguished, which can be linked respectively with the Archaic culture of Mexico, dating from before the Christian era, the Toltec of Teotihuacan, and the Aztec. Further, Dr. A. V. Kidder, reporting on his excavations in pit-tombs near Guatemala city, assigns their builders to a period corresponding with the middle period at Monte Alban, or when the great Toltec civilization of central Mexico was approaching its decline. It would appear that the pottery from the Guatemalan pit-tombs provides a key which links the tomb builders with other early cultures of tropical central America. Some light was also thrown on the development of agriculture among the early peoples by Dr. Pablo Martínez del Rio, who advanced the theory that agriculture may have had a more rapid rise in the New World than in the Old, on the ground that differences in methods of seed selection and cultivation speeded up results for the Indian farmer, so that it was not necessary to postulate, as some botanists have done, an extremely long period of development.

Electrical Development in Iraq

IN a paper communicated to the *Electrical Review* of August 18 by W. H. Peters of Baghdad, a review is given of the post-War development of Iraq. Both Baghdad, the capital city, and Basra, its modern seaport, were left electricity systems installed by the British Army during the occupation. Being war products, they were limited in capacity and of antiquated design. During the past fifteen years these supply undertakings have been transferred to concessionaries or to the Government. The most provincial of the centre towns have shown initiative in the promotion of schemes for small plants primarily to serve the requirements of the administrative authorities for fans and for street lighting. The largest supply undertaking is that in the capital city, Baghdad, the population of which is about 250,000. It is directed by the Baghdad Light and Power Co., which is registered in the United Kingdom. It is the only supply station left which is of foreign ownership. The main thoroughfares of the city are copiously lighted, the load exceeding 300,000 watts. The port of Basra set up an efficient power station five years ago and the sale of energy in the port and the municipal area which it supplies has exceeded all expectations. The rate at which it sells power is 4½*d.* per unit for lighting and 2½*d.* per unit for domestic power.

WITHIN a year the 'Iraqi State Railway will be finally completed to the northern city of Mosul and will permit of railroad goods traffic both westwards to Syria and southwards to Basra passing en route Basra, Baghdad, Syria, Turkey and so on to Europe. This great need once fulfilled is almost certain to develop the import and export trade of Mosul, thereby increasing its prosperity. Until three years ago all the Diesel power stations were run by plant entirely of British origin, but recently German plant has made considerable headway. Iraq's exports of oil and agricultural progress show a very satisfactory increase year by year and these contribute to increased national wealth and a higher standard of living. This increase in the standard of living is not confined to the property owners and married classes, but is apparent almost everywhere. It is noteworthy that Britain has hitherto enjoyed no commercial privileges in Iraq.

Coal Utilization by Electricity

ACCORDING to the *Electrical Review* of September 1, Mr. M. Anderson, the director of the Coal Utilisation Council, estimated that to keep the public properly warm would necessitate the consumption of eight million more tons of coal per annum. To raise the standard of 'heat comfort' was one of the principal aims of the plan of campaign outlined at the last National Coal Convention. Since the success of the campaign would depend largely upon the development of the domestic and industrial demand for electric power and especially that used for 'space heating', convenience rather than necessity would be the controlling influence in regulating the demand for coal for power. Mr. Anderson referred to several other methods of increasing the coal output to compensate for the falling off in the direct demand for coal owing to the increasing use of electric power and heating in many trades. Trolley buses, also, although they have greatly diminished the demand for electric tramways and in spite of the competition of oil-engine buses, have probably increased the total demand for electric power from the public mains and consequently for coal. Trolley-buses move faster and give a much better service than almost any other vehicles. In many ways the interests of coal and its derivative electricity appear to be much the same. The demand by electric power stations on the collieries for 'slacks', 'duff' and rough 'smalls' now exceeds the supply, although coal-breaking and crushing plant has been installed at a number of collieries. This would naturally add to the cost of production.

Water-cooled Lamps for Television

A SERIOUS difficulty in television studios is the necessity of providing about double the light required by an ordinary cinema studio without subjecting the occupants and contents to intolerable heat. This difficulty has been largely overcome by the General Electric Co. of America at the television station at Schenectady, New York, by the use of a battery of four water-cooled quartz mercury arc units, containing twelve argon-filled lamps having a light output equivalent to that provided by nearly 30,000 watts of incandescent light, but they give off practically no appreciable amount of heat. According to the *Electrical Review* of August 25, the lamps are about the size of a cigarette and have an exterior of quartz. Surrounding the tube is another quartz jacket through which water passes at the rate of three quarts a minute, dispersing about 90 per cent of the heat generated. The twelve 1,000-watt lamps used have a total light output of about 800 thousand lumens, while the same wattage of incandescent lamps would provide only 330 thousand lumens. The possibility of a burn from incandescent lamps, caused by the infra-red radiation, greatly inconveniences performers who appear before the television camera. In the case of the new lamps, more than 90 per cent of the infra-red radiation is absorbed by the circulating water. The cooling system of the lamps is equipped with a pressure-operated switch and magnetic valve, since the water in the jacket must be moving before the lamp is lighted and because the lamp must be turned off automatically in the event of failure or reduction of the water supply. During operation a pressure of more than 1,000 lb. per sq. in. is developed within the quartz jacket.

Railway Electrification at Home and Abroad

ALTHOUGH the date of opening of the electrified route between Manchester and Sheffield has not yet been fixed, orders have been placed for seventy electric locomotives. This follows on the orders for eight multiple-unit trains between Manchester and Glossop. During the last two months a number of new electric services in Kent have been opened. According to the *Beama Journal* of August, the Southern Railway now possesses 3,189 electrically operated passenger vehicles, of which 603 cars have equipment designed for a maximum speed of 75 miles per hour and the remainder of 60 m.p.h. These speeds appear slow when compared with the rated speeds of Continental expresses. It must be remembered that the Southern Railway undertaking is a huge suburban network, in which high average speed is of the greatest importance. The problem of the London–Brighton railway is very different from that of the line joining Milan and Brescia. For the latter route an electric locomotive with a commercial speed of 94 m.p.h. has just been designed. In preparation for the forthcoming electrified link between Berlin and Munich, the German State Railways have accepted a locomotive with an ordinary speed of 112 m.p.h. and a possible maximum of 140 m.p.h. The use of locomotives of this type will, it is believed, reduce the journey time between Berlin and Munich from eight to five and a half hours.

Health of the Army in India during 1937

STATISTICS of the health of the British and Indian troops in India are contained in the recently issued "Annual Report of the Public Health Commissioner with the Government of India for 1937", **2** (Government of India Press, New Delhi. Rs. 2-6, or 4*s*.). The year 1937 was, from the health aspect, a good year for both British and Indian troops. There was a reduction in hospital admissions among both groups as compared with 1936 (also a good year) of 14·3 per 1,000 of strength among British troops, and 37·0 among Indian troops. Although the admission ratio appears to be on the downward trend, conditions cannot be considered satisfactory according to modern health standards so long as 568 out of every 1,000 British soldiers and 390 out of every 1,000 Indian soldiers are admitted to hospital during the course of a year. Compared with the troops in the United Kingdom, the hospital admission ratio in India is almost exactly double. The reasons are partly climatic, and partly due to the more primitive methods of sanitation, both in the army and among the civil populations in contact with it. There has been, however, a reduction in incidence of such diseases as malaria and the enteric groups of fevers. A new synthetic drug named 'Certuna' has given promising results in the treatment of sub-tertian malaria. Information is given of the work being done to supply pure water to the stations, on conservancy systems, and on the sanitary control of milk and foods.

Work of Indian Medical Institutes

THE reports of the Haffkine Institute for 1938 and of the Pasteur Institute of India, Kasauli, for 1937, have reached us. The Haffkine Institute is the centre for the preparation of Haffkine's preventive plague vaccine, of which 1,137,086 doses were issued during the year. Some trials of the Institute's anti-plague serum were made in a small outbreak of plague, with a mortality of about 26 per cent, compared with a mortality of about 63 per cent with other non-specific treatments. Two of the sulphanilamide drugs, Prontosil and M. and B. 693, so valuable in streptococcal infections, were tried in plague but showed little or no curative power. A number of research studies on plague vaccine and serum, anti-malaria drugs, human and rat leprosy, fleas, and other subjects are summarized. At the Kasauli Pasteur Institute, anti-rabic treatment is carried out. The total number of patients attending the Institute and its centres was 28,076, of whom

20,936 received the full course of anti-rabic treatment, with a mortality of 0·45 per cent. The vaccine employed was a carbolized 5 per cent emulsion of brain of sheep inoculated with Paris fixed virus. The deaths from rabies registered in 1937 in the Punjab and the United Provinces numbered 438.

Cosmic Data

Two valuable summaries of the data at present available as to the motion of the galactic system among the nebulæ and as to the sources of stellar energy are contributed by Dr. E. Hubble, of the Mount Wilson Observatory, Pasadena, and by Prof. H. N. Russell, director of the Princeton University Observatory respectively, to the August issue of the *Journal of the Franklin Institute*. With respect to the extragalactic nebulæ taken as frame of reference, the galactic system is moving with a speed of the order of 100–200 kilometres per second in the direction of the northern galactic latitudes. The sun is rotating about the centre of the galaxy with a speed of the order of 275 kilometres per second in the galactic direction latitude 0°, longitude 55°. The resultant is a speed of the order 300 kilometres per second in the direction latitude 35° north, longitude 55°. After pointing out that the reactions which provide the stars with their energy must be accompanied by a loss of mass, Prof. Russell summarizes the recent work of Prof. H. A. Bethe, of Cornell University, on the six steps by which the impact of four protons, that is, hydrogen atoms, on a carbon atom which acts as a catalyst lead to the production of a helium atom. Owing to the diminution of mass involved in the conversion, the process is capable of supplying the sun's energy if its temperature is of the order 18–21 million degrees centigrade, that of Sirius at 22 million and that of γ Cygni at 30 million, all of which temperatures are in agreement with astrophysical observations.

The National Central Library

THE twenty-third annual report of the Executive Committee of the National Central Library refers to the way in which development has been hampered by the absence of sufficient funds. The only department which is able to provide anything like an adequate service is the Bureau of American Bibliography, recently established with the aid of a generous grant from the Rockefeller Foundation. The two main sources of income have been, as in previous years, the grants of £5,000 from the Treasury and £4,000 from the Carnegie United Kingdom Trust. Of the 10,825 volumes added to the library, 7,203 were presented; 46,715 books were issued to libraries and 11,968 to adult classes. The total number of outlier libraries is 135, consisting of 113 special libraries, 19 London borough libraries and 3 urban libraries, representing a stock of 4,201,000 volumes, from which 11,361 books were lent during the year. The regional library systems now cover the whole of England and Wales, embracing 479 libraries. During the year, 50,031 books were lent by libraries in regional systems to other libraries in their own system, and in addition 7,104 books were lent to libraries outside their own regional area through the National Central Library. Of the 3,538 books lent to university libraries, 1,846 were supplied by the National Central Library and its outliers, 1,536 by other university libraries, and 156 by foreign libraries. As against 508 books lent to libraries in 24 foreign countries, libraries in 16 foreign countries lent 283 books to libraries in the British Isles.

Data of Seismology

VALUABLE seismological data have just been received from India (Government of India, Meteorological Department, Seismological Bulletin, July–Sept. 1938). This publication contains readings of the seismograms received at the observatories of Agra, Bombay, Calcutta, Colombo, Dehra Dun, Hyderabad and Kodaikanal, together with non-instrumental reports. Readings from the Indian observatories are particularly important for the determination of the epicentres of earthquakes removed from North America, Europe and Japan, where the majority of the earth's seismological stations are situated. The non-instrumental reports indicate the occurrence of four local shocks in July, seven in August and six in September, some of which were followed by aftershocks. Silchar, Lahore and Kalat each reported shocks on two separate occasions.

Earthquakes during June 1939

ACCORDING to the Central Seismological Bureau at Strasbourg, 132 earthquakes were registered by seismographs or felt by people during June 1939. The most on any one day was ten on June 4, and the least on any one day was one on June 25. Undoubtedly the strongest shock during June was that of June 22 on the Gold Coast, having an epicentre provisionally calculated to be 5·7° N., 0·7° W. The next three in intensity were June 18, felt scale 7 (Rossi-Forel) at Costa Rica, June 5 with epicentre in the Atlantic west of the Azores, and June 8 with possible deep focus (130 km.) in the Islands of Samoa. Other shocks for which provisional epicentres could be obtained were June 3, Tananarive (scale 2); June 4, north-west Australia and Arizona; June 6, Algeria; June 12, Porto Rico; June 23, near Apia; June 24, two in California; June 27, Philippines; and June 29, Vrancea. During June the Fort de France station registered eight local tremors.

New Fellows in Pure Research at Mellon Institute

DR. R. S. Tipson and Dr. Warner Carlson have been appointed fellows in the Department of Research in Pure Chemistry in the Mellon Institute. Dr. Tipson was born in Derbyshire in 1906. He was awarded the degree of B.Sc. of the University of Birmingham in 1927 and then engaged in research on the carbohydrates under Prof. W. N. Haworth. Later he conducted an investigation, for the British Empire Cancer Campaign, on the preparation of tobacco tar and determination of its constituents. In 1929 he was appointed to a research fellowship in the department of industrial and cellulose chemistry, McGill University, Montreal, Canada, where, in collaboration with Prof. Harold Hibbert, he examined the structure of certain bacterial polysaccharides. He went to the United States in 1930 to become a research assistant to Dr. P. A. Levene on the staff of the Rockefeller Institute for Medical Research, New York, and in 1926 was promoted to the position of research associate. Dr. Carlson was born in Lincoln, Nebraska, in 1913. He pursued his early professional education at the University of Nebraska, from which he obtained the degree of B.S. in chemistry in 1933 and the degree of M.S. in the same field in 1935. A little more than a year was spent at the Iowa State College in biophysical chemistry, after which he transferred to the Ohio State University. At the latter institution he held a research fellowship in the Industrial Research Foundation, receiving the degree of Ph.D. in March 1939 with a thesis entitled "Physiological Studies on the Synthesis of Dextran by Bacteria of the Genus Leuconostoc".

Mathematical Tables

THE Works Progress Administration of the City of New York is undertaking extensive computation of mathematical tables. The work is sponsored by Dr. L. J. Briggs, director of the National Bureau of Standards, and is intended to give employment to clerical workers in New York. Several tables, including Bessel functions for complex arguments, exponential and trigonometric integrals, and the error function are completed or in active progress. Of the tables under consideration, the most noteworthy is a table of elliptic functions for complex arguments so designed as to cover a period parallelogram in each case.

Recent Sunspots

Two very large groups of sunspots have recently appeared. The first of these was a big single spot with companions increasing in size; the second group comprised a complex stream. Positions and areas are as follows:

Date on disk	Central meridian passage	Latitude	Maximum area
Aug. 26—Sept. 7	Sept. 1·0	15° S	3000
Sept 4—Sept. 17	Sept 10.5	15° S	2500

The areas are corrected for foreshortening and are expressed in millionths of the sun's visible hemisphere. An extensive bright eruption associated with the second group was observed at Greenwich on September 8 from 11h. 35m. until about 12h. 30m., the maximum being at 11h. 43m. U.T.

Announcements

THE printed addresses prepared in connexion with the Dundee meeting of the British Association, which include the presidential address by Sir Albert Seward, the addresses of sectional presidents, the first British and American Association Lecture, by Dr. Isaiah Bowman, on "Science and Social Pioneering", and Sir Richard Gregory's address as chairman of the Division for the Social and International Relations of Science entitled "Contacts of Religion and Science", can be obtained, temporarily, from the British Association, Down House, Downe, Farnborough, Kent, price 6*d*. each.

OWING to the outbreak of war, it has been necessary to postpone indefinitely the general discussion arranged by the Faraday Society on "The Electric Double Layer", which was to have been held September 25–27. It is at present hoped to publish the papers in an early issue of the *Transactions*.

THE National Emergency Blood Transfusion Service announces that registered blood donors in London and Greater London will be notified when they are required, and until then they need take no action. Donors having group *O* blood will be called upon first for blood to be stored for national use.

THE Joint Tuberculosis Council will hold a course in radiology at Shire Hall, Castle Hill, Cambridge, during September 20–22. A course in the diagnosis and treatment of pulmonary tuberculosis will be held at the Tuberculosis Office, 352 Oxford Street, Manchester, during October 10–14. Further information can be obtained from Dr. J. B. McDougall, Preston Hall, near Maidstone.

PROF. ALBRECHT SCHMIDT of Frankfort-on-Main and Prof. Johannes Stark, of the Physikalisch-Technischen Reichsanstalt, Berlin-Charlottenburg, have been awarded the Goethe Medal for Art and Science, and Dr. Karl Frik, director of the Werner Siemens Institute for Radiology in the Robert Koch Hospital in Berlin, has been awarded the Rieder Medal by the German Röntgen Society.

DR. GEORGE W. CORNER, professor of anatomy, University of Rochester School of Medicine, New York, has been appointed editor of the *American Journal of Anatomy* in succession to the late Dr. Charles R. Stockard.

THE issue of the *Medical Journal of Australia* for July 1 is a silver jubilee number containing articles on the progress of medicine, surgery, preventive medicine and medical journalism during the last twenty-five years.

AN institute for research in rural hygiene has recently been set up in a farmhouse at Lichtenstein in Bavaria, the birthplace of Max von Pettenkofer, the founder of experimental hygiene in Germany.

THE seventh International Congress on Rheumatism will be held in New York, Philadelphia and Boston during June 1–10, 1940. Further information can be obtained from the Ligue internationale contre le rhumatisme, Keizergracht 489, Amsterdam.

ACCORDING to official statistics, the population of Japan on October 1, 1938, was 72,227,700, or 969,000 more than in the previous year. Tokyo is the most populous city with 6,457,000 inhabitants.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 517.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Quantitative Comparison of the Biological Effects of Neutrons and other Ionizing Radiations

A CONSIDERABLE number of tissues have been exposed to very high energy Be-D neutrons ($\sim$ 12 Mev.) with the help of cyclotrons, in the United States. The published values of the ratio γ/N of the gamma-ray to the neutron doses for a given biological effect range from 2 to 8. These ratios should be comparable among themselves, but since the neutron doses were measured in arbitrary units they cannot, without further experiment, be regarded as indicating the ratio of the absorbed neutron and gamma-ray energy. Two investigations have been reported in which an attempt has been made to measure this quantity. Zimmer[1], using Li-D neutrons, found the ratio of gamma-ray to neutron energy necessary to produce the same increase in mutation rate in Drosophila sperm to be $\gamma/N' = 0{\cdot}7$, whereas for the lethal effect on the bean root we[2] have found $\gamma/N = 11$. Comparable procedures were adopted for the estimation of the neutron energy absorbed in the tissue in the two cases, and these were roughly checked by the exchange of ionization chambers[3].

Before attempting any biological interpretation of such a striking difference in the sensitivity of bean roots to gamma-rays and neutrons we have considered whether any known physical process could increase the energy absorption of a given beam of neutrons in tissue appreciably above the value which we have estimated. This value takes into account the recoil atoms of hydrogen, carbon, oxygen, and nitrogen, which contribute respectively 92 per cent, 1·7 per cent, 5·2 per cent, and 0·4 per cent of the total estimated energy absorption, and the disintegration of nitrogen, which adds a further 0·4 per cent. The interaction of fast neutrons with nearly forty elements has been measured by various authors[4], including all elements, other than the inert gases, up to and including calcium. The energy absorbed per unit mass of the element by the process of nuclear recoil is maximum for hydrogen, and falls steadily to 1 per cent of this value for calcium, and 0·05 per cent for lead. In some cases, for example lithium, a single atomic disintegration together with the subsequent decay of the unstable nucleus, may liberate more than ten times as much energy as that of the average recoil hydrogen atom. Such atoms, however, are present in tissue in altogether too small amounts to make an appreciable contribution to the total energy absorption, and a careful study of the data makes it fairly certain that in the case of irradiation by D-D neutrons no atomic disintegration or induced radioactivity is likely to make a larger contribution than that estimated above for nitrogen.

Lest any of the minor atomic constituents of protoplasm had been overlooked, the matter was tested experimentally. Grass tips were incinerated with nitric acid so as to obtain a fifteen-fold concentration of the non-volatile constituents. This ash was strongly irradiated for thirty minutes and tested (*a*) by insertion into a large ionization chamber connected to a Lindemann electrometer, (*b*) by a Geiger counter, for induced radioactivity. Measurements were commenced 30 sec. after the end of the irradiation. Method (*b*) showed some radioactivity. By introducing uranium into the position occupied by the ash it was possible to estimate the energy liberation in tissue corresponding to any given observed activity and decay constant. This made it clear that there was no element of period greater than $\sim$ 3 sec. present in the irradiated ash which, either during irradiation or the subsequent five days*, could make any appreciable contribution to the energy absorption in this tissue. To test for short-period activity the ash was applied as a thin layer to the inside of a small electron metal ionization chamber, with 15 per cent by weight of dextrin as a binder. When irradiated, the difference between the observed ionization and that to be expected from the chamber plus dextrin represented only 7 per cent of the total energy absorption in tissue.

We are thus unable to find any reason for supposing that our estimates of neutron energy absorption in tissue are seriously in error. Probably the explanation of the greatly increased sensitivity of certain tissues to neutron, as compared with gamma-ray energy, must be sought in terms of specific relationships between the distribution of ionization and biological structure. It is very desirable, however, first to know whether neutron and gamma-ray energy are equally efficient in producing simple chemical changes, and this we are in process of investigating.

We gratefully acknowledge the financial assistance of the British Empire Cancer Campaign.

L. H. GRAY.
J. READ.

The Mount Vernon Hospital
and the Radium Institute,
Northwood, Middlesex.
July 29.

* The period during which the growth of the beans was observed

[1] Zimmer, *Str. Th.*, 62, 517; 63, 528 (1938).

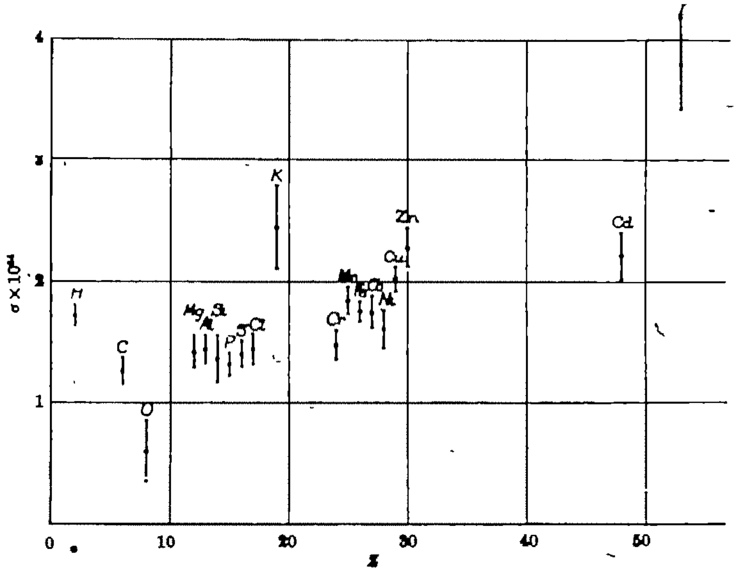
[2] Gray, Read and Mottram, NATURE, 144, 479 (1939)

[3] Gray and Read, NATURE, 144, 439 (1939).

[4] Ladenburg and Roberts, *Phys. Rev.*, 50, 1190 (1936) Kikuchi and Aoki, *Phys. Rev.*, 55, 108 (1939).

Scattering of D—D Neutrons

EXPERIMENTS hitherto performed on the scattering cross-sections of various substances for D—D neutrons have led to fundamentally different results. Most observers have found that the cross-section σ increases regularly with the atomic number, and some have deduced from their results the variation with Z of ξ, the 'sticking factor'. Kikuchi and Aoki and collaborators[1], however, have observed a periodic variation of σ with Z. The detectors used in all these experiments have been either sensitive to fast neutrons of wide range of energy, or sensitive to slow neutrons. Since the 170 min. period of phosphorus is excited only by neutrons of energy greater than about 2 Mev., it is an ideal detector for D—D neutrons, especially as our experiments have shown that there is no observable elastic scattering of these neutrons by elements of widely differing atomic number such as sulphur, iron and lead. The disadvantage of the use of phosphorus, however, lies in its relatively low intensity of excitation, so that the detector had to be placed near (9 cm.) the target. In consequence the geometry was not ideal, and only relative cross-sections could be obtained. In spite of this, however, the mean free path in paraffin wax was the same to within experimental error as that observed by Booth and Hurst[2], among others, using better geometry and an indium foil as a slow neutron detector.



This result is the more curious in view of the fact that for the majority of the elements investigated the cross-section observed was roughly half of the value obtained by previous observers. While our results vary in accuracy between 5 and 15 per cent, the fine structure observed by Kikuchi and Aoki is roughly corroborated. A graph showing variation of σ with Z (so far as iodine) is given.

A fuller account of the experiments performed will be published elsewhere.

W. D. Allen.
C. Hurst.

Clarendon Laboratory,
Oxford.
July 26.

[1] *Phys. Rev.*, 55, 109 (1939).

[2] *Proc. Roy. Soc.*, A, 161, 248 (1937).

Selective Oxidation of Aluminium Alloys

The superficial film formed on heating an alloy in air consists usually of a mixture of oxides of the alloying metals. In some circumstances, however, the oxide of only one of the elements—often of a minor constituent—appears on the surface. This has been known for some time to be the case with oxidized surfaces of brass and stainless steels. Electron-diffraction investigations have lately furnished a considerable number of similar examples[1–4].

Experiments with some aluminium alloys have shown that selective oxidation in these alloys occurs with a hitherto unrecorded prominence. The alloys in question were aluminium-beryllium and aluminium-magnesium, they were oxidized in an electric furnace, in air at atmospheric pressure. The composition of the surface layers after oxidation was investigated with the aid of an electron-diffraction apparatus.

A 99·8 per cent aluminium 0·2 per cent beryllium alloy oxidized at 630° C. gave the electron-diffraction pattern of BeO; at lower temperatures the well-known diffuse Al_2O_3 pattern was recorded. So small an admixture of beryllium is thus sufficient to cause a layer of pure BeO to form on the surface, provided that the alloy is oxidized at a sufficiently high temperature. For an alloy containing 3 per cent of beryllium, the limiting temperature was 500° C. on surfaces oxidized at 500° C. and higher, BeO only appeared on the surface.

The selective character of oxidation of the surface of aluminium-magnesium alloys has already been recorded[1]. Preston and Bircumshaw found that MgO is formed on the surface of an alloy containing so little as 0·5 per cent magnesium. We were successful in extending this limit by producing a film of MgO on an alloy containing no more than 0·03 per cent of magnesium. The indispensable condition was to perform the oxidation just below the melting point of the alloy. The specimen was kept for twelve hours in a furnace where the temperature was maintained between 650° and 660° C. In the case of an alloy containing 0·1 per cent magnesium, an oxidation temperature of 620° C. was sufficient. With a 1·4 per cent magnesium alloy the surface layers consisted of MgO at 400° C.

In looking for an explanation of such striking facts as the formation of a layer of pure MgO on the surface of an alloy containing barely one atom of magnesium for about 3,000 atoms of aluminium, chemical arguments are of little help. As a matter of fact, the heat of oxidation of aluminium (namely, 190) is much greater than that of magnesium (143) or beryllium (131). 'Preferential' oxidation in the sense of greater chemical affinity of magnesium or beryllium for oxygen, or reduction of the previously formed Al_2O_3 by beryllium or magnesium, can thus scarcely be considered as a probable hypothesis.

The accumulation of ZnO on the surface of brass has been attributed by some investigators to the higher vapour pressure of zinc. The same might have played some part in aluminium-magnesium alloys. Beryllium, however, possesses a much higher boiling point than aluminium. Thus it would be expected that aluminium would have a higher vapour pressure at the temperatures at which oxidations were performed. Accumulation of BeO in surface layers cannot be explained, therefore, in this way either.

One of us has pointed out the important role of the surface tension of the constituents of an alloy in determining the composition of its surface layers[3]. Unfortunately, there are no data with regard to the surface tension of the three metals involved in these investigations. This makes it impossible to predict which of the metals should be adsorbed on the surface. If we assume, however, that the difference of surface tensions is the cause of highly selective oxidation of aluminium-beryllium and aluminium-magnesium alloys, it is to be inferred that the surface tension of magnesium and beryllium is much lower than that of aluminium.

S. DOBIŃSKI.
M. NIESŁUCHOWSKI.

Institute of Experimental Physics,
University, Poznań.
July 24.

---

[1] Preston, G. D., and Bircumshaw, L. L., *Phil. Mag.*, 20, 706 (1935).

[2] Iitaka, I., and Miyake, S., NATURE, 136, 437 (1935); 137, 457 (1936).

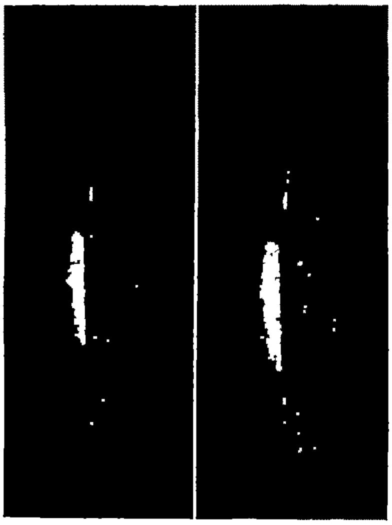
[3] Dobiński, S., NATURE, 141, 81 (1938) and *Bull. Int. de l'Acad. Pol.*, 169 (1938).

[4] Dobiński, S., and Jagielski, A., *Bull. Int. de l'Acad. Pol.*, 424 (1938)

[5] Dobiński, S., and Grycza, J., *Acta Physica Polonica*, in the press.

Extremely Bright Spots on Coolidge Tube Target

WHILE making tests with a newly made Coolidge tube with molybdenum target, we discovered several bright spots of unusual brightness on its target surface.



(*a*) (*b*)

The accompanying illustration shows (*a*) photographs of the target when only the cathode of the Coolidge tube was heated, that is, while the X-rays were not being radiated, and (*b*) of the same target taken when a voltage of 50-cycle 40 kv. (peak value) was impressed on the anti-cathode and an electronic current of 20 mA. D.C. was flowing, that is, while X-rays were being radiated. In front of the lens of the camera, a right-angled glass prism was attached so as to prevent the X-rays being projected on the sensitized plate of the camera. In (*b*) several white spots will be seen, whereas in (*a*) no such spots exist. The photograph does not show these spots well; the actual bright spots glare quite intensely and look as if they were embossed on the target surface. The target of the Coolidge tube was continuously cooled with running water.

In order to ascertain whether these bright spots were produced during the half-cycle in which the electronic current follows, or during the other half-cycle, a stroboscopic observation was made, and it was found that they were produced only during the former half-cycle, and the larger the instantaneous value of current the greater the intensity. Furthermore, when the heating current of the cathode was kept constant, there was practically no change in the brightness of the spots, even when the anode voltage was lowered to a voltage such as 10 kv. (peak value), at which no radiation of the characteristic X-rays of molybdenum would take place; but when the heating current was varied, the brightness was greatly affected, these spots being nearly invisible when the electronic current was less than 10 mA.

From these results it would appear that the spots are due to electronic bombardment; in other words, due to a particularly intensified electric field at some minute protrusions accidentally existing on the target surface, the protruding points become incandescent. As clearly seen from the photographs, the surface of the target is not perfectly smooth; it is covered with scratches, as if the surface had been brushed over. These facts support the view put forward.

I. KOGA.
M. TATIBANA.

Department of Electrical Engineering,
Tokyo University of Engineering,
Tokyo.
June 19.

A SIMILAR phenomenon to that described by Messrs. Koga and Tatibana has been observed during the course of certain research work on multi-segment magnetrons operating under rather abnormal circuit arrangements at about 80 cm. wave-length.

Brilliant points of luminescence have been observed on the rear surfaces of the anode segments, which are each in the form of a hollow tantalum triangle with one curved face receiving the electron stream, and generally running very hot, about yellow-white. The appearance of these spots of light was so distinctive that it was at first thought that holes had been formed in the anode rear surface, making visible the almost white-hot inner face. On examination, when not operating, it was seen that the anodes were not punctured, nor was it possible to account for such puncturing, although a 'cyclotron' effect has been observed giving a charge on a screen surrounding the anodes four times the voltage applied to the anodes.

It was found that a high output was needed before the spots appeared and the general order was about 400 watts radio frequency with the anodes dissipating about 175 watts. Furthermore, the spots were critical with regard to filament emission and also disappeared suddenly below 2,100 volts on the anodes, but were quite unchanged by large variations of voltage above this: a fact which is noticed by the Japanese investigators.

I remember noting several years ago similar effects in a Farnsworth cold cathode multiplier (photo-electric cathodes with focusing magnetic field) where flash-overs kept occurring, maybe due to the liberation of gas from an almost microscopic incandescent protuberance.

JAN FORMAN.

Ultra-short Wave Laboratory,
London Hospital Medical College,
Turner Street, London, E.1.

Vitamin B_6 and Skin Lesions in Rats

VITAMIN B_6[1] has been defined[2] as "that part of the vitamin B_2 complex which is responsible for the cure of the specific dermatitis developed by young rats fed on a vitamin B-free diet supplemented with purified vitamin B_1 and lactoflavin" (riboflavin). The specific skin lesions ("rat acrodynia") are characterized by symmetrical dermatitis with œdematous, scaly skin, mainly on the most peripheral parts of the body, such as the mouth, nose, paws, ears and tail.

In a later study, Lepkovsky, Jukes and Krause[3] have shown that rats need a further factor, in addition to vitamin B_1, riboflavin and vitamin B_6, to supply the requirements for normal growth and development on a diet deficient in vitamin B. In the opinion of the authors mentioned, this additional factor corresponds presumably to the so-called chicken pellagra factor or the "filtrate factor"[4]. Addition of vitamin B_6 (called [3] also Factor 1) alone did not permit growth in rats, and "some of the rats developed swollen eyelids which tended to stick together. The eyes were watery and the nose was inflamed"[3]. Addition of the filtrate factor (called also Factor 2) alone resulted in slow growth, and the rats developed the specific acrodynia-like skin condition. Addition of both Factor 1 and Factor 2 assured normal growth and development.

Apart from the sticky eyes and sore nose, the skin lesions were not attributed to deficiency of the filtrate factor but almost exclusively to that of vitamin B_6, which was regarded as the specific skin factor of the vitamin B_2 complex for rats, the skin lesions in riboflavin deficiency in rats being less conspicuous. Thus, the designation *adermin* has been proposed by Kuhn and Wendt[5] for vitamin B_6.

In a preliminary paper[6], attention has been directed to the fact that this conception was not borne out by direct experiments in which pure vitamin B_6 was substituted for the crude vitamin B_6 concentrate used by Lepkovsky, Jukes and Krause[3]. Admittedly, in rats suffering from acrodynia (with the exception of a few refractory rats), addition of 10 micrograms daily of vitamin B_6, natural or synthetic*, brought about improvement of the specific dermatitis and in many instances led to complete cure. In the further course of these experiments, rats often died from other internal deficiency diseases, such as panmyelophthisis, adrenal hæmorrhage, liver injury and kidney injury, the nature of which need not be discussed here. Later, in a large percentage of the remaining group of rats, there developed extreme and severe skin lesions which differed from those seen in acrodynia in rats. Three more or less distinct types of lesions were observed in this group of rats, which to date includes more than 100 animals.

Type I. The hair over the abdomen is matted together, appears damp and is sticky to the touch. There is loss of hair around the chin, nose and eyes and over the forehead between the ears. The sides of the cheeks and also the abdomen are often covered with scales, which are generally brown in colour. These scales may sometimes become quite thick. In advanced cases, the lids of the eyes seem to be inflamed and are sometimes kept closed, while the brown scaliness may extend over the sides of the forehead. Probably on account of irritation, the animals often rub the forehead and cheeks with the forepaws and thus transfer a coating of the brown scaly matter to the paws. There is emaciation and manition.

Type II. After complete cure of the acrodynia, new lesions start around the mouth, the groin and the axillæ, in the form of inflammation and scale production. Later, alopecia follows, extending to the neck and over the back. Hyperæmia may be seen also on the ears, and the forepaws often become excoriated. In several animals generalized scaliness (exfoliative dermatitis) has been observed.

Type III, the rarest in our observation, corresponds to the descriptions given[4,7] of rats with watery eyes which stick together and sore mouth.

Concentrates of liver and yeast and filtrates from wheat germ, yeast and rice polishings, after adsorption on fuller's earth, in proper doses assure complete cure of all these skin manifestations.

In view of these results, the part played by the vitamin B_2 complex in dermatologic conditions has to be extended beyond vitamin B_6, and the term *adermin*, because it is misleading, should be abandoned. In accordance with the chemical nature of vitamin B_6, which is a pyridine derivative containing several oxy (methoxy) groups, the term *pyridoxin* appears to be appropriate.

PAUL GYÖRGY.
ROBERT E. ECKARDT.
(Fellow in the Dept. of Biochemistry, assigned to Dept. of Pediatrics.)
The Babies and Children's Hospital,
and the Department of Pediatrics,
School of Medicine,
Western Reserve University,
Cleveland, Ohio.
July 25.

---

* Synthetic vitamin B_6 has kindly been put at our disposal by Merck and Co., Inc.

[1] Gyorgy, P., NATURE, 133, 498 (1934).
[2] Birch, T. W., and Gyorgy, P., *Biochem. J.*, 30, 304 (1936).
[3] Lepkovsky, S., Jukes, T. H., and Krause, M. E., *J. Biol. Chem.*, 115, 557 (1936).
[4] Elvehjem, C. A., and Koehn, C. J., Jun., *J. Biol. Chem.*, 106, 709 (1935); Lepkovsky, S., and Jukes, T. H., *ibid.*, 114, 109 (1936).
[5] Kuhn, R., and Wendt, G., *Ber. deutsch. chem. Gesell.*, 71, 780 (1938).
[6] Gyorgy, P., *J. Amer. Chem. Soc.*, 60, 983 (1938).
[7] Olsson, J. J., Bird, H. R., Elvehjem, C. A., and Hart, E. B., *J. Biol. Chem.*, 127, 23 (1939).

Influence of Glutamine on the Growth of *Streptococcus hæmolyticus*

IT has been recently demonstrated by McIlwain, Fildes, Gladstone and Knight[1] that glutamine is an essential growth factor for most strains of hæmolytic streptococci freshly isolated from pathological processes. By the use of glutamine, these investigators have been able to replace completely the hitherto essential meat extractives in their culture medium.

We have been able to confirm the work of McIlwain and his co-workers. Employing a strain of *Streptococcus hæmolyticus* isolated from a case of septicæmia which terminated fatally, good growth was obtained in a peptone base medium, similar to that used by McIlwain *et al.*, when it was supplemented with glutamine. Controls showed little or no growth. The specimen of glutamine used was prepared from natural sources by the method of Vickery, Pucher and Clark[2]. Under similar test conditions, glutamine exhibited a moderate growth-stimulating effect on several stock cultures of *Str. hæmolyticus*.

It is of considerable interest to recall the observations of Dart[3], who showed that beet juice contains a powerful growth-stimulating hormone for *Str. hæmolyticus*. He was able to demonstrate a marked reduction in the 'lag phase' during the growth of this bacterium in beef infusion broth to which had been added 0·1 per cent beet juice. Since beets are a rich natural source of glutamine, the connexion is suggestive.

In an attempt to grow the freshly isolated strain of *Str. hæmolyticus* in a medium of completely defined chemical composition, including glutamine, the peptone in McIlwain's medium was replaced with an amino-acid mixture (Fildes[4]) frequently used in this laboratory for nutritional studies. No growth was obtained under these conditions, nor was growth observed when the peptone was replaced with acid-hydrolysed casein. In view of these findings, it seems likely that there is present in peptone another factor (or factors) which must be available before freshly isolated strains of *Str. hæmolyticus* can be cultivated in a medium of known chemical composition.

MAURICE LANDY.

General Biochemicals, Inc.,
Division of John Wyeth and Brother, Inc.,
Cleveland, Ohio.
July 20.

[1] McIlwain, H., Fildes, P., Gladstone, G. P., and Knight, B. C. J. G., *Biochem. J.*, 33, 223 (1939).

[2] Vickery, H. B., Pucher, G. W., and Clark, H. E., *J. Biol. Chem.*, 109, 39 (1935).

[3] Dart, R. K., *Proc. Soc. Exp. Biol. Med.*, 32, 363 (1934).

[4] Fildes, P., Richardson, G. M., Knight, B. C. J. G., and Gladstone, G. P., *Brit. J. Exp. Path.*, 17, 481 (1936).

Nature of a Group in Papain Essential to its Activity*

MUCH of the literature on the activation and inactivation of papain[1,2,3,4] supports the hypothesis that there is an essential SH group in the active enzyme.

The active crystalline enzyme[5], however, does not give a positive nitroprusside test or a satisfactory titration with porphyrindin[6]. Crystalline papain, like certain other proteins, was observed to give a positive nitroprusside test in the absence of cyanide only after denaturation. If, however, the native protein was first inactivated with iodoacetate, then separated from the excess of iodoacetate by precipitation with salt and finally denatured as before, no nitroprusside test without cyanide was obtained. In agreement with this observation, hydriodic acid was detected in the mother liquor from the salt precipitation. Titration of the denatured protein in urea solution by iodine gave results which indicate that only one sulphur group (of about ten in the papain molecule) is involved and that it disappears when the enzyme is inactivated by iodoacetate or cystine. This is supported by the observation that inhibition of papain activity is produced by one molecular equivalent of iodoacetate. Papain is still 'native' after reaction with cystine; that is, the solubility is apparently unaltered and the protein can still be crystallized.

It may be concluded that the SH group that appears on denaturation is blocked from reaction with some but not with all reagents while the protein is in the native state. Dr. M. L. Anson informed us by private communication that he has observed that SH groups in certain proteins react with iodoacetamide, but are not attacked by oxidizing agents.

Results of titrating denatured papain SH groups with iodine are shown in the accompanying table:

Enzyme preparation	Treatment of protein	Equivalents of protein × 10^7		Equivalents of sulphydryl × 10^7	SH per equivalent of active protein
		Total	Active		
A	None	37	30	28	0·93
A	Iodoacetate	37	2	5	—
A	None	19	15	17	1·13
A	Iodoacetate	19	1	1	—
B	None	32	23	27	1 17
B	Cystine	32	10	11	1·1
B	Cystine	31	7·3	11	1·5
B	Iodoacetate	31	1	2	—

The equivalents of protein are calculated using a molecular weight of 30,000[7]. The enzyme preparation treated with iodoacetate contained 21 milk clotting[7] units of papain per mgm. of protein nitrogen when activated with cyanide, and the one treated with both cystine and iodoacetate contained 27 units.

After the native protein had been freed of the 5–10 fold excess of iodoacetate or the excess of solid cystine, it was denatured by heating at 70–75° C. for 10 minutes. The protein was centrifuged out, washed and finally dissolved in strong urea solution. This solution was treated essentially by the method described by Lavine[8] for the estimation of cystine except that the temperature was 0–5° C. The sodium thiosulphate solution was 0·01 *N*. The blanks agreed to within 0·02 ml.

A. K. BALLS.
HANS LINEWEAVER.

Food Research Division,
Bureau of Agricultural Chemistry
and Engineering,
U.S. Department of Agriculture,
Washington.
July 25.

---

* Food Research Contribution No. 448

[1] Bersin, T., *Erg. Enzymforsch.*, 4, 68 (1935).

[2] Hellerman, L., *Physiol. Rev.*, 17, 454 (1937).

[3] Ganapathy, C. V., and Sastri, B. N., NATURE, 142, 539 (1938).

[4] Morgan, E. J., and Friedman, E., *Biochem. J.*, 32, 862 (1938).

[5] Balls, A. K., Lineweaver, H., and Thompson, R. R., *Science*, 86, 379 (1937).

[6] Greenstein, J. P., *J. Biol. Chem.*, 125, 501 (1938).

[7] Balls, A. K., and Lineweaver, H., *J. Biol. Chem.*, in the press.

[8] Lavine, T. F., *J. Biol. Chem.*, 109, 141 (1935).

Glutamic Acid as a Hydrogen Carrier in Animal Tissues

IT has previously been shown that α-ketonic acids liberate carbon dioxide when added to animal tissues under anaerobic conditions[1]. The evolution of carbon dioxide was found to be due to a 'dismutation'.

$$(1)\quad 2\,\mathrm{R.CO.COOH + H_2O = R.CH(OH).COOH + R.COOH + CO_2.}$$

We have now found that the anaerobic carbon dioxide formation from α-ketoglutaric acid in kidney and in heart muscle is greatly increased by the addition of ammonium chloride. The analysis of this effect showed that α-ketoglutaric acid 'dismutes' with α-iminoglutaric acid (which arises on addition of ammonium salt to α-ketoglutaric acid)[2] as follows:

$$(2)\quad \underset{(\alpha\text{-ketoglutaric acid})}{\mathrm{COOH \cdot (CH_2)_2 \cdot CO \cdot COOH}} + \underset{\alpha\text{-iminoglutaric acid)}}{\mathrm{COOH \cdot (CH_2)_2 \cdot CH : (NH)\;\; COOH}} + \mathrm{H_2O}$$
$$= \underset{(\text{glutamic acid})}{\mathrm{COOH \cdot (CH_2)_2 \cdot CH(NH_2) \cdot COOH}} + \underset{(\text{succinic acid}).}{\mathrm{COOH \cdot (CH_2)_2 \cdot COOH}} + \mathrm{CO_2}$$

For example, 17·9 mgm. sliced kidney cortex (rat) produced in 140 minutes in the presence of

0·02 *M*. α-ketoglutarate 0·02 *N*. ammonium chloride	0·02 *M*. α-ketoglutarate	
327	136	μl carbon dioxide
222	80	μl succinic acid
234	81	μl glutamic acid

In the presence of molecular oxygen reaction (2) is followed by reaction (3).

$$(3)\ \text{glutamic acid} + \tfrac{1}{2}O_2 = \alpha\text{-ketoglutaric acid} + NH_3;$$

and the net result of (2) and (3) is the oxidation of ketoglutaric acid to succinic acid and carbon dioxide:

$$COOH.CH_2.CH_2.CO.COOH + \tfrac{1}{2}O_2 = COOH.CH_2.CH_2.COOH + CO_2$$

The system

$$\text{glutamic acid} \rightleftarrows \alpha\text{-iminoglutaric acid}$$

thus acts as a hydrogen carrier in the oxidation of α-ketoglutaric acid. It has been known for some time that, in kidney, ammonium salts increase the rate of oxidation of α-ketoglutaric acid and of those substances which may give rise to the intermediary formation of α-ketoglutaric acid, namely, glucose, lactic acid and pyruvic acid[3,4]. This may now be explained by the fact that ammonia, according to reaction (2), is required in the oxidation of ketoglutaric acid.

Reaction (2) was not observed in liver, pigeon brain or pigeon breast muscle. Several facts suggest, however, that glutamic acid (or glutamine) acts as a hydrogen carrier in these tissues also, but it is not yet clear from which substrates the hydrogen is accepted. Isocitric acid[5] and β-hydroxybutyric acid[6] which may donate hydrogen to iminoglutaric acid in artificial enzyme systems do not appear to react in the intact cells.

H. A. KREBS.
P. P. COHEN.

Department of Biochemistry,
University of Sheffield.
August 4.

---

[1] Krebs and Johnson, *Biochem. J.*, 31, 645 (1937).

[2] Knoop and Oesterlin, *Z. physiol. Chem.*, 148, 294 (1925).

[3] Krebs, *Z. physiol. Chem.*, 217, 191 (1933); *Klin. Woch.*, 11, 1744 (1932).

[4] Edson, *Biochem. J.*, 29, 2082 (1935).

[5] Adler, von Euler, Günther and Plass, *Biochem. J.*, 33, 1028 (1939)

[6] Dewan, *Biochem. J.*, 32, 1378 (1938).

Tarsiers in Captivity

SPECTRAL tarsiers have been maintained in captivity for varying lengths of time by a number of observers[1,2,3]; but only at stations actually within the area of their geographical distribution (Melanesia). No record has been found of this form reaching the zoological gardens of Europe or North America.

The present note relates to a pair of tarsiers that have been held under laboratory conditions at New Haven, Connecticut, for the past nine months. These specimens, a mature female and her presumptive offspring, a young male, were captured by Mr. J. S. Eckman at Barrio Bad-As, Province of Surigao, N.E. Mindanao, Philippine Islands, in July 1938. Mr. Eckman kept them as pets until October 1938 when, coming to the United States, he brought them at our request to Los Angeles, California, arriving in mid-November. From there they were at once shipped by air to New York, and were received at New Haven on November 18, 1938.

These animals have thriven in captivity, in spite of a somewhat less than ideal environment. During the winter the temperature of their room executed fluctuations ranging from 24° to 30° C., although we sought to maintain an average of 28° C. A crude humidifier was only partially successful. They are kept in a basement room with a north-western exposure, receive no sunlight, and only a low intensity of light. They have received, however, about 3 hours light every other day from a 'Sperti' ultra-violet lamp.

The only food which they have accepted with absolute consistency has been mealworms (Tenebrio larvæ), of which they have taken some 50–60 each per day. To a dish of this food have been added, every day or so, a little salt mixture and a few drops of cod liver oil. New-born mice were eaten, two or three a day each, for the first few weeks that we had the tarsiers; but these are now always refused. Nor will they touch raw beef or liver since becoming accustomed to the live food, and both fruit and milk are always rejected. The weight of the female increased rapidly from 164 gm. to a maximum of around 208 gm.; this probably represents weight regained plus certain fat deposition. The weight of the male has increased more steadily from 106 to 159 gm., most of which increase would appear to represent growth.

The tarsiers are kept in a large cage containing a smaller 'hide-out' cage to which they keep for the greater part of the day, and to which they rapidly retreat when frightened. They emerge around 6 p.m. and are feeding and very active until at least 4 a.m. Their reaction to the ultra-violet light is quite capricious; sometimes they come out and bask within a foot of it, at other times they seek to remain hidden.

The female has been observed to exhibit cyclical swelling of the external genitalia, coupled with a dramatic change in the cellular content of the vagina from the normal mixture of leucocytes and nucleated epithelial cells to complete or almost complete cornification of the epithelials with partial or complete disappearance of leucocytes. The times between the estimated peaks of these cycles have ranged from 23 to 28 days over six such cycles. A sufficiently intensive search for red blood cells in the vaginal lavage has not yet been made. The reproductive status of the male, who would now be somewhat more than a year old, is not known, although erections have been noticed.

Observations on other aspects of the special physiology and behaviour of the tarsiers are being continued.

HUBERT R. CATCHPOLE.
JOHN F. FULTON.

Laboratory of Physiology,
Yale University School of Medicine.
New Haven, Conn.
July 17.

---

[1] Clark, LeGros, *Proc. Zool. Soc. Lond.*, 217–223 (1924).

[2] Lewis, G. C., *J. Mammal.*, 20, 57–61 (1939).

[3] Cook, N., *J. Mammal.*, 20, 173–177 (1939).

Formation of Cleistogamic and Chasmogamic Flowers in Wild Violets as a Photoperiodic Response

IN the spring of 1938, an investigation was undertaken to study experimentally the physiological conditions for cleistogamy in violets. It seemed obvious that the results of Bergdolt[1] do not offer a satisfactory explanation of the occurrence of this phenomenon in Nature. Nutritional difficulties are not likely to occur suddenly and so regularly as to account for the seasonal appearance of cleistogamic and chasmogamic flowers. As a matter of fact, most of his experiments also indicate an influence of the photoperiod. Curiously enough, Uphof[2] in his review of cleistogamic flowers overlooked the influence of this ecological factor, although a detailed investigation by Allard[3] showed the decisive effect of the photoperiod for the formation of cleistogamic and chasmogamic flowers in the hog peanut (*Falcata comosa*). Garner and Allard[4] also report on the influence of day-length actually for a species of violet (*Viola fimbriatula*).

Consequently I considered it appropriate to make a detailed study on the influence of the photoperiodical response on wild violets. My assumption has proved correct with regard to flower-formation. I have investigated the effect with the following species: *Viola biflora, canina, hirta, odorata, mirabilis, palustris, riviniana, silvestris*. Different species need different lengths of day. As a general rule, however, photoperiods less than twelve hours produce no flowers; with photoperiods between 13 and 15 hours, chasmogamic flowers normally appear; and when the photoperiod exceeds 17 hours, cleistogamic flowers appear. Additional morphological reactions have been observed. The plants have been grown in pots under identical conditions and the various flower types appear regardless of the season. Cleistogamic flower-buds fall off when transferred to a shorter photoperiod. Chasmogamic buds differ in the reaction to prolonged day-lengths. The induction of rejuvenation and everblooming responses are being investigated, and the study will be extended to elucidate the modifying effect of other ecological factors.

These results give a probable explanation of the fact that violets commonly flower for the second time in the autumn, and that cleistogamic flowers occur regularly in the summer. Most likely this photoperiodic reaction accounts partly for the fact that the alpine violets mainly are chasmogamic (Schroeterer[5]), while cleistogamy is a conspicuous feature of the violets in the northern countries and especially in the Scandinavian mountains (Lindman[6]). Other factors, especially the existence of different ecotypes, must however also be taken into consideration.

A detailed account of these experiments will be published later.

GEORG BORGSTRÖM.

Botanical Laboratory,
University of Lund.
July 18.

---

[1] Bergdolt, E., *Bot. Abh.*, 20 (1932).

[2] Uphof, J. C. Th., *Bot. Review*, 4 (1938).

[3] Allard, H. A., *J. Agric. Res.*, 44 (1932).

[4] Garner, W. W., and Allard, H. A., *Ann. Report Smiths. Inst.* (1920).

[5] Schroeterer, C., "Das Pflanzenleben der Alpen". (2nd edit. Zurich, 1926).

Lindman, C. A. M., *Bot. Centralb.* 30 (1887)

Genetical Proof of the Existence of Coffee Endosperm

IN the last few years several opinions have been published regarding the nature of the nutritive tissue of the coffee seed. Houk[1] came to the conclusion that the bulk of the mature coffee seed is perisperm formed by an enlarged nucellus, the scantily formed endosperm being evanescent. In a second paper[2] the same author puts forward the view that nucellus and integument of the ovule are so intimately fused that they cannot be distinguished from each other. This hypothesis of the 'integument-nucellus' had already been proposed by Lloyd[3]. Mayne[4] does not agree with Houk's assumption, and states that endosperm formation passes through a long rest period shortly after fertilization; meanwhile the nucellar tissue develops, evolving the true endosperm; later on, however, the endosperm begins to grow rapidly, replacing the nucellar tissue, which in the mature seed is represented by the inner layer of the 'silver skin'. Leliveld[5] confirms von Faber's[6] opinion, that the coffee ovule contains a very small nucellus "surrounded by a single stout integument". As the seed develops, the nucellar tissue is supposed to be suppressed and the integument enlarges, surrounding the embryo-sac. Endosperm formation is induced later on; it then takes all the space in the seed, the remnants of the integument finally forming the silver skin. The author claims to have determined the triploid nature of the endosperm by actual chromosome counts. Joshi[7] also agrees with von Faber that the ovule of coffee "has a weakly developed nucellus and a massive integument"; but he seems to agree with Houk that the nutritive tissue of the coffee seed is of maternal origin.

In the present note, we wish to put forward a genetical proof for the existence of true endosperm in the mature coffee seed. A few years ago a new mutant of *Coffea arabica* L. called 'Cêra'[8], which differs from the normal *Coffea arabica* varieties by having *yellow* seeds, was found in two coffee-growing regions of the State of São Paulo. Cutting through a mature seed, one notes that the whole of its nutritive tissue is of that colour. Yellow seeds are easily distinguished from normal green coffee beans. A genetical analysis of this new character, as yet not complete, furnished the following preliminary results:

(*a*) plants grown from *yellow* 'Cêra' seeds produced seeds of the same colour when the flowers were selfed;

(*b*) pollinating flowers of these plants with pollen of normal *green* seeded individuals (*C. arabica* L.), *green* hybrid seeds were always produced; the colour of these hybrid seeds cannot be distinguished from that of pure green seeds;

(*c*) pollinating flowers of 'Cêra' plants with pollen of *C. excelsa* Chevalier and *C. liberica* Hiern., which also have *yellow* seeds, hybrid seeds of the same colour were always obtained.

The results of (*b*) prove that a typical case of xenia occurred, one gene (or genes) for green colour dominating entirely two genes (or more) for yellow colour derived from the polar nuclei of the embryo-sac.

As the production of green hybrid seeds in the crosses between 'Cêra' type and normal green-seeded varieties is not likely to be explained by the occurrence of metaxenia, it is concluded that the bulk of the mature coffee seed is formed by real endosperm.

C. A. KRUG.
A. CARVALHO.

Genetics Department,
Instituto Agronomico do Estado de São Paulo,
Campinas, Brazil.
June 1.

---

[1] Houk, W. G., *Science*, 83, No. 2159, 464–465 (1936).

[2] Houk, W. G., *Amer. J. Bot.*, 25, 56–61 (1938).

[3] Lloyd, F. E., *Mem. Torrey Bot. Club*, 8, 1–112 (1902).

[4] Mayne, W. Wilson, *Mysore Coffee Exp. Sta. Bull.*, No. 16, 6 (1937).

[5] Leliveld, J. A., *Arch. voor de Koffiecultuur in Ned. Indie*, No. 3, 127–164 (1938).

[6] Faber, F. C. von, *Ann. Jard. Bot. Buitenzorg, Java*, 25, 59–160 (1912).

[7] Joshi, A. C., *Curr. Sci.*, 7, 236–237 (1938).

[8] Krug, C. A., Mendes, J. E. T., and Carvalho, A., *Bol. Tecn.*, No. 62 do Inst. Agronomico do Est. de S. Paulo (in the Press).

Natural Variances of Mental Tests, and the Symmetry Criterion

When two correlation matrices R_1 and R_2 have a *symmetrical* product $R_1R_2 = R_2R_1$, they have the same latent vectors[1,2], and Prof. Cyril Burt has recently proposed[3] to use this as a criterion that two batteries of mental tests contain the same mental 'factors'. I do not myself think that one can draw any safe conclusions about identity of factors in two batteries unless some tests are common to both batteries. But if one accepts Burt's criterion, I wish to point out that when R_1R_2 is asymmetrical, the product of the *covariance* matrices $D_1R_1D_1$ and $D_2R_2D_2$ may conceivably be symmetrical, where D_1 and D_2 are diagonal matrices of standard deviations. If an experimenter therefore has psychological reasons for thinking that two batteries contain identical factors, but finds R_1R_2 to be asymmetric, he may be able to discover variances which would make the product $D_1R_1D_1D_2R_2D_2$ symmetric. In that case he would have considerable reason for assuming these to be the natural variances of these tests.

Godfrey H. Thomson.

The University,
Edinburgh.
August 7.

---

[1] Eckart, C., and Young, G., *Psychometrika*, 1, 217 (1936).
[2] Young, G., *ibid.*, 2, 24 (1937).
[3] Burt, C., *ibid.*, 3, 161 (1938).

Effect of Tube-Length on the Visibility of Dust Particles with an Oil-immersion Objective

The phenomenon described by Messrs. Beadle and Patterson in Nature of August 19, p. 327, is well known to practical microscopists, since it occurs whenever a considerable change in the working aperture of a wide-angled objective is made, and admits of a simple explanation.

It is generally admitted that the perfect correction of all the zones of a high aperture oil-immersion objective for spherical aberration is a practical impossibility. It is therefore usual for the computer to concentrate on the inner and outer thirds of the aperture, leaving an intermediate zone in which the corrections are less accurate. When adjusting the tube-length for such an objective under full aperture conditions, the predominating rays for which symmetry of defocusing is obtained are those from the two preferred zones mentioned above.

In the case of the examination of objects mounted dry upon the cover, and of such a nature that no stray light is reflected or refracted into the portion in excess of N.A. 1·0, the first and intermediate zones only are in use, and since the corrections for the rays from the latter will but rarely coincide exactly with those for the outer zone, a change in tube-length will almost certainly be required. The extent of this alteration, and whether plus or minus, will depend entirely on the skill and inclination of the computer, and the figure given by Messrs. Beadle and Patterson of minus 20 mm. to 30 mm. cannot therefore be regarded as having any scientific significance.

F. E. J. Ockenden.

59 Stanhope Avenue,
Church End,
Finchley, N.3.

Dipterous Larvæ and Wound Treatment

During the war of 1914–18, W. S. Baer[1], in the United States, noticed that when troops wounded in battle had been lying out on the ground unattended for some time, their wounds very commonly became infested with larvæ of certain kinds of flies. He noticed specially that when the wounds had acquired about their maximum maggot population they did not exhibit dangerous after-effects. On the other hand, men whose wounds had received prompt early treatment often developed infection. It was found that the presence of these larvæ was especially beneficial in cases of osteomyelitis. It was discovered that the larvæ were eating the necrotic tissue which was supporting the main bacterial infection, and at the same time these larvæ were inhibiting further bacterial growth. Stewart[2] claimed that the scavenging larvæ play an important part in clearing the necrotic tissue, but that calcium carbonate, which is constantly excreted by the larvæ, is also important in alkalizing the medium (the wound) in which the bacteria live, and of increasing phagocytic activity.

The larvæ used in the earlier treatment of osteomyelitis belonged chiefly to the species *Lucilia sericata* (Meig.), *L. cæsar* (L.) and *Phormia regina* (Meig.). Stewart[3] showed, however, that due precautions must be taken, and a proper knowledge of the biology of these larvæ is essential. Some species will feed on both necrotic and normal tissue and are potentially dangerous to the latter.

Much study has been devoted to the technique of rearing dipterous larvæ under aseptic conditions, and also of retarding their normal development until they were actually needed for implantation within wounds. Sterilization of the eggs in a 5 per cent solution of formaldehyde mixed with a 1 per cent solution of sodium hydroxide for five minutes has been found satisfactory by Robinson[4]. The full details of this process, and that of the subsequent rearing of the larvæ, is given by the last-named author. Livingston and Prince[5] were successful in eliminating the inconvenience and unpleasantness associated with the actual 'maggot therapathy' by using a sterile extract of the creatures themselves. Robinson[6] claimed that the blow-fly larvæ contain allantoin in their excretion, and that the rapid healing of wounds as the result of 'maggot therapathy', is due in the main to this agent. He did not claim, however, that it could be entirely substituted for the application of the living larvæ. Robinson carried his investigations further and found that a watery solution of allantoin provides the necessary healing agent, without the presence of dipterous larvæ at all. In 1935 allantoin was a rare chemical in the laboratory, but it soon came to be made synthetically. Robinson also pointed out that a part of the allantoin molecule can be split off by hydrolysis to form urea. Further work led to the discovery that a 2 per cent water solution of urea has the equal healing properties of allantoin or of the fly larvæ themselves. It has the further advantage of being much cheaper than allantoin.

Not only osteomyelitis, but also many other kinds of non-healing wounds, have been treated in the manner just described, including gangrene, heat burns, X-ray burns, varicose and diabetic ulcers, etc. So far as I am aware, Paramonow in 1934[7] was the first to use dipterous larvæ in the treatment of gas gangrene. He applied maggots of the house fly, *Musca domestica*, since Calliphora larvæ were prone to devour healthy as well as necrotic tissue. He states that he cured three cases of gas gangrene when amputation appeared inevitable, and that the healing process set in 48 hours after the treatment began.

In this brief summary, I have stated the present position of the subject in so far as it is known to me. It is desirable, at the present early stage in the world calamity that we are facing, that the foregoing information should be made as widely known as possible. There is no doubt that further research into the technique of this method is urgently required. Also, I believe that it is correct to say that this method of wound treatment has been more widely explored in the United States than in England. The literature on the subject is already extensive, and I have only mentioned a few of the chief writings here.

Zoological Laboratory,
Cambridge.
Sept. 7.

A. D. IMMS.

---

[1] *J. Bone and Joint Surgery*, 13, 438–475 (1931).

[2] *Proton. Rep. Surg. Gynaec. and Obst.*, 58, 155–165 (1934).

[3] *Ann. Trop. Med. and Paras.*, 28, 445–460 (1934).

[4] *U.S. Dept. of Agric., Bur. Entom. Ser. E.*, 311 (1933).

[5] *J. Amer. Med. Assoc.*, 98, 1143–49 (1932).

[6] *J. Econ. Ent.*, 30, 41–48 (1937).

[7] *Z. wiss. Insektenbiol.*, 27, 82–86 (1934).

Points from Foregoing Letters

In view of the large apparent difference between the sensitivities of bean roots to neutrons and γ-rays, a search was made by L. H. Gray and J. Read for possible contributions to the energy absorption in tissue resulting from neutron irradiation, such as induced radioactivity. The activity induced in ashed grass was measured experimentally, and was found to correspond to a quite inappreciable contribution to the total energy absorption. The difference in sensitivity to neutrons and γ-rays is therefore considered to be real.

The scattering cross-sections of various elements for D—D neutrons have been measured by W. D. Allen and C. Hurst, using phosphorus as a fast neutron detector The cross-sections thus observed are smaller than those obtained by previous experimenters.

The superficial oxide films formed on aluminium containing small admixtures of beryllium or magnesium are found by S. Dobiński and M. Nieśluchowski to consist in most cases of BeO or MgO, even when the additional element is present at so low a concentration as 0·03 per cent in the case of magnesium.

When testing a new Coolidge tube with molybdenum target, I. Koga and M. Tatibana observed brilliant spots and scratch markings on the target while X-rays were being emitted. They suggest that the spots are due to electronic bombardment of minute protrusions from the surface of the target. Jan Forman describes similar appearances which were noted when using multi-segment magnetrons under certain conditions; the luminescent points were on the backs of the anode segments. He has also seen a similar effect in a Farnsworth cold cathode multiplier.

According to results obtained by P. György and R. E. Eckardt, the part played by the vitamin B$_2$ complex in dermatologic conditions has to be extended beyond vitamin B$_6$. In the presence of vitamins B$_1$ and B$_6$ and riboflavin, three further types of dermatologic conditions were observed.

M. Landy has confirmed earlier work by other investigators, who showed that some strains of hæmolytic streptococci can be grown on a peptone base medium supplemented with glutamine; but when the peptone is replaced by a stock amino-acid mixture frequently used for nutritional studies, he finds no growth, suggesting that peptone contains a necessary growth factor.

A. K. Balls and H. Lineweaver state that the exposure of crystalline papain to iodoacetate, or for longer periods to cystine, resulted in the disappearance of sulphhydryl as determined by a titration with iodine on the later denatured protein. The loss corresponded approximately to one –SH group per molecule of the enzyme protein inactivated by the reagent. Qualitative tests for –SH with nitroprusside in the absence of added cyanide were positive only on denatured protein that had not been treated with iodoacetate or cystine. The results permit the conclusion that an –SH group or the precursor thereof is essential to the enzymic activity of papain. It is also evident that native proteins exist for which the nitroprusside test is not informative.

H. A. Krebs and P. P. Cohen describe a 'dismutation' between α-ketoglutaric and α-iminoglutaric acids leading to the formation of glutamic acid, succinic acid and carbon dioxide. The reaction is an intermediary process in the metabolism of heart and kidney.

H. R. Catchpole and J. F. Fulton give an account of the first recorded survival of the spectral tarsiers in captivity outside the area of their normal distribution (Melanesia). A pair were brought from Surigao in the Philippines to New Haven, Conn., U.S.A., in November 1938, and they are now thriving under laboratory conditions. The female is mature and has exhibited regular œstral cycles of 23–28 days duration.

The photoperiodical response of several Swedish violas has been studied experimentally by G. Borgstrom. It seems that chasmogamy and cleistogamy are due to different photoperiods. When the photoperiod is less than 15 hours chasmogamic flowers normally appear, and when exceeding this day length cleistogamic flowers occur. Several additional morphological responses have been observed. These results partly account for the occurrence of these different flower-types in Nature.

G. H. Thomson points out that Burt's symmetry criterion for identity of mental factors in two batteries of tests, if accepted, may conceivably enable the natural variances of such tests to be ascertained.

A mutant coffee growing in Brazil has seeds which are yellow throughout. Pollination of these plants with normal green-seeded coffee produces hybrid seeds which are green, according to C. A. Krug and A. Carvalho. It is inferred that true endosperm constitutes the bulk of the mature coffee seed.

RESEARCH ITEMS

Two Bronze Age Cairns in Wales

THE report on the excavation by Sir Cyril Fox of the Simondston and Pond Cairns, Coity Higher Parish, Bridgend, Vale of Glamorgan, which appeared originally in *Archæologia* (87, 129–180, 1938), has now been issued in reprint as a publication of the National Museum of Wales (Cardiff: 1939, pp. 51, 2*s*. 6*d*.). Of the two cairns, that at Simondston is the earlier, its primary deposits in 'enlarged food vessels' indicating a date in Middle Bronze Age A, about 1500 B.C.; while the Pond cairn is definitely later, the deep collar of its well-wrought cremation urn belonging to Middle Bronze Age B, say 150 years later, or about 1300 B.C. Both cairns being situated on Lias limestone, the economic basis of their makers was similar, depending on a forest growth, mainly ash and other trees demanding calcareous soil, such as was widely occupied in neolithic and bronze age times in the Vale. The differences between the culture of the Simondston cairn and that of the Pond cairn are so profound that the latter must be regarded as intrusive in the district, while the former represents an ancient cultural tradition, the megalithic. The Pond cairn culture seems to be that of settlers from the other side of the Severn sea. Co-operation with workers in other fields of science (of which the results are here printed in appendixes) have produced results which indicate that the suggestion that the time had come to intermit for a period field-research on 'round barrows' was premature. Thus the present investigation has produced the first scientifically controlled record of wheat in the bronze age of Britain, the earliest record of barley, the identification of the charcoals of the fuels used for pyres and other purposes, and evidences of the use of coal in the bronze age in South Wales.

Standards of Physical Development in School Boys

IN view of the lack of standards based on recorded measurement of groups of adolescents, whose home environment, health record, and heritage present favourable conditions, an investigation was undertaken by H. Bathurst Norman of 500 public school boys, who in every case exceeded the standard required of the nutritive elements for the maintenance of perfect health, and for purposes of comparison, a homogeneous group of 501 secondary school boys, such as those among whom, according to current reports, the diet compares unfavourably with that of public school boys. The age groups range from thirteen to nineteen years; and the height, weight, sitting height, lumbar pull, and chest girth in expiration and inspiration were recorded (*Lancet*, August 19). There are significant differences in the results of the two groups. At each year between the ages of fourteen and eighteen a boy of Group I is approximately 16 lb. heavier and 3 in. taller than a boy of Group II. His lumbar pull is 30 lb. greater. The difference in height is shown, by measurement of sitting height, to be due to difference in the length of leg; while a record of ratio of weight to height shows a greater weight per unit of height in the public school group. The differences in physique are maintained roughly throughout the age periods under review. There is no progressive deterioration in the secondary school boy, nor any obvious tendency in the higher ages to approximate to the older of the public school boys. There is no abnormal acceleration of growth in either group. Heredity is an important influence in determining stature, but the real correlation is one of diet rather than of inherited genes. The limits of growth are due to heredity; but how nearly the limits are approached depends upon a variety of environmental conditions, of which correct nutrition during the growing period is one of the most important.

Penaeids of the John Murray Expedition

DR. RAMADAN has recently described an interesting series of Penaeids (excluding the genera Benthesicymus and Gennadas of the sub-family Aristaeinæ) (Crustacea: Penaeidæ. British Museum (Natural History), The John Murray Expedition 1933–34. Scientific Reports, 5, No. 3; 1938). The material is rich, and besides this a number of Penaeidæ in the collection of the British Museum material obtained by the German Deep Sea Expedition and other specimens have been examined for comparison. The descriptions are critical and detailed. A key is given to the genera of the Aristeæ, the chief distinction being the presence or absence of a hepatic spine on the carapace and the presence or absence (or reduction) of podobranch on the third leg and epipodite on the fourth. Seven (or perhaps eight) species of Aristeus are known, four of which, including two new species, are represented here. In discussing the genus Plesiopenaeus (p. 50) the author contradicts himself, for in paragraph 1 it is stated that *P. edwardsianus* does not possess exopodites on the walking legs, whilst in paragraph 3 they are stated to occur in this species. Again, on p. 51 it is inferred that they are absent. As Bouvier distinctly says that exopodites on the walking legs are absent in *P. edwardsianus*, the first statement is almost certainly correct and the second a slip; but an important slip in this case when the validity of the genus Aristeopsis is involved. Dr. Ramadan agrees with Burkenroad that Aristeopsis should be regarded as a synonym of Plesiopenaeus.

White Rot of the Elm

THE fungus *Ustulina vulgaris* causes the rotting of several kinds of forest trees, and its depredations have formed the subject of a recent series of papers by Mr. W. H. Wilkins. He has lately considered the parasitism of the organism upon elm (*Trans. Brit. Mycol. Soc.*, 23, Pt. 2; July 1939), and proved its pathogenicity by isolation of the fungus and re-infection. The sap-wood of the host is not attacked: but cells of the heart-wood apparently lose their starch and become discoloured, though no fungal hyphæ have been found. Patches of diseased wood occur, however, delimited by a black line, and hyphæ occur within this zone. It is suggested that parasitism of the fungus occurs in two stages, namely, infiltration, where products of the organism diffuse into healthy heart-wood, and cellular disintegration, which progresses only in the presence of the fungus. The disease is similar to a white rot of the lime, caused by the same pathogen.

Rayleigh Waves in an Inner Stratum of the Earth

K. Sezawa and K. Kanai, by mathematical calculation (*Bull. Earthq. Res. Inst., Tokyo*, 17, Pt. 2, 179–189; 1939) have determined several properties of Rayleigh waves such as can exist and be transmitted through an inner stratum of the earth. Some of the more important of these properties may be summarized as follows. In every case the velocity of the boundary waves ranges between the velocity of distortional waves in the stratum and that in the adjacent media. In the case of the displacement distribution of the waves that is symmetrical with respect to the middle plane of the stratum, there is only one dispersion curve for any ratio of μ' to μ. In the case of the distribution that is anti-symmetrical with respect to the middle plane, there are in general a number of dispersion curves for certain ratios of μ'/μ. These dispersion curves correspond to the waves of the fundamental and higher order types, namely, waves with several nodal planes of vibration parallel to the stratum. Yet even in the case of waves of anti-symmetrical vibration, if the velocity of distortional waves in the stratum is higher than that in the outer media, there is only one dispersion curve that corresponds to waves of fundamental vibration. The ordinates of the dispersion curves at abscissa $L/H = 0$ represent the velocities of Stoneley waves that are transmitted along any one boundary between the inner layer and the outer media.

Magnetic Observations in Sweden

WE have just received the second part of the report of the general earth magnetic investigation which was carried out during the period 1928–34 by the Geological Survey of Sweden. The first part of the report was published in 1936 under the title "A General Earth Magnetic Investigation of Sweden. Part 1—Declination S.G.U. Ser. Ca. No. 25", and this second part, which is No. 29 of the same series, entitled "Inclination", was compiled by Dr. Kurt Molin. Older determinations have been taken into account, as have also the measurements made by the Hydrographic Service of Sweden, but the chief part of the work has been done by seven persons on twenty expeditions. There were 2,257 observation places with an average of one I point in 177 km.^{2} and a rather greater density in Skåne. Dip circles were used throughout. For the mountainous districts, on account of its lightness, Chasselon dip circle No. 84 having a needle 6·5 cm. long was used, but owing to this not being so accurate as the other dip circles such as the Dover 8·9 cm., Casella 8·7 cm. and Gambey 25 cm., it was not used after 1931. An account of the corrections made and the method of reduction of the observations to the main epoch 1933·5 is given, together with explanatory maps and graphs. The main inclination table covers 42 pages, giving in each case the name of the station, latitude, longitude from Stockholm, altitude, geology, date of observation, values of dip in 1928·5, number of observations, average error, inclination in 1929·5 and 1933·5, and 1933·5 observed-calculated values. Four very valuable and beautiful colour-printed maps appended give: (1) inclination for epoch, July 1, 1933, (2) lines of equal anomaly, (3) values of anomaly of inclination, and (4) anomaly of inclination of Skåne. Since Sweden is interested economically in her iron ore deposits, this publication should be particularly valuable to Swedish authorities although it also affords a very valuable addition to the data of terrestrial magnetism and geology. Investigators interested in greater detail than it has been possible to give in this Swedish publication may obtain transcripts or photographic reproductions of the complete tables from the Geological Survey of Sweden.

Hydrolysis of Alkyl Halides

CONSIDERABLE controversy has centred around the interpretation of the rates of hydrolysis of alkyl halides by neutral water, one hypothesis assuming a slow dissociation of alkyl halide into halide ion and organic cation with an incomplete valency shell (an 'open sextet'), followed by the rapid reaction of this cation with water to yield alcohol and hydrogen ion, whilst the other hypothesis postulates that the rate-determining step is a bimolecular reaction of a water molecule with alkyl halide to yield halide ion and a cation the valency shell of which is completed by co-ordination of a previously unshared electron pair of a water molecule. R. A. Ogg, jun. (*J. Amer. Chem. Soc.*, 61, 1946; 1939), has reviewed the energetics of the various reactions and finds that the dissociation of an alkyl halide (in aqueous solution) into a methyl ion with an 'open sextet' and a halide ion is endothermic by at least 50 k. cal. per mol, and more probably by 70 k. cal. On the other hand, reaction with water to yield halide ion and the co-ordinated methyl ion CH_3OH_2+ is practically thermoneutral. Comparison with the experimental data for methyl halide hydrolysis shows that the first hypothesis stated (involving CH_3+) is much less probable than the second (involving CH_3OH_2+). It is suggested that carbonium ions with an open sextet never play an appreciable part in observable organic reactions and that mechanisms involving such ions should be abandoned.

Vitamins K_1 and K_2

THE antihæmorrhagic vitamins have recently been isolated in a condition of demonstrated purity and some work on the degradation of vitamin K_1 has been reported, so that preliminary suggestions as to their structure have been made. The evidence from the degradations is incomplete and in some points uncertain, so that L. F. Fieser, W. P. Campbell and E. M. Fry (*J. Amer. Chem. Soc.*, 61, 2206; 1939) have made some synthetic studies of quinones related to vitamins K_1 and K_2. The quinonoid character of the two vitamins was reported by Doisy, and it now appears that the absorption spectra of the vitamins resemble those of 1,4-naphthoquinones more closely than those of other series. Such a structure would account for a number of properties of the substances, and the chemical properties and absorption spectra of synthetic model compounds, as well as the marked antihæmorrhagic activity of 2,3-dimethyl-1,4-naphthoquinone (assayed by the Almquist procedure), lend support to the formulation of vitamin K_1 as 2-methyl-(or ethyl) 3-phytyl-1,4-naphthoquinone and of vitamin K_2 as 2,3-difarnesyl-1,4-naphthoquinone. The purple colour reaction of β-unsaturated alkyl naphthoquinones with sodium ethylate is shown to involve the replacement of the unsaturated side chain by hydroxyl, which accounts for the formation of a phthiocol-like pigment as the end-product of the colour reaction with vitamin K concentrates, and the pigment is probably phthiocol or the ethyl homologue. The phthiocol isolated from human tubercle bacilli may have arisen from the alkaline cleavage of a K-type vitamin.

SOCIOLOGICAL ASPECTS OF THE CINEMA

THE sociological and psychological importance of the film was under review in four papers at the first meeting of the Psychology Section of the British Association at Dundee on August 31. The discussion ranged from the film tastes of the adult to the uses that could be made of the film in the classroom, and in this connexion the question was raised whether sufficient attention is being given to the possible uses of the cinema apart from entertainment.

Knowledge of its manifold uses is so meagre that a suggestion was put forward for the creation of a Cinema Research Institute with an income of £50,000 a year. The objects of such an institute would be to co-ordinate to their mutual advantage the conflicting viewpoints of the various sections of the trade; to equate the demands of the public with the financial, technical and artistic resources of the industry, and lastly to use modern methods to discover the uses to which films could be put in the service of the modern democratic and world community. Its work would also be of value to Government Departments, official and semi-official bodies, municipal authorities, transport concerns, advertisers, social workers, and last but not least to the cinema industry itself.

The first investigation which it was suggested should be carried out was a general market research. There has never been any attempt to classify cinema-goers by age, sex or social categories. All that is known to-day is that the total number of regular cinema-goers in Great Britain in normal times is between 16 and 17 millions per week, with another 7 millions a week of more occasional visitors.

The second task a Cinema Research Institute should undertake is a research into the likes and dislikes of audiences by trained observers. The makers of films have certain 'hunches' that such and such a film will be a success, but the intuition is based on empirical calculations alone. Such an investigation would also doubtless show that the motives for attendance at the cinema are various. There are those who go to the 'pictures' for escape; the suburban housewife, for example, or the clerk or the manual worker slaving away at a monotonous job. There are, too, the courting couples who have no more interest in the pictures on the screen than in the man in the moon and to whom the comfort and isolation of the cinema is infinitely preferable to the chill of the city streets or the hardwood chairs and continuous interruptions of their own homes. Then there are those who go for an evening of good family entertainment on a regular day each week.

None of these groups is highly critical of the content of the films which they see. On the other hand, since receipts from films vary considerably, there must be a large but unknown number of people who pick and choose their film entertainment. Some go to see a particular star; others to see a dramatization of a play or a novel of which they have heard and which they think they will enjoy upon the film. Others go because their friends say that it is a good picture. Others because they have seen a good review in the 'fan' press or enjoyed the 'trailer' shown the week before. Lastly, there are the few who go to the films because they are interested in films as an art form similar to the theatre or music.

The last line of research that ought to be immediately undertaken is one into the film sociological and psychological effects. What, for example, will be the effect in international relations and political thought of the new tendency of the American film-makers to inject political propaganda into the films now being put upon the public screen? How far should the film be used for domestic government propaganda? The documentary or realist films sponsored by great interests like gas, oil or the General Post Office, are cases in point. "Housing Problems" directs attention to the need for better houses; "Enough to Eat" to problems of nutrition; "The Londoners" to the system and importance of local government; "Men in Danger" to industrial disease; or the American-made film "The River" to the Tennessee Valley Authority's work.

Nevertheless, in some respects all films have propagandist effect. The young people of to-day are better turned out than they used to be, and homes are more comfortable, all because of the effect of the film. Where one should draw the line between conscious and unconscious attempts to influence the filmgoer, is a question yet to be resolved. So far as the British public is concerned, direct propaganda rarely succeeds unless it is camouflaged as 'interest'.

The 'interest film' is capable of much further development. Both adults and children will stand for a great deal of education provided that it is not too obvious. Almost any pill will be swallowed if nicely coated with jam! Where so many amateur organizers of children's matinées go wrong, is that they bore their audiences and hence the experiment is unsuccessful. The professional children's matinée such as is run by some 700 picture houses in Great Britain is entertainment pure and simple. It consists of a good action film or serial, a cartoon sufficiently simple for children to understand, and an interest short film and a comedy. Dr. Inglis, of the University of Glasgow, made a plea for the film, which he said is not nearly so bad as it is painted, for it gives the children a love of adventure and a sense of beauty. It certainly has no effect on juvenile crime. In fact, closing these theatres would be likely to lead to an increase in anti-social conduct.

Side by side with the use of the film as children's entertainment runs the use of the film as one of the optical aids for children's instruction. Its value as a teaching aid has been abundantly proved. Films enable children to retain facts longer, open up the wider world around the child and, last but not least, instruct them in citizenship.

The reception given to this year's discussion emboldens one to suggest that the cinema is worthy of more than a sectional discussion and the committee might well consider if next year it should not form a topic for one of the evening lectures, perhaps under the auspices of the Division for the Social and International Relations of Science.

OLIVER BELL.

SOCIAL BIOLOGY AND POPULATION IMPROVEMENT

IN response to a request from Science Service, of Washington, D.C., for a reply to the question "How could the world's population be improved most effectively genetically ?", addressed to a number of scientific workers, the subjoined statement was prepared, and signed by those whose names appear at the end.

The question "How could the world's population be improved most effectively genetically ?" raises far broader problems than the purely biological ones, problems which the biologist unavoidably encounters as soon as he tries to get the principles of his own special field put into practice. For the effective genetic improvement of mankind is dependent upon major changes in social conditions, and correlative changes in human attitudes. In the first place, there can be no valid basis for estimating and comparing the intrinsic worth of different individuals, without economic and social conditions which provide approximately equal opportunities for all members of society instead of stratifying them from birth into classes with widely different privileges.

The second major hindrance to genetic improvement lies in the economic and political conditions which foster antagonism between different peoples, nations and 'races'. The removal of race prejudices and of the unscientific doctrine that good or bad genes are the monopoly of particular peoples or of persons with features of a given kind will not be possible, however, before the conditions which make for war and economic exploitation have been eliminated. This requires some effective sort of federation of the whole world, based on the common interests of all its peoples.

Thirdly, it cannot be expected that the raising of children will be influenced actively by considerations of the worth of future generations unless parents in general have a very considerable economic security and unless they are extended such adequate economic, medical, educational and other aids in the bearing and rearing of each additional child that the having of more children does not overburden either of them. As the woman is more especially affected by child-bearing and rearing, she must be given special protection to ensure that her reproductive duties do not interfere too greatly with her opportunities to participate in the life and work of the community at large. These objects cannot be achieved unless there is an organization of production primarily for the benefit of consumer and worker, unless the conditions of employment are adapted to the needs of parents and especially of mothers, and unless dwellings, towns and community services generally are reshaped with the good of children as one of their main objectives.

A fourth prerequisite for effective genetic improvement is the legalization, the universal dissemination, and the further development through scientific investigation, of ever more efficacious means of birth control, both negative and positive, that can be put into effect at all stages of the reproductive process—as by voluntary temporary or permanent sterilization, contraception, abortion (as a third line of defence), control of fertility and of the sexual cycle, artificial insemination, etc. Along with all this the development of social consciousness and responsibility in regard to the production of children is required, and this cannot be expected to be operative unless the above-mentioned economic and social conditions for its fulfilment are present, and unless the superstitious attitude towards sex and reproduction now prevalent has been replaced by a scientific and social attitude. This will result in its being regarded as an honour and a privilege, if not a duty, for a mother, married or unmarried, or for a couple, to have the best children possible, both in respect of their upbringing and of their genetic endowment, even where the latter would mean an artificial—though always voluntary—control over the process of parenthood.

Before people in general, or the State which is supposed to represent them, can be relied upon to adopt rational policies for the guidance of their reproduction, there will have to be, fifthly, a far wider spread of knowledge of biological principles and of recognition of the truth that both environment and heredity constitute dominating and inescapable complementary factors in human wellbeing, but factors both of which are under the potential control of man and admit of unlimited but interdependent progress. Betterment of environmental conditions enhances the opportunities for genetic betterment in the ways above indicated. But it must also be understood that the effect of the bettered environment is not a direct one on the germ cells and that the Lamarckian doctrine is fallacious, according to which the children of parents who have had better opportunities for physical and mental development inherit these improvements biologically, and according to which, in consequence, the dominant classes and peoples would have become genetically superior to the underprivileged ones. The intrinsic (genetic) characteristics of any generation can be better than those of the preceding generation only as a result of some kind of *selection*, that is, by those persons of the preceding generation who had a better genetic equipment having produced more offspring, on the whole, than the rest, either through conscious choice, or as an automatic result of the way in which they lived. Under modern civilized conditions such selection is far less likely to be automatic than under primitive conditions, hence some kind of conscious guidance of selection is called for. To make this possible, however, the population must first appreciate the force of the above principles, and the social value which a wisely guided selection would have.

Sixthly, conscious selection requires, in addition, an agreed direction or directions for selection to take, and these directions cannot be social ones, that is, for the good of mankind at large, unless social motives predominate in society. This in turn implies its socialized organization. The most important genetic objectives, from a social point of view, are the improvement of those genetic characteristics which make (*a*) for health, (*b*) for the complex called intelligence, and (*c*) for those temperamental qualities which favour fellow-feeling and social behaviour rather than those (to-day most esteemed by many) which make for personal 'success', as success is usually understood at present.

A more widespread understanding of biological principles will bring with it the realization that much more than the prevention of genetic deterioration is to be sought for, and that the raising of the level of the average of the population nearly to that of the highest now existing in isolated individuals, in regard to physical wellbeing, intelligence and temperamental qualities, is an achievement that would—so far as purely genetic considerations are concerned—be physically possible within a comparatively small number of generations. Thus everyone might look upon 'genius', combined of course with stability, as his birthright. As the course of evolution shows, this would represent no final stage at all, but only an earnest of still further progress in the future.

The effectiveness of such progress, however, would demand increasingly extensive and intensive research in human genetics and in the numerous fields of investigation correlated therewith. This would involve the co-operation of specialists in various branches of medicine, psychology, chemistry and, not least, the social sciences, with the improvement of the inner constitution of man himself as their central theme. The organization of the human body is marvellously intricate, and the study of its genetics is beset with special difficulties which require the prosecution of research in this field to be on a much vaster scale, as well as more exact and analytical, than hitherto contemplated. This can, however, come about when men's minds are turned from war and hate and the struggle for the elementary means of subsistence to larger aims, pursued in common.

The day when economic reconstruction will reach the stage where such human forces will be released is not yet, but it is the task of this generation to prepare for it, and all steps along the way will represent a gain, not only for the possibilities of the ultimate genetic improvement of man, to a degree seldom dreamed of hitherto, but at the same time, more directly, for human mastery over those more immediate evils which are so threatening our modern civilization.

F. A. E. Crew
C. D. Darlington
J. B. S. Haldane
S. C. Harland
L. T. Hogben
J. S. Huxley
H. J. Muller
J. Needham
G. P. Child
P. R. David
G. Dahlberg
Th. Dobzhansky
R. A. Emerson
C. Gordon
J. Hammond
C. L. Huskins
P. C. Koller
W. Landauer
H. H. Plough
B. Price
J. Schultz
A. G. Steinberg
C. H. Waddington

CONTACTS OF RELIGION AND SCIENCE

SIR RICHARD GREGORY, in choosing "Contacts of Religion and Science" as the subject of his chairman's address prepared for the Division for the Social and International Relations of Science for the Dundee meeting of the British Association, selected from the many topics of discussion open to him the one which, perhaps, most consistently holds the interest of those who are laymen in the double application of the term. He could have rendered no better service in both provinces of thought than he did by clarifying the issues, which in the popular mind are so frequently, but as Sir Richard maintained, erroneously held to conflict.

At the very opening of his address Sir Richard made his point of view clear when, after defining religion as "the reaction to an inner impulse as to what is conceived to be sacred and arouses awe or reverence", and science as "the accumulation of knowledge of the properties of natural objects—animate and inanimate—in relation to man's needs and his understanding of them through the use of his intelligence", he went on to show that there can be no conflict between them when they are conceived as joining in a higher unity, in which "all who are searching earnestly for truth, are considered to be worshipping at the same shrine". The dogmatisms of a few generations ago, both of men of science and theologians, are now giving way to a more liberal spirit. As he said, "The study of science creates a feeling of infinite greatness in all who pursue it, and though it may lead to imperfect interpretation, its motive cannot be irreligious. . . . It is in the service of high ideals that science, without which we cannot live, and religion, without which most people see no meaning in life, can find a common field of action."

When Sir Richard had thus made clear his conception as a man of science of the relation between religion and science, he proceeded in a brief historical survey to show what had been in fact the interactions of religion and science. Making special reference to the science of astronomy, he traced these relations from their beginnings in primitive forms of society, through their development in the civilizations of Mesopotamia, Egypt, India, the cosmogonies of the Greeks, the beginnings of modern scientific astronomical and physical knowledge down to Darwinism and the development of the theory of evolution, "which placed man in a new relationship to the rest of living creatures".

In regard to evolutionary theory, or rather its mechanism, the struggle for existence, Sir Richard was at pains to point out the erroneous character of the view sometimes put forward that this is a striving after personal or national mastery at all costs—"a crude misconception repudiated alike by its founder, and by Huxley, its most powerful exponent, as contrary to the best ends of civilization". Further, man as "Nature's insurgent son", continually fighting against forces of evil which would destroy him, is yet able to survive by the use of his intelligence. "He may not know the reason for his existence, but he does know that there is a law and order in the natural world, and if he breaks them, the penalty is inevitable. He has to obey the laws of Nature in order to survive."

Lest the charge of materialism should be brought against him for such doctrine, Sir Richard went on to show in effect that no break in the logical chain of argument, such as is sometimes imputed, is required to find a place for faith in such a view of Nature. For while "science is unable to provide any positive evidence for survival of personality after death—that belief is a powerful ethical factor in human development. It is just as permissible, therefore, to assume that another world awaits habitation by an exalted type of humanity after this earth has come to an end, as it is to believe in the eternal existence of personality."

In conclusion, Sir Richard once more emphasized the historical note. The attempts to find support for Christian belief in general, and the Mosaic account of Creation in particular, in naturalistic or rationalistic explanations, or those which aimed at fitting new knowledge into a system of thought having no claims to scientific accuracy, served no useful purpose to the Bible or to science. A much sounder basis was to be found in applying evolutionary principles to religious thought and studying sacred books as stages in man's progressive discovery in theology. In science there are no final interpretations or unchangeable hypotheses; and when the same principle is recognized in theology, religion will share some of the vitality of the natural sciences. "It is through the acceptance of the idea of evolution in the spirit, as well as in the body of man, that the partition which formerly separated religion and science is being dissolved."

THE ANCESTORS OF THE EUTHERIA

By Dr. A. A. Abbie, Department of Anatomy, University of Sydney

WHATEVER may be the opinions of individual investigators, or even of groups of investigators, as to the status of the ancestors of the eutherian mammals, there has not as yet appeared any conclusive evidence which can determine the issue in favour of any one of the several theories available. Dentition, placentation, details of the skeleton and other somatic characters have all alike failed to supply a decisive solution to the problem. The ancestors may have been amphibians, reptiles, monotremes or marsupials; the Eutheria may have been derived together with the Prototheria and the Metatheria from a common ancestor; or the placentals may own one ancestor, the monotremes and marsupials another; or they may all have arisen independently from distinct pre-mammalian ancestors. At the present moment any of these propositions could be advanced with little fear of contradiction, although a general consensus of opinion would probably be found to favour descent of the Eutheria from some primitive, marsupial-like predecessor.

While bearing in mind Graham Kerr's caution against building too much upon the evidence of a single system, it may be asserted, nevertheless, that in the brain there appears a structure—the corpus callosum—which is peculiar to the Placentalia[1,2,3], and that if the conditions essential to the formation of a corpus callosum could be defined with sufficient precision, they would provide a guide to the structure of the brain in the ancestor of the Eutheria.

Elliot Smith presented the view that the corpus callosum is produced by infiltration of the dorsal part

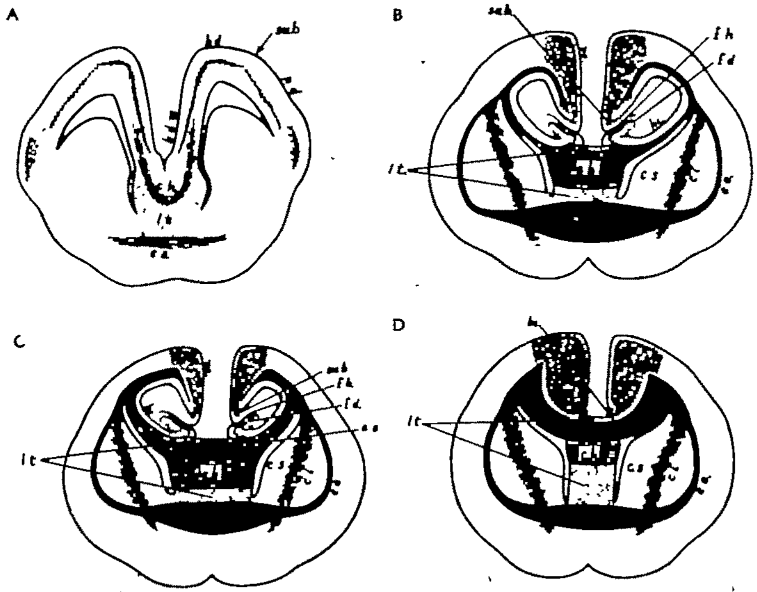


Fig. 1.

A, SECTION THROUGH THE BRAIN OF A REPTILE, TILIQUA, TO SHOW THE COMMISSURES AND THE POSITION OF THE FASCIA DENTATA, HIPPOCAMPUS AND DORSAL PALLIUM.

B, C, D, STAGES IN THE EVOLUTION OF THE CORPUS CALLOSUM ACCORDING TO ELLIOT SMITH: THE NEOCORTICAL FIBRES ARE SAID TO PASS THROUGH THE HIPPOCAMPAL COMMISSURE VENTRAL TO THE HIPPOCAMPUS.

(For key to lettering, see end of article).

of the hippocampal commissure with neocortical fibres which pass ventral to the hippocampus (Fig. 1, *B*, *C*). The hippocampus above the callosum then atrophies to the attenuated remnant which is represented chiefly by the indusium griseum (*C*). Elliot Smith expressed the opinion that the new neocortical connexion had been imposed upon the hippocampal commissure of marsupials, but a glance at *A* will indicate that it might as readily have been imposed upon that of reptiles—or even of amphibians, for that matter. His work, then, left the problem no closer to solution than before.

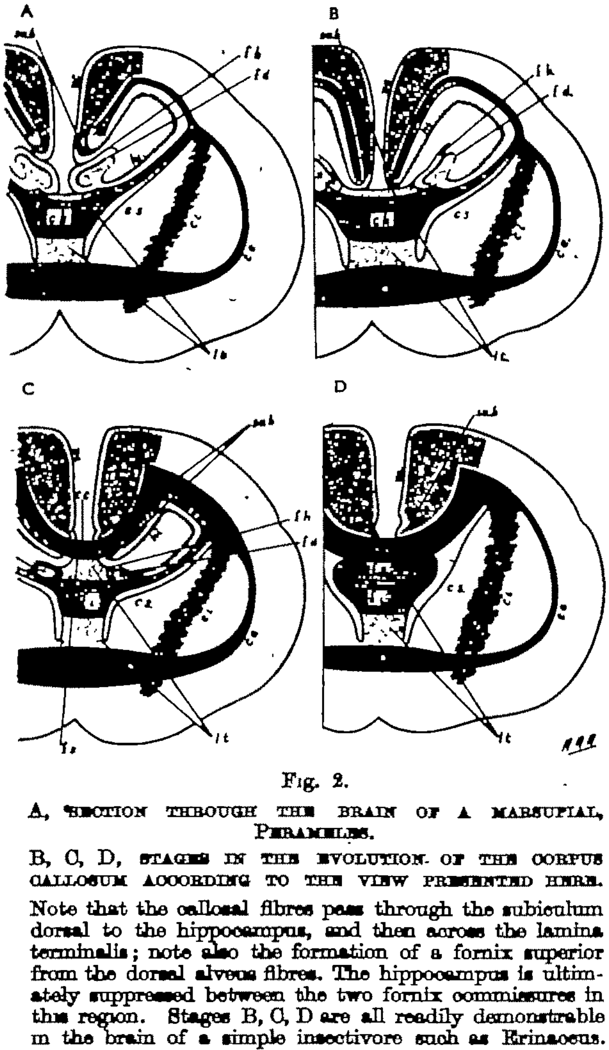


Fig. 2.

A, SECTION THROUGH THE BRAIN OF A MARSUPIAL, PERAMELES.

B, C, D, STAGES IN THE EVOLUTION OF THE CORPUS CALLOSUM ACCORDING TO THE VIEW PRESENTED HERE.

Note that the callosal fibres pass through the subiculum dorsal to the hippocampus, and then across the lamina terminalis; note also the formation of a fornix superior from the dorsal alveus fibres. The hippocampus is ultimately suppressed between the two fornix commissures in this region. Stages B, C, D are all readily demonstrable in the brain of a simple insectivore such as Erinaceus. All figures semi-schematic. (For key to lettering, see end of article.)

It has been shown[3] that in reality the corpus callosum has appeared in quite a different manner. The neocortical fibres do not pass ventral to the hippocampus and through the hippocampal commissure; on the contrary, they pass through the subiculum dorsal to the hippocampus, separating this from the neocortex (Fig. 2, *A*, *B*, *C*). Thus the supra-callosal structure is really a lip of subiculum everted by the pressure of the issuing callosal fibres (*D*). Incidentally, these neocortical fibres carry on their ventral aspect some of the dorsal alveus fibres from the hippocampus to form a second hippocampal commissure—the fornix superior.

The callosal fibres, then, pass directly through the medial wall of the hemisphere at the subiculum, and cross on the dorsal aspect of the lamina terminalis to reach the opposite hemisphere. In the submammalia the subiculum is far removed from the lamina terminalis, its representative being found probably on the dorso-lateral aspect of the hemisphere (Fig. 1, *A*). It is clear that an essential preliminary to the production of a corpus callosum in the manner just described is approximation of the subiculum to the lamina terminalis. Such approximation is achieved when expansion of the neopallium produces the characteristic inrolling of the hippocampus with the formation of a hippocampal fissure; at this stage of evolution the subiculum lies at the apex of the dorsal lip of the hippocampal fissure[4] in close anatomical relationship with the lamina terminalis (Fig. 2, *A*).

Expansion of the neocortex and the consequent formation of a hippocampal fissure are the minimum essentials to the production of a corpus callosum, and this condition is first realized in the brain of monotremes and marsupials. The ancestor of the Eutheria must, therefore, be sought in these two groups of mammals, not among the pre-mammalia.

The ancestors of the monotremes are little known, while the brain in existing representatives of this group is far too specialized to serve as a starting point for the Eutheria. Among marsupials, the possession of a fasciculus aberrans in the anterior commissure[5,6] immediately excludes all Diprotodontia. Of the Polyprotodontia, such representatives as the Cænolestidæ and Peramelidæ, Myrmecobius, Notoryctes, Sarcophilus, Thylacinus and some of the Didelphiidæ are all too specialized in other directions to serve as possible candidates, and there remain only some of the Didelphiidæ and Dasyurinæ, and the Phascogalinæ. Finally, assuming that the possession of a pouch constitutes another bar to direct ancestry, the ultimate choice must fall upon some small pouch-less phascogale or didelphid of bodily structure sufficiently generalized to approximate that of the insectivore-like primitive placentals.

A word of personal explanation is probably required. The late Sir Grafton Elliot Smith was my teacher and friend, and what I know of science I learnt from him; but he was a man in whom scientific accuracy outweighed all personal considerations, and this paper is published in the knowledge that were he still alive, such would have been his wish.

c.a., anterior commissure
c.c., corpus callosum
e.c., external capsule
c.h., hippocampal commissure
c.i., internal capsule
c.s., corpus striatum
f.d., fascia dentata
h., hippocampal fissure
.i., fornix inferior
f.s., fornix superior
h.d., dorsal hippocampus
h.d.m., dorso-medial hippocampus
hi., hippocampus
l.t., lamina terminalis
ne., neocortex
p.d., dorsal pallium
sub., subiculum

---

[1] Smith, G. Elliot, "The Origin of the Corpus Callosum—A Comparative Study of the Hippocampal Region of the Cerebrum of Marsupialia and Certain Cheiroptera", *Trans. Linn. Soc. Lond.*, 2nd Ser., Zool., 7, 47 (1897).

[2] Smith, G. Elliot, "Some Problems Relating to the Evolution of the Brain", *Lancet*, 1, 147, 221 (1910).

[3] Abbie, A. A., "The Origin of the Corpus Callosum and the Fate of the Structures Related to it", *J. Comp. Neur.*, 70, 9 (1939).

[4] Abbie, A. A., "The Relations of the Fascia Dentata, Hippocampus and Neocortex, and the Nature of the Subiculum", *J. Comp. Neur.*, 68, 307 (1938).

[5] Smith, G. Elliot, "On a Peculiarity of the Cerebral Commissures in Certain Marsupialia, not hitherto recognized as a Distinctive Feature of the Diprotodontia", *Proc. Roy. Soc.*, 70, 226 (1902).

[6] Abbie, A. A., "Some Observations on the Major Subdivisions of the Marsupialia, with Especial Reference to the Position of the Peramelidæ and Cænolestidæ", *J. Anat.*, 71, 428 (1937).

A MESOLITHIC SETTLEMENT IN SURREY

THE discovery of a mesolithic village at Farnham, Surrey, was due in the first instance to Mr. W. F. Rankine, who established the fact of mesolithic occupation on the Farnham Valley Sewage Farm in 1929 in the course of a surface survey of the district. Trial excavations were carried out during 1930–35. Mr. J. G. D. Clark, recognizing the importance of the site, then undertook its systematic investigation. Excavations were carried out by him in 1937–38, Mr. Rankine co-operating. A report on the results of the excavations has been prepared under their joint authorship and is now available[1].

The village is situated to the north-east of Farnham on the gravel of the old course of the Blackwater at a height of 250 ft. above O.D. Water supply and geographical conditions combined to make the site attractive to early man, as is indicated by the discovery of archæological remains of many periods, ranging from Neolithic to Romano-British.

The trial excavations revealed the existence of some eighteen depressions in the gravel, some rich in worked and burnt flints, and most of them between three and four feet deep. The area selected for intensive work was a small rectangle showing less evidence of surface disturbance than other parts of the site. Here in 1937 three pits were discovered. These had a reddish-brown soil infilling, rich in worked and burnt flints. From Pit I, nowhere more than three feet in depth below the modern surface, some 851 crackled and more than 3,464 worked flints were recovered, while in a fourth pit, located and cleared in 1938, in which the floor had been cut through the gravel into red clay, 10,709 worked flints and 3,880 burnt flints were found. This pit was shown to be situated in a sandy hollow in the nature of a swallow hole, into which flints had been swept in mesolithic times. Flints were recovered to the number of 12,135 worked and 6,847 calcined. No significant differences in type were shown by flints from different levels. Evidences of Neolithic B occupation were found, but it is clear that the swallow hole had been choked with sand before neolithic peoples settled on the mesolithic site.

The size and contents of the pits and their general characteristics do not allow any doubt that they were dug as the floors of dwellings by the people whose worked flints were found in them. They were evidently intended for occupation over a considerable period of time; and in this connexion the existence of a permanent water-supply near by must be remembered. The excavation of these floors by their makers provided a certain amount of soil to serve for walls, on which roofs could be placed; but the irregular plan of the pits and the absence of post-holes argue against any kind of rigid frame construction. In regard to character and purpose, or mode of occupation, comparison may be instituted with the dwellings of Upper Palæolithic age investigated in Russia and Siberia and the earth-houses of recent circumpolar peoples.

Typological analysis of the flint implements found indicates a homogeneous industry, consisting of various types of microliths, of which slightly more than 30 per cent are geometric, flakes, scrapers, awls, burins, and core tools. Two techniques are to be noted, one core and the other flake. In the latter, microliths account for two-thirds of the whole.

Farnham is one of a number of sites in the area, extending to Aldershot, Guildford, Haslemere, and Bentley, on which the culture is essentially the same. Study of its distribution indicates the importance of geologico-ecological factors, and emphasizes the importance of water, and a subsoil of gravel or sand. Extending the survey to the south and east in Surrey, Sussex and parts of Kent, it would appear that the mesolithic sites are predominantly situated on the U-shaped band of Lower Greensand which surrounds the Weald, taking in sites at Dorking, Reigate, Redhill, and so far as East Malling, near Maidstone. A mace from Blackdown, now in the Haslemere Museum (and similar finds elsewhere), resembles a form from the heart of the Maglemose culture, which goes back to Boreal times. It is, therefore, evident that Farnham, Silmeston, Horsham, and other closely related sites form a group of industries differing in detail, but having in common features not found in combination elsewhere. They occupy a well-defined geographical area on analogous geological formations; and they therefore belong to a narrowly distributed but self-standing culture, for which the term Horsham culture has been proposed.

The key to the wider affinities of the Horsham culture is afforded in its combination of microlithic and core-axe elements—a combination which can be matched only in the Maglemose culture. While, however, the Maglemose strain must be recognized, certain differences must be admitted. The proportion of core axes is lower in relation to the microliths; and the microlithic forms are more varied. The microliths resemble most closely the Middle Tardenoisian of north-east France and Belgium. The Horsham culture, then, must be regarded as being basically Maglemosian, with a strong influence from Middle Tardenoisian. It is known that Maglemose spread over land now submerged, leaving outliers above modern sea-level in Holderness, East Anglia, the valley of the Thames and its tributaries, and probably the Isle of Wight and its hinterland. It was no doubt on the fringe of this territory on the western verge of the Maglemose culture-spread that the Middle Tardenoisian entered Britain; and it can scarcely be a coincidence that the Horsham culture, showing elements from both, is situated precisely in the zone of contact between the two.

Throughout history Britain has benefited from a variety of movements and influences from a variety of Continental sources. Already in mesolithic times two separate influences are to be seen flowing into England, one predominantly northern and the other predominantly western in character. The Horsham culture typifies the development of the British people which, drawing its inspiration from many sources, has yet managed to acquire its own distinctive features.

---

[1] *Proc. Prehist. Soc.*, **5**, 1; 1939.

SCIENCE NEWS A CENTURY AGO

The Acoustics of Buildings

ON September 18, 1839, George Goodwin, jun., wrote to the editor of the *Civil Engineer and Architects' Journal*: "Sir. The report recently made to the Commissioners of Her Majesty's Treasury, by Messrs. Barry, De la Beche, W. Smith and Charles Henry Smith, on the sandstones, limestones and oolites of Great Britain . . . forms with the numerous tables and results of experiments by Messrs. Daniell and Wheatstone appended to it, one of the most valuable contributions to architectural science that has been made in modern times. . . .

"This being the case, then it must, I think, seem desirable to all that government should continue the good work . . . and I would venture to suggest touching the next step to be taken, the importance of appointing a committee to inquire into the most desirable forms of buildings, and the best mode of construction in a phonocamptic point of view, to investigate the science of sound and to deduce principles to be hereafter applied in the erection of buildings. On this subject, which is of the most vital importance to the excellence of the new houses of parliament, we are confessedly entirely ignorant (and I speak of not architects *alone*), we do not know so much as would enable one to say with certainty before a building be finished, whether or not it will be well adapted for oratorical purposes. . . . Sincerely therefore do I hope that a commission will be immediately appointed to collect information on the subject, and conduct a series of experiments on a large scale, without which nothing effectual can be looked for. . . ."

Chemical Powers of Light

"M. EDMOND BECQUEREL has recently communicated to the Académie des Sciences some important investigations on the chemical powers of solar light, which will probably lead to new and valuable results. It has been long known that light has the power of variously affecting certain chemical compounds; sometimes causing combination between two elements, and in other cases effecting the decomposition of compound substances; and it has been found that when a pencil of light is decomposed by passing through a prism of glass, those rays which possess this power are differently refracted from the coloured rays, and hence the existence of peculiar rays to which the name of Chemical Rays is given, has been deduced. The chief difficulty in experiments on these rays has been the slow nature of the action caused, and the difficulty of appreciating them. M. Becquerel has overcome these sources of uncertainty, and is enabled to study the chemical powers of light with ease, and measure the effects produced with considerable accuracy. The manner in which this is done is very simple. Two liquids of different densities, but both conductors of Electricity, and of such a nature as to act chemically upon each other when exposed to the influence of solar light are selected, and a portion of both is put into a cylindrical vessel blackened on the exterior". Plates of platinum are immersed in the liquids and connected to a delicate galvanometer. "If when thus arranged a ray of light is suffered to pass through the mass of the fluid, it causes chemical action to take place at the surface of contact of the two liquids, and a current of electricity which this sets in circulation is immediately rendered evident on the galvanometer. As the angle of deflection of the galvanometer indicates the power of the electric current, and as that is in exact proportion to the chemical action which originates it, it is evident that the arrangement gives an accurate measure of the chemical rays of light, at different times, from different sources, and under various circumstances" (*Athenæum*, September 21, 1839).

Tunnelling through the Alps

THE *Mechanics Magazine* of September 21, 1839, quoting from the *Mark Lane Express* said: "M. Vanino Volta, the engineer of Como, who in conjunction with M. Bruschetti of Milan, obtained in 1837, from the Austrian Government, a privilege of fifty years for the construction of a railroad between Milan and Como is now negotiating with the Swiss Cantons of Grisons and St. Gall, an enterprise which would vie in magnitude with the Thames Tunnel, viz., the piercing through the Grisons Alps. . . . M. Volta, reckoning that thirty years will be required to execute the works, demands an exclusive privilege of a hundred years with liberty to establish companies, in order to procure funds or to transfer his privileges to others."

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 22, N.S., Nos. 15–17: Leaf Movement on Release of Sap Tension, by Prof. Henry H. Dixon; Studies in Peat, Part 6: The 'Water Phase' in Azeotropic Extraction Solvents, by J. Reilly and D. F. Kelly; Studies in Peat, Part 7: Water Distribution in Peat Wax Azeotropic Extraction Solvents, by J. Reilly, D. F. Kelly, J. Duffy and E. Coughlan. Pp. 175–194. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 2s. [258

North of Scotland College of Agriculture. Calendar, Session 1939–1940. Pp. viii+112. (Aberdeen: North of Scotland College of Agriculture.) [258

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, 27th July 1939. Pp. 34. (Edinburgh: Scottish Society for Research in Plant Breeding.) [268

Town Planning Institute. Report on Planning for Air Raid Protection. Pp. 6. (London: Town Planning Institute.) 1s. [308

Other Countries

U.S. Department of Agriculture. Miscellaneous Publication No. 336: The Mosquitoes of the Southeastern States. By W. V. King, G. H. Bradley and T. E. McNeel. Pp. 91. (Washington, D.C.: Government Printing Office.) 15 cents. [258

Contributions from the Biological Laboratory of the Science Society of China, Zoological Series. Vol. 12, No. 10: Oligochaeta from Hainan, Kwangtung. By Y. Chen. Pp. 375–428. Vol. 13, No. 1: On some New Gastropods from Anhui. By C. Ping. Pp. 8. Vol. 13, No. 2: *Study of some Forest Insects of Nanking and its Vicinity*, 2: Observations on Lappet Moth (*Metanastria ample* Walker.) By C. P. Miao. Pp. 9–22. Vol. 13, No. 3: Dinoflagellata of the Hainan Region, 2: On the Thecal Morphology of *Blepharocysta*, with a Description of a New Species. By Da-shu Nie. Pp. 23–42. Vol. 13, No. 4: On the Distribution of the Motor Centers on the Normal and partly Decorticated Cerebrum of the Rabbit. By C. Ping. Pp. 43–56. (Shanghai: Science Society of China.) [268

Bee-keeping in India Series. Pamphlet No. 4: The Beehive. Pp. 40. (Naini Tal: Bhupen Apiaries.) 8 annas; 1s. [288

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 90: *Studies of the Physiology and Toxicology of Blowflies*, 1: The Development of a Synthetic Medium for Aseptic Cultivation of Larvae of *Lucilia cuprina*. By F. G. Lennox. Pp. 24+1 plate. (Melbourne: Government Printer.) [288

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 109. 1ère partie: Procès-verbaux (Mai 1939). Pp. 65. 3.00 kr. 2ème partie: Rapport administratif (1938–1939). Pp. 80. 4.00 kr. 3ème partie: Appendices (1938–1939). Pp. 34. 6.50 kr. (Copenhague: Andr. Fred. Høst et fils.) [288

Commonwealth Solar Observatory, Mount Stromlo, Canberra. Memoir No. 6: Fraunhofer Intensity Table 3924–4300 A. By Dr. C. W. Allen. Pp. 37. Memoir No. 7: The Conduction of Electricity in the Lowest Levels of the Atmosphere. By A. R. Hogg. Pp. 24. (Canberra: Government Printer.) [288

Editorial & Publishing Offices :
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

Telegraphic Address :
Phusis, Lesquare, London

Telephone Number :
Whitehall 8831

Vol. 144 SATURDAY, SEPTEMBER 23, 1939 No. 3647

SOCIOLOGICAL ASPECTS OF EVACUATION

THE complaints which are being received regarding the operation of evacuation schemes in England have at least the merit of preventing any undue complacency arising from the smoothness and efficiency with which the actual transport arrangements were carried out. The success of that operation and its fortunate freedom from attack might well have engendered undue optimism and encouraged the tendency to forget that the real test of evacuation has yet to come. The problem of dispersal, however urgent as a first step in national defence, is simple compared with the more abiding social problems which evacuation presents, not only under emergency conditions but also in the permanent re-integration of national life.

It is well to recall at the start that, as Dr. T. Adams pointed out in his able paper at the British Association meeting at Dundee, under certain conditions, evacuation, however difficult and costly, must remain for some few cities an indispensable element of defence while the possibility of war remains, unless we are prepared deliberately to forgo certain of the advantages which can only be realized in a properly administered city. Accordingly it is important that the experience gained at every stage from the actual preparation and conduct of the evacuation, to arrival and settlement in the reception areas, the social problems of the evacuated areas, until the final return to and re-settlement in the evacuated areas when the emergency has passed should be carefully sifted and studied by scientific and impartial minds.

The outstanding feature of evacuation in England is indeed that it is a social experiment on a very large scale, and its success or failure will depend on the attention which is given to the social factors, and the thoroughness and impartiality with which they are investigated and handled. It should be obvious that many of the well-founded complaints which are encountered arise primarily from neglect of, or imperfect attention to, social factors in the preparation for the dispersal. Certain misfits or embarrassments were almost inseparable from a domestic re-shuffle on the existing scale. Differences of outlook and of social position must be expected and should provide no insuperable bar to domestic harmony. Different conceptions of what constitutes personal cleanliness present much more intolerable difficulties, and complaints on this score have come as freely from those acting as hosts as from evacuees who shrink from the squalor of the homes in which they have been placed.

The extent to which such complaints have been voiced is clear evidence that something has been seriously amiss with the planning of the evacuation. Insufficient attention has been paid to the relative social types of evacuating and receiving areas. In some instances accommodation of the exact type required has been untapped while the evacuees were received into neighbouring districts under conditions which promptly stimulated a migration homewards. The veriest attempt at social survey or comparison of receiving and evacuating areas would have greatly reduced the proportion of misfits.

It should not, of course, be too late to remedy the worst mistakes, and indeed certain education authorities have taken wise and effective action. Too much stress cannot be laid on the importance alike of checking any homeward drift and of encouraging the good will between the evacuees and their hosts which is generally so conspicuous a feature. The value of this sympathy and understanding can scarcely be overstressed in relation to the social re-integration which lies ahead.

That is the aspect upon which attention should next be concentrated, and the reopening of the schools and development of the educational organization in the reception areas is only a special aspect of this problem. Difficulties raised by such questions as equipment and buildings are of secondary importance compared with that of ensuring that the evacuated children are living in a background favourable to their development, and repairing so far as possible the damage which upheaval and separation from homes and parents and familiar surroundings may have engendered.

If it is necessary to plan for a period of three years or more, as indicated by the Government, something more than temporary expedients will be required, whether in regard to educational equipment or social background. Moreover, the drawbacks of improvisation in teaching are all the greater if the satisfaction and support which the normal home surroundings afford are lacking. Equally the social services which the development of education has been rendering may be even more imperative under the conditions which obtain in the reception areas if the nation's capital in youth is not to be wasted.

To maintain existing standards of education and well-being among children and adolescents in the conditions imposed by evacuation is no simple problem, but its solution is essential, and no exigencies of national defence can justify its neglect. Indeed, the experience of the War of 1914-18 should remind us of the danger of abandoning policies already laid down for improving those standards. It is not to be expected that no checks will be encountered or no harm done under the conditions of strain and hazard imposed on the whole nation; but there is no more vital national interest than that of seeing that the young are shielded from any untoward effects so far as possible, and the disturbance of their normal development and training minimized.

The educational problem is only one of the issues raised by evacuation, and even here there are features which may yet prove to be assets. To thousands of children from congested areas and slums a new world is opening, and the spirit of adventure in which they set out at least holds promise of an opportunity of bringing townsfolk to learn something more of the countryside and of its life which could give a new meaning to some of the content of educational syllabuses. The spirit in which most people in the reception areas have accepted their responsibilities and the courage and adaptability of most adult evacuees are other solid assets that have not only made the evacuation scheme workable but also helped to alleviate the wholesale disruption of family life entailed.

The opportunity of social re-integration must not be missed, and the good will displayed in the actual evacuation cannot be allowed to be dissipated. Steps must be taken to mitigate and to eliminate the disruption of family life so far as possible and to explore rapidly all avenues, such as the construction of rural camps which offer the prospect of terminating the separation of mothers and children. Besides this, problems of health and hygiene will demand close attention if the dangers of epidemics, especially under the stress of emergency conditions, are to be prevented or minimized, and excessive strain on health, sanitation, water supply and other public services in the reception areas avoided.

Many of these matters call for wise planning and scientific investigation; but no complete solution can be achieved if we fail to remember that the problem is a national one and not merely that of a number of independent reception areas. The evacuated areas themselves will be subjected to economic and social stress and strain even if fortunately spared from actual attack from the air. Not merely private households, but also general trading conditions, amenities and public services cannot but be profoundly affected if not dislocated by the removal of a high proportion of the population of an area.

The economic problems of evacuation are large and complex. No less important are those of recreation and fitness. These reach far beyond the provision of facilities for organized games for the schools in the reception areas. The existence of amenities for physical and mental refreshment is a vital factor in the psychological adjustments involved and in the maintenance of morale.

The psychological aspects of evacuation are possibly the most important of all. Neglect of them may delay the establishment of reasonably satisfactory conditions in reception and in evacuated areas. At the worst it may lead to deterioration in morale, which by frustrating the very purpose of evacuation may endanger the whole national effort. The stresses set up both in evacuation and in reception areas, like those caused through the whole fabric of civil life by the necessity of re-adapting or even re-orientating life to the restrictions of movement, lighting, etc., imposed by wartime exigencies, and the strain of long hours, often with responsibilities in some branch of civil defence in addition to the working day, demand some opportunity for relief from time to time if serious physical or psychological damage is not to result.

On this ground alone the question of recreation presents problems which cannot long be neglected. Means must be found, consistent with public safety, of ensuring reasonable opportunities of entertainment and relaxation. Possibly the transfer or redistribution of such facilities in the reception areas may be involved as part of the policy of developing an adequate communal life. It should not be forgotten, however, that the migration to the reception areas has, together with the curtailment of public and private means of transport, largely closed for purposes of recreation areas which derive most of their importance from their value as health resorts. As the war continues, the need for attention to such questions cannot but increase.

These are only some of the more immediate problems which evacuation presents. There are others equally important which will require attention before the normal trend of the national life can be resumed. The dispersal of business and industrial firms as well as of Government departments and the accompanying decentralization will raise questions of policy before a return can be made to previous locations. New and unexpected opportunities of town planning and of guiding the location of industry may well present themselves, if the experience now being gained is wisely utilized. In these, as in the more immediate and pressing problems, impartial survey and patient scientific investigation of the many economic, social, technical and psychological factors involved are essential. Scientific workers would be unworthy of their own traditions if they failed to insist on the importance of a scientific study of the problems which evacuation presents, or to direct attention to factors which threaten to sap either the physical or the moral welfare of the nation in the task to which it is now addressed.

FLUID DYNAMICS

Modern Developments in Fluid Dynamics
An Account of Theory and Experiment relating to Boundary Layers, Turbulent Motion and Wakes. Composed by the Fluid Motion Panel of the Aeronautical Research Committee and others, and edited by S. Goldstein. (Oxford Engineering Science Series.) Vol. 1. Pp. xxiv + 330 + 29 plates. Vol. 2. Pp. xii + 331–702 + plates 30–35. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 50*s*. net.

THE present work is dedicated to the memory of Horace Lamb, the father of classical dynamics, whose fundamental work, "A Treatise of the Mathematical Theory of the Motion of Fluids", appeared in six English editions as well as in several foreign translations and is in the hands of every specialist in the theory of fluid motion. By 'classical' hydrodynamics, we understand the hydrodynamics of the nineteenth century in contrast to that of the twentieth, which is distinguished chiefly by a more detailed and at the same time extensive study of the influence of viscosity, particularly in the case of fluids of small viscosity, so that a much nearer approach to reality has been attained. Even those parts of the modern theory which are fundamental for the ideal frictionless fluid have been enriched in very important points by new research. Here, the knowledge of the existence and behaviour of surfaces of separation was effective in the discovery of new ways in which to obtain practical results.

During the last twenty years, much new knowledge, with practical applications, has matured concerning the disturbance occurring in the majority of technical fluids—of which the ultimate cause is still a problem—which is known as turbulence. These developments have proved extremely fruitful where scientific application is concerned, as, for example, in meteorology and oceanography.

The great interest which has developed in recent years in aeronautical science, for which fluid theory is of basic importance, had considerable influence on the rapidity of progress in the science of hydrodynamics. In consequence, research in the subject has advanced at such a pace and has given rise to such an immense literary output, that it has become increasingly difficult for any one individual to keep up with it. Hence a number of works of a co-operative nature have appeared in which the attempt is made to present a survey of all the results obtained by research. Two earlier works of this kind are "Handbuch der Physik", Vol. 8 (1927), by Geiger and Scheel, and "Handbuch der Experimentalphysik, Vol. 4 (I–IV, 4 (1930–1932)). A newer work in six volumes, entirely devoted to aerodynamics, is "Aerodynamic Theory" (1934–1936), by W. F. Durand.

Although the present work is distinguished from previous ones by its intentional limitation to particular fields which are intimately connected with one another, the sections in themselves are amazingly comprehensive. For this reason alone, the book is certain to remain for a long time indispensable to the further development of research in these fields. A characteristic of the whole domain with which this book is concerned is that it includes those branches of hydrodynamics and aerodynamics which are concerned with viscous fluids and particularly those possessing low viscosity, or, in other words, with laminar and turbulent flow, with special consideration for flow near the surfaces of solid bodies and in the domain of great turbulence behind them. Furthermore, the transference of heat in laminar and turbulent fluid motion is considered. On the other hand, neither potential fluid motion, nor the three-dimensional aerofoil theory, nor the propeller theory are dealt with. Nor indeed do the problems of compressibility and cavitation come under consideration.

The contributors to this work include members of the Fluid Motion Panel of the Aeronautical Research Committee, of which Sir Horace Lamb was a member for many years and which now includes eleven British research workers and four younger workers. It is a truly co-operative work in which even the names of the authors are kept well in the background. In fact the only name which appears is that of the editor, Dr. S. Goldstein, who directed the research and writes an introduction for the benefit of the reader, in which the most important concepts in hydrodynamics are expounded in a brief but extraordinarily clear manner.

The contents of the book are arranged as follows. Of two introductory sections, the first is concerned with fundamental concepts and with the laws of motion of the ideal non-viscous fluid, and the second with laminar and turbulent boundary layers and their effect with regard to drag. In the third section, a strict mathematically formulated account of the laws of viscous fluids accompanied by accurate solutions of the equations is given. The fourth section expounds the mathematical theory of fluid boundary layers, the fifth is devoted to the concept of turbulence, while the sixth discusses experimental apparatus of all kinds (wind tunnels, experimental tanks, whirling arms, velocity and pressure measurements, visualization of fluid motion). In the seventh section as well as in the eighth, with which the second volume begins, fluid motion in pipes and canals and along level plates, obedience to the law of the laminar and turbulent forms of motion together with the relation of the former to the latter, are very thoroughly expounded In Section ix the problem of resistance in the case of symmetrical cylinders is discussed, while Section x is concerned with the resistance of asymmetrical cylinders and special aero-foils; in Section xi rotation shapes (airship shapes) are considered. The different kinds of control of boundary layers are examined in a further section, which is followed by another to consider events taking place in the wake of a moving object. The final sections, xiv and xv, are concerned with heat transfer by conduction and convection in laminar and turbulent fluid motion.

The excellent illustrations are a special feature of the work. Wherever possible they are taken from original monographs, and the photographs—the majority from the original—are excellent half-tone prints reproduced in thirty-five plates. This natural documentation increases the interest of the book and is very welcome. Furthermore, the value of the work, which is carried out most conscientiously in all sections, is much enhanced by very complete author and subject indexes covering twenty-two pages. The reviewer noted with great appreciation that not only important English works on the subject, but also all those known to him in the foreign literature also are included. There is no doubt that this work will contribute enormously to the furtherance of research in the subjects with which it deals and that it will be of inestimable use to students.

The reviewer would like to make one suggestion, namely, that short explanatory legends under the illustrations—which are absent in this work—are very helpful to those who have not studied the text of the book itself. Such explanatory legends are particularly helpful when one is glancing through the book for the first time. L. P.

SYMBIOSIS BETWEEN FUNGI AND SCALE INSECTS

The Genus Septobasidium
By Prof. John N. Couch. Pp. ix + 480 + 114 plates. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1938.) 5 dollars.

UNDER the able leadership of Prof. W. C. Coker, the Botanical Department of the University of North Carolina has produced several major works on fungi: "The Saprolegniaceæ, with Notes on other Water Molds" (1923); "The Clavarias of the United States and Canada" (1923); "The Gastromycetes of the Eastern United States and Canada" (1928); and "Studies of the Genus Pythium" (1931). To these there has recently been added John N. Couch's splendid monograph on the genus Septobasidium.

By means of sucking tubes, scale insects obtain their nutriment from the cambial region of the plants to which they become attached. Von Hörnel and Litschauer in 1907 were the first to direct attention to the remarkable fact that, in the dried species of Septobasidium investigated by them, scale insects are always present under the hyphal mats formed upon the bark of twigs or branches. Couch, working for more than ten years on living material, has now shown that scale insects are present in the hyphal mats of Septobasidium species in general and that the fungi and the insects live together symbiotically. A Septobasidium can extend its development only in connexion with scale insects, and when these insects die the growth of the fungus ceases. The insects are protected from their enemies by the fungus, and the fungus draws its nutriment from, and is distributed by, the insects. The symbiotic relationship of the fungi and their associated insects has been discussed by Couch in detail.

In *Septobasidium Burtii*, the life-history of which Couch describes and illustrates very fully, the fungus mat above an insect's body on an oak branch is nowhere in direct contact with the insect, but the two are connected together by numerous coiled hyphæ. This arrangement gives the insect freedom of movement to breathe, so that it will not suffocate. The coiled hyphæ are attached to the insect at the dermal pores and setæ. By means of the threads passing through the natural apertures of the insect's body-wall the haustoria of the fungus within the insect's body are connected with the mat and thence with the other parts of the fungus. The haustoria are found only in the circulatory system or hæmocœl of the insect, and they are coiled in form.

With the help of the haustoria, the fungus obtains the nutriment necessary for its growth and for the production of basidiospores on its exterior surface. Not all the insects beneath a stroma are parasitized, but those that are are dwarfed and incapable of reproduction. The young insects are infected by bud cells formed by the spores and never by fungal hyphæ. Some of the insects which have become infected by crawling over the spore-bearing surface may crawl back beneath the fungus colony under which they were born, others may settle down beneath other fungus colonies, and some settle down on the bare bark. The first two groups of insects are solely responsible for the survival and continued growth of fungus colonies, while the third group, which settle down on clean bark, are solely responsible for the distribution of the fungus. Under natural conditions, whereas the fungus cannot live without the insects, the insects are able to live without the fungus; but the life of insects unprotected by the fungus is precarious.

Septobasidium is widely distributed in the world. There are numerous species in the United States, the West Indies, Brazil, Ceylon, Java, and the Philippine Islands, and a few species have been found in Europe and Australia.

By far the larger part of the volume is devoted to taxonomy. On the basis of the symbiotic relationship, Couch has raised the Septobasidiaceæ to the rank of an order, the *Septobasidiales*, coordinate with the Auriculariales, the Uredinales, and the Ustilaginales. A key for identification is followed by a description of 163 species, 5 varieties, and 2 hybrids. Some 56 species are described as new.

The illustrations are numerous and admirable. Among other things they depict: the insect houses and their occupants; the relations of the fungi and insects with one another and with the tree at the expense of which they both ultimately live; the ways in which the fungi extend their colonies by the capture and infection of more and more young insects; and the microscopic details of structure of nearly all the species of Septobasidium which have been described.

Prof. Couch is to be heartily congratulated on the outcome of his labours. By long-continued and exact observation he has added greatly to our knowledge of Septobasidium species, and at the same time he has made a series of beautiful discoveries concerning the relations of fungi and insects. His book is a valuable addition to biological literature, and its contents will appeal not only to mycologists but also to entomologists and naturalists in general. A. H. REGINALD BULLER.

SPECTROSCOPY IN INDUSTRY

Spectrographic Analysis in Great Britain
Edited by A. C. Candler. Pp. 80. (London: Adam Hilger, Ltd., 1939.) 7*s*. 6*d*. net.

MODERN spectrographs suitable for industrial work originated in Great Britain nearly thirty years ago, and their application to industry has been continuously increasing for three main reasons. First, for purely routine control, the spectrographic method is often much more rapid than a purely chemical one and, moreover, may require fewer workers. Secondly, chemical analysis may be less reliable when the estimation of mere traces of certain elements is involved. Finally, only small quantities of material are required for spectrographic analysis.

The monograph under consideration comprises twenty-eight articles describing the application of spectroscopic methods to a wide range of subjects, including analysis of alloys, detection of metallic contamination of beers, agricultural problems, archæology, and last, but by no means least, to forensic science. All the articles are brief.

The spectrograph, for example, has proved helpful in tracking down the causes of obscure diseases of crops and stock. Thus teart, to which cattle in certain areas are subject, is found to be associated with an increased molybdenum content in the herbage. In view of the minute traces of molybdenum involved, a long time would undoubtedly have elapsed before this discovery could have been made, had chemical methods alone been available.

The concluding article, which deals with forensic science, suggests numerous ways in which the spectroscope can assist in tracking the criminal. Thus counterfeit coins may be compared with dust from the suspect's pockets; a fragment of glass from the turn-up of a suspect's trousers may be compared with the glass of a window broken in a smash and grab raid.

The monograph may be recommended to all interested in the application of spectroscopy to almost every walk of life.

J. NEWTON FRIEND.

THE FACTORS OF THE MIND

The Factorial Analysis of Human Ability
By Prof. Godfrey H. Thomson. Pp. xv + 326. (London: University of London Press, Ltd., 1939.) 16*s*. net.

MOST psychologists have assumed that all mental activities are reducible to a small number of independent 'factors', such as intelligence, emotionality, verbal capacity, manual capacity, introversion or its opposite, and the like. Prof. Thomson's book is concerned, not so much with discovering what these factors may be, but rather with a critical examination of the mathematical procedure by which, it has been claimed, their existence may be established.

The older 'faculty school' simply postulated such elementary capacities as they were required; the newer school of statistical psychology supposes that they can be deduced mathematically by analysing correlations between test-performances or estimates of character. Various methods have been devised for this purpose—all loosely covered by the broad term 'factor analysis'. Of these the earliest was Prof. C. Spearman's well-known attempt to demonstrate that all mental processes involve a single intellectual factor, identifiable with 'general intelligence'. His formulæ assumed that two factors only were sufficient to account for every test performance. Later work in Great Britain, particularly in the field of educational testing, indicated that more specialized factors (verbal capacity, arithmetical capacity, etc.) appeared to enter into different tests, in addition to the 'specific factor' peculiar to each one and the 'general factor' common to all. The notion of multiple factors, as a substitute for that of dual factors, has since found strong support in America; and recent workers have endeavoured in various ways to generalize the simpler theorems of the two-factor hypothesis to meet these wider needs.

In the book under notice, Prof. Thomson brings together into a single clear and systematic exposition all the chief factorial methods that have hitherto been put forward. He explains their mathematical derivation in an elementary way for the student of psychology, and briefly compares their merits and their disadvantages. He also incorporates a summary of his own very valuable contributions, including more particularly a revised version of the sampling theory which he had put forward as an alternative to the two-factor theory of Prof. Spearman. From the first page to the last the treatment is remarkably lucid, suggestive, and impartial.

Prof. Thomson claims that his book is written primarily for the reader "with little or no mathematical knowledge beyond what is ordinarily imparted in the secondary school". Nevertheless, even the professional psychologist and statistician will welcome the compendium of formulæ and proofs brought together in the mathematical appendix, and throughout the book will find new light continually shed on old problems. In common with most recent contributors to the subject, Prof. Thomson believes that these problems are best solved by matrix algebra; and, in their abstract form, the solutions reached are, as a matter of fact, often strikingly similar to results independently obtained by quantum physicists. But, as the present reviewer has more than once pointed out, although these methods were originally developed for the analysis of the results of psychological testing, they would be almost equally applicable to the solution of analogous problems in many other fields—in physiology, biology, sociology, medicine, economics, agriculture and, indeed, in almost any science where causal factors are numerous and inextricably interlinked. The book must at once take its place as one of the most important publications of the year in the field of education and psychology; at the same time it should be of great interest to all who are engaged on statistical research, no matter what their special sphere.

C. B.

TABLES FOR STATISTICIANS

Statistical Tables for Biological Agricultural and Medical Research

By Prof. R. A. Fisher and F. Yates. Pp. viii+90. (London and Edinburgh: Oliver and Boyd, 1938.) 12*s*. 6*d*. net.

MODERN statistical analysis, particularly that relating to the production of adequate and exact tests of significance, owes much to the painstaking researches of R. A. Fisher, whose text-book, "Statistical Methods for Research Workers", has gone through a number of editions since it was first published in 1925. Not the least valuable feature of this work is the collection of tables, which have proved so indispensable to the statistical worker of to-day that they have been repeatedly referred to, and in certain cases reprinted, through the generosity of author and publisher. The desirability of having them separately published has been felt in many quarters, and in the volume now before us we have a work in which the tables of Fisher's book have been not only reprinted but also amplified, and many other tables have been added. While not a complete manual of statistical tables, available for all purposes (it is not, for example, very easy to fit a normal curve from the tables provided), the book is a very useful collection, and should be the indispensable companion of every statistician.

The first set of tables consists of those from Fisher's book, considerably extended (especially as to the z-table and its accompanying "variance ratio"), and with two new tables. The second set consists of tables of probits and angular transformations, found useful in medical research. We then come to a section of non-numerical tables, lists of Latin squares, and combinatorial solutions required for the design of balanced incomplete blocks—a set of tables which should be very useful to the agricultural experimenter. Following this are tables of a more miscellaneous character, including an interesting and useful new table of orthogonal polynomials, which should much simplify the calculations in problems of fitting curves. Finally, to complete the set, we have tables of logarithms, including natural logarithms up to 100, squares, square roots, etc., and tables of certain trigonometric functions. The last is a new table of random numbers.

As an example of mathematical table construction the work is excellent. The printing, spacing and presentation, and the large flat page, are according to the best canons. Where interpolation is necessary, the tables are adequate for the purpose, and the methods to be used are stated. In the case of standard tables, with mean differences, there is the interesting innovation of providing mean differences for half the interval only, thus teaching the user to subtract as well as add, and making for greater accuracy in the final result. The introduction, as is to be expected, has points of originality and interest, and is in itself a worthy piece of mathematical research. While some readers may be disappointed by not having standard uses of the standard tables illustrated, they will on the other hand welcome new statistical tests there described, together with suggested new uses of old tables, and the ways of using effectively the new tables.

J. Wishart.

PERSPECTIVES IN EVOLUTION*

By Prof. J. Ritchie

University of Edinburgh

"ALL useless science is an empty boast," Shakespeare is alleged to have said, but he lived before that pernicious cleavage had been made between pure science and economic science, which suggests, as Hinton once said, that the latter is a gold-digger while the former excavates only knowledge. And while we are strongly in favour of those lines of scientific endeavour which make their first purpose an attack upon the evils that man and his possessions fall heir to in the course of Nature, and which aim at easing the human struggle for existence, there are questions of no immediate practical moment to which the inquiring spirit of humanity demands an answer. I do not think Shakespeare would have called these recurrent problems "useless science", for the mind of man requires satisfaction as well as his material need.

The Secret of Life

Much that was mysterious about life has disappeared or is disappearing before the persistent inquiries of the physicist and chemist. Life processes of the physiological order are ruled and guided by the self-same laws which regulate action in the non-living world.

But it is just as obvious that none of these interpretations reaches the secret spring of life itself. The physical explanation of the architecture of animals must assume the power of the living thing to react and mould itself to the forces that play upon it. The Donnan equilibrium, which interprets a condition of thermodynamical balance, meets the case of a living cell only when the cell activity is at its lowest, and the more active, that is the more alive, a cell is, the less does the Donnan theory become applicable Enzymes may be necessary for the complete activity of a cell, but, though it may hasten a chemical reaction, no catalyst can set a reaction in motion; in the case of the cell that appears to be the prerogative of 'life'.

Let us turn, then, from the minute analysis of the unit of life which in recent years has done so much to reduce the mystery of life, without, however, reaching the kernel of the mystery, to see what suggestion may arise from another point of view, a perspective of evolutionary processes.

The occurrence of certain organic aggregates on land and in the ocean, and the increase in orderly arrangement of matter revealed in the evolution of life from more simple to more complex, leads to the conclusion that in practice the second law of thermodynamics, so well established for physical happenings, cannot be satisfactorily applied to living processes; and that while no one would deny that living things in the long run and in a universal sense are subject to its demands, and indeed that in their workings they are probably controlled by it, nevertheless organisms *appear* to be able temporarily to hold up or withstand the physical course of degradation of matter, if they do not actually reverse it.

From this point of view, then, the secret of the living organism, that is its essential difference from non-living matter, is its power of trading with its environment in such a way that it can build up its body stores of high potential energy from materials of lower potential.

Phenomena of life elude treatment by the laws of thermodynamics, not necessarily because living matter does not obey these laws, but because the unknown conditioning of working organisms is too complex to yield to analysis applicable to inorganic states. Nor does it seem likely, since livingness exists within a very limited range of temperature and is readily extinguished by interferences, that it can ever be subjected to the sort of analysis which has led to the interpretation of the constitution of physical matter. It seems logical, therefore, to take as axiomatic the existence of life, not as a vital force which animates something different, namely matter, but as the activity of an atomic combination the very activity of which renders it unanalysable by the standard methods of the physicist and chemist. Thus, as one of the greatest of living physicists, Niels Bohr, has pointed out, the biologist would accept for the living world a position analogous to that accepted by the physicist for the non-living. "The existence of life must be considered as an elementary fact that cannot be explained, but must be taken as a starting-point in biology, as in a similar way the quantum of action, which appears as an irrational element from the point of view of mechanical physics, taken together with the existence of the elementary particles, forms the foundation of atomic physics."

The biologist, admitting 'life', may build up a whole body of biological theory, as distinctive and peculiarly his own, and as logical in the logic of probability which Professor Darwin advocates, as are the theories of the physicist or the chemist in their own limited fields.

---

* From the presidential address before Section D (Zoology) of the British Association, delivered at Dundee on August 31.

Lengthening of Life Perspective

There is another notable development of this century which must affect evolutionary thought, the expanding idea of the time during which the earth and life upon the earth have been in existence.

From the earlier discussions it would appear that a psychological element entered into the final estimates, as if the calculators drew back aghast at the possibility of the enormous age of the earth at which their estimates hinted. Thus almost all tended in their final summing towards the minimum of their scales, and little is heard of the other extreme—Lord Kelvin's independent maxima, reached by different methods, of 1,000, 400 and 500 million years, or Geikie's 400 million years—although these came much nearer to the modern estimate.

Now, a consensus of opinion admits credibility to estimates based upon the break-up of radioactive minerals in the rocks. We may say that life has existed upon the earth for perhaps 1,200 millions of years; and then to complete the picture that the birth of the earth and, as the new cosmology seems to indicate, perhaps also at the same time the stupendous birth of sun and stars, took place about 2,000 million years ago.

Stability of Organism and Slowness of Evolution

This amazing extension of the time concept of life emphasizes anew some of the striking features of evolution. We are accustomed to lay stress on the variation of living things, upon which evolution depends, but surely more remarkable is the stability of living organisms, which retain their own characters in spite of changes in the environment, and whose germ cells pass these characters unaltered through countless generations. The edible mussel (*Cardium edule*) has retained its specific characters for two million years or more; its genus, in a wide sense, lived 160 million years ago in the Trias. The Crinoid genus Antedon which flourishes in our own seas antedated that old bird Archæopteryx in the Jurassic Period, 140 million years ago. It is surprising enough to realize that genera of foraminifera, like Nodosaria (Silurian) and Saccammina (Ordovician), still abundant in our oceans, have retained their generic characters for about 300 million years. But they are relatively simple organisms; it is still more astonishing to think that contemporaneous with them or before them lived modern genera (again in the wide sense) of more highly organized brachipods, like Lingula (Ordovician) and Crania (Ordovician), and that these have experienced the geological upheavals and secular changes since Palæozoic times without turning a hair, or, in the revised version, without the shift of a gene upon a chromosome.

It is in agreement with that stability of organisms that we must conceive of evolution as a process of extreme slowness, as if living things are loth to change, and ultimately change only under the direct compulsion of circumstances. Of that slow progress in its minor phases the new chronology gives us a measure.

If this time-factor is a necessary element in the evolution of species in Nature, doubt is thrown upon the validity of arguments concerning evolution based upon laboratory experiments, in which intensification of means produces rapid change. There is no reason why the reaction of an organism under such exaggerated stimuli should be the same as that produced by minimal influences of the same nature over an exceedingly long time. Even in inorganic Nature the reaction of inanimate environment may differ according to the time element. The sensitive organism delicately adjusted to a particular environment is less likely than inorganic environment to give a 'natural' answer under concentrated compulsion.

Advent of Man and Evolution

The lengthening of the time perspective of life upon the earth adds new insignificance to the span of man's tenancy of the world and new impressiveness to the part he has played as an agent in evolutionary processes. Man of our own genus, beginning in the early Pleistocene Period, has probably less than a million years behind him, but the species of man now dominant in the world (*Homo sapiens*) appeared only at the close of the Würm Glacial stage, no longer than 25,000 to 40,000 years ago. Yet even this relatively short space of time exceeds man's span as an effective agent in world change, for in spite of the arts he developed in early post-glacial times he remained practically submerged in the fauna, having little more influence upon his environment than the beasts with which he shared it.

It was Neolithic man who set the ball a-rolling through his outstanding achievements in domesticating wild animals and in developing the cultivation of the soil and the growing of crops. For these achievements, apart from laying the foundation of a new era in the progress of civilization, started a series of changes which have profoundly influenced the distribution of life upon the earth. In one direction the safety of flocks and herds demanded the elimination of beasts and birds which threatened them, and in another the need of land for crops and pasturage played havoc with the wild environment and so with the fauna which it sustained and sheltered, although the crops themselves encouraged the multiplication of certain elements in the fauna which became the pests of agriculture.

The Neolithic Age, which originated these changes, reached Western Europe only some 8,000 years B.C., though in the East and in the lands of old culture it began several thousands of years earlier. But Neolithic man, although he initiated the most far-reaching changes in plant and animal life, was himself, with his implements of wood and stone and limited powers of offence, ineffective in his interference. Even in a limited area like Scotland, few animals died out during his rule and it would be difficult to bring home to him responsibility for their disappearance. For the effective introduction of man as an agent of evolutionary change we must look to a time more recent. And that time is determined by his increasing efficiency as a cultivator and destroyer, and particularly by the need for food and fire demanded by an increasing population. These influences began to make their mark about the tenth century of our era, when several of the interesting members of the primeval fauna of Great Britain had disappeared or were on the verge of extinction, but in the centuries following the sixteenth they commenced a period of pressure, which, increasing in intensity, has transformed the faunas of civilized lands.

It is not an accident that the emergence of man as a major factor in the evolution of faunas coincided with the increased power of destruction presented to him by the invention of gunpowder and guns, and with that extraordinary increase in population which in the last three hundred years has multiplied, almost five times over, the numbers of mankind upon the earth. For this burst of population was itself the accompaniment of intensified agriculture and stock-rearing, of the spread of industries and development of commerce, all of which have had profound repercussions upon aboriginal faunas and floras.

While modern man has existed upon the earth for some 30,000 years, his part as a distinctive agent in the evolution of faunas is limited to a thousand years, and within that span his great transformations are practically confined to the last three hundred years. That is a period infinitesimally short compared with the ages during which the aboriginal faunas into which he was launched had been differentiating, redistributing and establishing themselves in a natural balance. What transformations has he wrought in so short a time ?

I do not propose here to examine in detail the magnitude of this new world factor in the evolution of faunas and floras. That is best shown in a limited area which can be intensively studied, and I have elsewhere described with reasonable thoroughness the stages and sum-total of this process in Scotland, the recent geological history of which makes it particularly suited for such an analysis

I may, however, indicate the depth of penetration of this new faunistic factor by pointing out how superficial is the view that regards man merely or mainly as a destroyer. He has indeed deliberately reduced numbers or extirpated animals for his own protection or for that of his flocks and crops, for food and other necessities, for sport, and to satisfy the whims of luxury ; and without intention his cultivation of plains and marshes and destruction of primeval forest have destroyed feeding grounds and banished their former tenants. Yet his addition to numbers far outweighs his destruction. Intensive cultivation has added a stock of domestic animals far beyond the bearing capacity of wild country, besides increasing the numbers of wild creatures which also benefit from his crops. Deliberate protection of animals, for sport, for utility, for æsthetic reasons, and on account of popular superstition, has also multiplied numbers. Furthermore, apart from numerical changes within the aboriginal faunas, man has changed their qualitative composition by introducing foreign animals deliberately (here we must include domestic animals), and unintentionally through the ramifications of international commerce.

These are simple primary effects of man's interference ; secondary and remote consequences are even more impressive in their ultimate issues. In general it may be said that, wherever civilization has made itself felt, three main faunal changes are noticeable : the largest animals tend to be reduced in numbers and eventually to disappear ; smaller creatures, dependent upon cultivation and human habitations, multiply far beyond aboriginal numbers ; and the deliberate or accidental spread of 'foreign' creatures is creating a degree of cosmopolitanism throughout the world's faunas.

How do these changes brought about by man stand, viewed in the perspective of the long evolution of faunas upon the earth ? There are two types of change in progress in the natural assemblage of animals in any region. There is a constant ebb and flow within the fauna itself due to local and temporary influences, a swing of the pendulum about a mean, the 'balance of life' which is never quite struck. But there is also a faunal drift, revealed in the story of the rocks or in any long vista of faunal history, and this is due to great secular changes, to geological influences, to modifications of climate, to the insurgence of the forces of life.

Where man's interference is temporary and casual it may be compared to the internal faunal tide, which is of little moment in the long run ;

but where his interference is persistent in any direction it must be reckoned as sharing with the great secular forces of Nature in propelling a fauna upon a path along which there is no return.

Such is the remarkable conclusion to which the long view of man's place as a natural agent brings us—that he has set in motion forces which, in our era and mainly in the last three hundred years, have wrought faunal changes which can be compared only with the great secular changes of world evolution. When the ridiculously short span of his interference is contrasted with the slowness of natural processes, the probability forces itself upon us that in a few more thousand years of man's inheritance of the earth the old order of Nature will be superseded in the faunas of the world by a new order of mankind.

MAN IN EVOLUTIONARY PERSPECTIVE

Having thus assigned to man dominance among the forces which determine faunal assemblages, let me now endeavour to put him in his place in the long perspective of life and evolution.

Many have speculated upon the new view of man's future. To some it has seemed likely that future progress will be along the lines of individual development, that brains and mind will become more perfect in their working until man is master of all Nature. Others look to a future in which not the individual as a unit, but society as an integration of individuals will become more closely knit and more perfect in its functioning.

Still others see in the modern developments and threats of warfare a warning finger of the doom of civilization. I would remind these doubters that evolution as we know it is built upon destruction; that the development of the whole animal kingdom rests upon the destruction of green plants, which biologically are formed of the same stuff as we are, and that within the animal kingdom the flesh-eaters have risen upon the bodies of their fellow-creatures. The drama of wars amongst mankind and the imminence of war seizes the imagination, and history-books bias the mind by emphasizing wars and ignoring the quiet but effective work of millions of unknown citizens through the ages. But in our perspective of hundreds of millions of years these are the merest incidents and, war or no war, the quiet progress of evolution flows through life carrying the world of living things steadily but unobtrusively from one step to a higher.

In his short past man has been moving towards a higher intellectual, spiritual and moral standard, and the biological view would be that in the immediate future (geologically speaking) that movement will continue, and that for human beings this future lies in the development and perfection of social life and in the spreading of the social idea to include peoples and nations as well as individuals, with all the correlated advances that these imply.

That is the short view of man's future, but what of the long view of mankind upon the earth? I notice that Sir James Jeans contemplates, at any rate fancifully, the existence and progress of humanity until the shadow of the extinction of life upon the earth falls upon the world, many millions of years hence. Does our vista of life support such a view? We must admit that any view of science about the future of humanity can be only a short-range forecast; of the long-range forecast it can say nothing. The reason is that science knows only the past and the present, so that it can read into the future only the glorification or degradation of what has already been expressed in mankind, let us say better brains, better social organization, less self-seeking. Yet the unfathomable characteristic of life is that it is always throwing up something new; evolution proceeds not only by permutations and combinations of the old, but by the emergence of new lines of development. The physicist can foretell with accuracy the movements of the planets, the return of eclipses and comets, but who, knowing only fishes, could have foretold the amphibia which arose from them, or, knowing only the reptiles, could have foretold their descendants the birds and the mammals? When we leave details in the world of living things we can be wise only after the event; we cannot be wise before the event. Therefore the long future of evolution upon the earth is unknowable, so far as science is concerned.

Nevertheless, bearing that warning in mind, we may gain some hint from our perspective of life upon the earth.

We look upon man, and rightly so, as the crowning glory of evolution: stage by stage, we say, the evolution of the past has led up to him; we can imagine nothing higher, evolution appears to have reached its goal.

But step back some 180 million years in our time-scale to the Triassic period when the great dinosaurs dominated the earth and nothing higher than reptiles had been evolved. To themselves and to the creatures which shared the world with them, they must have seemed (if they had any self-consciousness), and indeed they were, the crowning glory of creation; stage by stage the evolution of the past had led up to them; nothing higher could be imagined, evolution appeared to have reached its goal. That could be said by their contemporaries of the highest creatures at every stage in the course of 1,200 million years of evolution, just as it is said of man to-day. A hundred million years have rolled past since the time of the dinosaurs, and they and all their immediate kin have disappeared for ever, and new and unforeseen trends of life have blossomed, as they have done over and over again, and have carried the story of evolution on to the present, when man is the dominant and highest.

Looking back over that 1,200-million-year vista of the steady climb of life upon the path of evolution, it seems presumptuous for us to suppose that man, the latest newcomer, is the last word or the final crowning glory amongst many, and that with his coming the great steps in evolution have come to an end. Looking forward to the future of life upon the earth, it seems even more presumptuous for us to suppose that for the next 1,000 million years life, so surprisingly inventive in the past, should be tied for all time to come to trifling changes like increase of brain power or better social organization for mankind.

The truth is that we, bound by the past, can imagine nothing more, but if the long vista of evolution is any clue to the future, we cannot regard mankind, the crowning glory of the present, to be more than a stage in life's progress and a milestone upon the path of evolution towards a greater future. To think otherwise is to imagine that with the coming of man, so insignificant in time, the advance and inventiveness of evolution, steadily carried on through an unimaginable vista of years in which no trace of slackening can be perceived, has all but come to an end.

It may seem to you that our perspectives have carried us far afield into a future so remote that it is scarcely worthy of consideration. My excuse must be that we are so accustomed to think of man as the sole significant inhabitant of the world that it is worth while now and again to look upon him in his biological setting as but one, and yet so far the greatest, of the manifestations of life upon the earth.

THE FUTURE OF FLYING*

BY DR. H. E. WIMPERIS, C.B., C.B.E.

LATELY DIRECTOR OF SCIENTIFIC RESEARCH, AIR MINISTRY

EVER since man inhabited the earth, he has lived not by his physical powers, which are slight, but by the exercise of his wits. Every new invention he has made has had its warlike use as well as its peaceful purpose, and each has challenged his wits to ensure that good rather than harm shall result from the new discovery. To bend the newest invention of all, the conquest of the air, to the service of mankind is now his great task. In it, success is essential lest we presently find that it is the air that has conquered mankind rather than mankind the air. Before we can regard the conquest of the air as achieved, we must control the warlike menace.

I believe that the scientific advances of the present time, and their probable development in the near future, will help us to solve, and not to aggravate, our central problem—the task Lawrence of Arabia spoke of as "the biggest thing to do in the world to-day"—to bend the newest invention of all, the conquest of the air, to the true service of mankind.

Mechanical flight was achieved when Wilbur Wright flew in December 1903 in that odd-looking machine now so proudly housed in the Science Museum at South Kensington. It certainly does look a queer machine to modern eyes. Although the engine weighed 180 lb., it gave but 12 h.p.! Of course it was natural that this, like all the other early aeroplanes, should be built with two pairs of wings. Engineers were well accustomed to carrying bending moments by a form of girder construction having an upper and a lower boom, and in the biplane form of construction the loads could be carried in this familiar way. Such early trials as were made of the monoplane type merely seemed to confirm the idea that a strong wing structure could not thus be found, and the biplane became the accepted type. Speeds in those days were low, and even long after the war of 1914–18 it was thought that the attainment of high speed would be mainly a matter of putting in more and more engine power. More and more power was accordingly put in. This led indeed to the achievement of higher speeds, but far-sighted designers saw that there was a limit to the extent of progress by this means. But, as a Spanish proverb has it: "When one door shuts another opens". The new door in this case proved to be the streamlining of the external form of the craft as a whole.

That the cleaning up of the aerodynamic structure could carry performance much further than had hitherto been realized, and do so without any increase of engine power, was first clearly pointed out, little more than ten years ago, by Prof. B. M. Jones of Cambridge.

---

* From the presidential address to Section G (Engineering) of the British Association, delivered at Dundee on August 31.

Flying To-day

The consequence of these and other changes in design from the original Wright machine brought a steady growth in speed, which during the last score of years has increased by an average of well over 10 miles an hour in each year.

Speeds have grown because of the smoother shapes used in construction and through the greater engine powers provided. Can speeds continue to rise indefinitely ? We may have gone almost as far as we can in using ship-shaped forms, though we still know very little about the possibility of ensuring an increase in the extent of the laminar flow of the air over the surface of wings or body: if this could be done the resistance would drop considerably. So far as prospective increases in engine power are concerned, there is little publicly revealed in these days, but one hears of testing plants being adapted to deal with engines of no less than 3,000 h.p. apiece. But even with these increases a definite speed limit is being approached —not one imposed by the laws of any State but by the laws of Nature. As I pointed out two years ago in a presidential address to the Royal Aeronautical Society, there is good reason to believe that, although speeds of 500 m.p.h. may be attained, it is unlikely that 600 m.p h. will be much if at all exceeded, for the latter figure is some 80 per cent of the speed of sound, and when the latter is approached the drag rises to a level far ahead of any prospective engine improvements. Although nothing in the physiology of man forbids even higher speeds, as witness the high orbital speed of the earth on which we all live with some measure of tempered comfort, there is soon imposed a physiological limit if high speed is combined with rapid manœuvre. If the latter is required, then the speed must be controlled to suit the conditions. Only the future can reveal how the balance between the two will be struck.

No simple summary can be given of what has been done as regards engine development, for, great as has been the change from the fifteen pounds per h.p. of the original Wright engine to the one pound, and less, of to-day, one remembers that in this one respect the engines of the last Schneider Trophy Race were as meritorious ; where the latter were much below modern standards was in their lack of reliability when working at this power ratio. To-day's engines run without attention for hundreds of hours, a very different matter from endurance for a short race.

Even if engines of 3,000 h.p. may be said to be in sight, they are still some way from achievement. Progress depends not only on the skill of the engine designer and the metallurgist, but also on the ingenuity of the industrial chemist in producing his remarkable fuels—wonderful alike for their uniformity of quality and for their ability to resist detonation even when employed in engines of very high compression ratio.

Improvement in load-carrying capacity depends also on improvements in materials, though it is fair to designers to record the progress made in reducing the percentage which the structure forms of the total flying weight in modern aircraft. Nowadays as good a figure is shown for this in large flying-boats as in landplanes, a remarkable achievement. The flying-boat used to be thought of as slow and heavy, but to-day it holds its own, in efficiency, whether aerodynamic, structural, or economic, with any other mode of flight.

The flying-boats of to-day represent a great technical advance in quality over their predecessors of ten, or even five, years ago, but they have not yet shown any marked advance in size. The fine fleet of Empire flying-boats is made up of 20-ton units ; the new Short 'Golden Hind' class for the Atlantic weigh 33 tons apiece ; the Boeing 'Yankee Clipper' has a total weight of nearly 40 tons ; but the 'Dornier Dox' which long preceded them ran to 50 tons laden. On the other hand, there has been a great gain in speed and in carrying capacity. The Boeing boat, for example, is reported to carry 10,000 lb. of load over and above its 4,000 gallons of fuel: as this amount of fuel will weigh 30,000 lb., this makes a total load of 40,000 lb., or almost exactly half of the total flying weight, the same as for the 'Golden Hind', and a truly remarkable percentage. The improved Empire flying-boats intended for the Atlantic crossing are planned to take-off at a flying weight of about 20 tons and to take 3 tons of additional fuel after they are air borne, by supply from a flying tanker on Sir Alan Cobham's scheme. This will increase the load on the wings from 30 lb. to 35 lb. per square foot, and may be regarded as a first step towards what could be done with wings specially designed and stressed for high loading. The 'Golden Hind' class is designed for a range of 3,400 miles without refuelling, and this with full load. Its early programme may include a survey flight along the route to Latin America.

It is naturally impossible in the course of this address to discuss all the many problems in the science of aeronautics which are being investigated at the present time. They are far too numerous and the time too short. But to some of them I must refer. One of great importance and quite fascinating interest is the investigation of the change in the air flow over a wing surface from the laminar to the turbulent state. It is known that if the flow could be kept laminar, the drag would be vastly reduced, but it has yet to be discovered how to do this. A step in the right direction may lately have been made at the Langley Field Laboratories, for during Dr. Lewis's recent Wilbur Wright Lecture before the Royal Aeronautical Society mention was made of some wind tunnel tests in which a special form of aerofoil gave a drag coefficient figure of only about one-third of that usual. Further particulars will be awaited with interest. Many laboratories and experimental stations are studying this same problem, and, as not infrequently happens in such cases, success, once met with, itself creates a batch of new problems. For one thing it is clear that the presence of laminar flow can but be hindered by the use of the tractor type of airscrew now almost universal. It may be necessary to change to pusher designs, and as this will involve a marked rearward movement of the centre of gravity of the whole aircraft, all the stability factors will be gravely affected, to say nothing of the many engine problems also raised.

Other special problems relate to the possibility of having wing areas adjustable in flight by telescopic or other means, to the study of the very considerable increase in the control forces required of the pilot in large machines of high speed capacity, of the special problems raised by variable pitch airscrews, particularly in relation to the landing run, of the advantage at high air speeds of two-speed gear boxes, and of the special problems involved in pressure cabins.

The problem of the rotating wing is in a class by itself. Aircraft so fitted are quite unable to compete in speed with those with normal wings, but they easily beat the latter in take-off and landing. Many types are now in the field, the Cierva, the Hafner, the Kay and the Focke, to mention no others. The scientific problems are largely solved, as are the great mass of the mechanical ones. What is required is such a degree of user as will call for this form of aircraft to be constructed in numbers. When that happens, rotary wing aircraft will benefit in their design by that skilled attention from the production engineer which alone seems able to produce results that really look right.

The growth in recent years of the interest taken by the public in aviation, over land and over sea, is most striking. Partly, of course, it is due to the increase in the Air Arm and all that is thereby implied. But there is also a very rapidly growing use being made of the abundant facilities for air travel offered by the civil air transport services. The United States is often thought to lead the world in this respect—as it certainly does in the use of the automobile—but I believe that in proportion to the size of the population, and that is the true criterion, the total mileage flown annually is larger in Australia than it is in any other single country in the world; and there is good reason to expect that that pre-eminence is likely to continue.

THE FUTURE YEARS

Let us consider what lies ahead in the coming years in respect of speed, size and range. No doubt military craft will go as fast as they can. But since it seems that they cannot exceed 600 m.p.h. much if at all, there is little doubt that speeds between 500 and 600 m.p.h. will become usual Not so, however, for the civil air services, where quiet, comfort and cost are all-important: here there is good economic reason for speeds to settle down in the 200–300 m.p.h. range. In both these classes we seem therefore to be approaching some degree of finality.

Altitude and range are alike in that so much depends on the discovery of new materials of construction and new ways of using them. Steady progress may be expected, though probably nothing sensational unless the use of reinforced plastics be so reckoned. For civil work the advantage of long-range flying depends on the ability to fly by night, and this is advancing rapidly. Radio services are improving and the vagaries of the ionosphere are becoming better understood. High altitude flying—whether in the stratosphere or just below it—requires the sealed cabin, and it will, I fancy, chiefly be sought by those whose first care is speed and whose lesser concern is cost.

When, however, we come to think of such other factors in the future of flying as the size of the craft, and the wing loading employed, we are concerned with quite other considerations. Size depends mainly on engine power, for there is a limit to the number of power units which can be conveniently looked after. Even if we have tractor and pusher airscrews in tandem (and tractor screws may well become unpopular where the highest aerodynamic efficiency is sought), six such pairs may be the practicable limit. This would give us twelve engines, which, at 3,000 h.p apiece, makes the total power 36,000 h p. At 15 lb. carried per h.p. available, this would give a total flying weight of 540,000 lb. or some 250 tons. Such a craft would naturally be a large boat, taking two hundred passengers or more; and that is the largest flying craft that can be said to be now in sight, although I ought perhaps to mention that in a lecture to the students of the Royal Aeronautical Society, who alone perhaps might be expected to live to see it, Dr. Roxbee-Cox was bold enough to include an American forecast for a boat of 3,120 tons! But difficult as it may be to foretell accurately the future of the large flying-boat, there can be little doubt that we shall soon see such craft in active competition with their older rivals—which use the surface of the sea—for all rapid passenger transport on the important Atlantic routes.

The Air Arm

Among the world's many political preoccupations there is no more pressing or more intractable problem than that of curbing in some way the universal growth of armaments. It is true that, in so far as the product is entirely produced within the country of origin, the mere cost is of little moment. One makes armaments instead of making something else, and in the case of a people who loved above all having lots of lethal weapons, there would be nothing more to be said, though the taste might be thought odd!

It is not, however, solely a matter of finance, since normal peoples would much prefer the energy directed to armament production to be given to articles of service in civil life such as houses, pictures, sailing-boats, holiday camps and the like; and for the general body of such activity to be guided into channels which fit in with the quantity and quality of the labour available in the country. Moreover, just as a house containing a store of high explosives is not looked on as a happy abode, so there is always a fear that in highly armed international life a trigger in some remote spot may be pulled by accident, or by mischief, with irreparable harm to the whole world.

When some years ago an effort was made to come to an international understanding about air armaments, success was not attained. This was due, it is true, in some measure to the existence of strong professional interests and to the relative lack of attention to the needs of the ordinary man, but it was partly due to the inherent difficulty in the then state of the art of distinguishing between military and civil types. Even suppose, it was asked, that one could abolish all military aircraft, how would one deal with the civil types which could be so easily converted? In those days this was a germane question. But is it now? I think not, and for this reason.

The speeds of military aircraft are now in excess of 400 m.p.h. and will rise still higher. But civil aircraft rarely go faster than 250 m.p.h., and it is doubtful whether it is economically advantageous to have even so high a speed as that. This at once makes a great difference in the types. Again, the comfort and space needed for civil transport tends to produce a design of body which does not in the least resemble military requirements. In so far as the civil types in their really large sizes come more and more to take the flying-boat form, so are they the less like military types. Perhaps I should say here that I am leaving aside reconnaissance duties and troop-carrying, and thinking mainly of the aggressive type, the bomber.

Hence I submit that, as I suggested in a recent address at Chatham House, the position has been reached when, so far as technical considerations are concerned, an agreed limitation could be set on military production without the effort being nullified by the existence of civil types to which no such limitations applied. It must be remembered, however, that when a political man talks about 'parity in the air', he may not really understand what he is saying. What he probably means is equality in offensive force, for mere parity in numbers might be got by the absurd equation of putting 100 bombers plus 1,900 interceptor fighters as equal to 1,900 bombers plus 100 interceptors, because both sides add up to 2,000. It cannot worry any peace-loving country if one of its neighbours builds 1,000 or 10,000 interceptor fighters, any more than it would if that neighbour built immense numbers of anti-aircraft guns and searchlights. In fact, as a gain to the general strength of defence it would be rather comforting than otherwise.

In my view there will be no reason, once the international situation has cleared, why there should not be an agreed limitation in respect of numbers or tonnage of bombing aircraft—leaving the interceptor fighters entirely aside. It would be but cautious to agree on a limit to the speed of civil types, but as this would merely confirm what economic requirements would themselves suggest, it need be no hardship; excessively high speeds for civil types do not pay, are much more dangerous to passengers, are much more noisy to everyone, and need wasteful forms of air ports.

When this difficulty of our own age has been at last happily solved, we may be very content to leave our successors the even more threatening menace of dealing aright with the problem of atomic energy. This it is not necessary for me to describe. I will only say that, in a recent broadcast address, Prof. J. D. Cockcroft spoke of an atomic trigger action between the metal uranium and a single neutron which is reported to be capable of releasing a 100,000,000-fold increase in energy! Perhaps there are immense practical difficulties in doing this on a large scale; I earnestly hope there are! For ourselves we may well consider that in our own day we are quite sufficiently occupied with the thoughtful handling of our own special problem, how rightly to guide the future of flying.

NEWS AND VIEWS

The Universities and War

APART from the University of London, the rest of the universities of the British Isles are aiming at carrying on their work at their present posts, so far as is possible. A few departments and faculties of various universities have, we understand, made tentative arrangements to move to other quarters; but at present no steps have been taken. Dates for the beginning of the new term have been changed in certain cases. The University of Liverpool is to carry on at Liverpool, though instruction in certain faculties and departments will also be given at Harlech College on Cardigan Bay. Accommodation in certain colleges in Wales has also been acquired by that university, and will be used if necessary. So far as can be ascertained, the University of London is making the following changes: Administration—Royal Holloway College, Englefield Green, Surrey; Examinations—Courleigh, The Cleves, Reigate; University College—Aberystwyth (men), University of Sheffield (women); King's College—University of Bristol; Institute of Education—University College, Nottingham; Imperial College of Science and Technology—University of Edinburgh (Mining Department—Camborne, Cornwall); Queen Mary College—King's College, Cambridge; London School of Economics and Political Science—Peterhouse, Cambridge; School of Oriental Studies—Cambridge; Bedford College for Women—Girton College, Cambridge; Westfield College—St. Peter's Hall, Oxford; Goldsmiths' College—University College, Nottingham. The medical schools of the University are being distributed among several centres in Great Britain.

Blood-group Tests of Paternity

THE House of Lords Select Committee, to which the Bastardy (Blood Tests) Bill was referred after its second reading in February last (see NATURE, Feb. 18, p. 294), has now made its report. It will be remembered that this Bill, which was introduced in the House of Lords in December, 1938, by Lord Merthyr, sought to enable courts of summary jurisdiction to order blood-group tests to be made in bastardy cases. The chairman of the House of Lords Committee was Lord Strathcona and Mount Royal, and included among its members were Lord Dawson of Penn and the Bishop of Salisbury. The Committee gave it as its unanimous opinion that the qualities of blood underlying blood-grouping and the laws of inheritance governing the transmission of these qualities from parents to children are accepted by such a consensus of scientific opinion as to render it desirable in the interests of justice for this knowledge to be applicable to affiliation cases. After certain amendments, it recommended that the Bill be passed into law. It was stressed by the Committee that although the tests can exclude paternity in about one case out of three only, nevertheless the tests might prevent injustice. The Committee was also satisfied that the risk of error in making blood-tests has been reduced to negligible proportions; and it noted that the public is becoming ready to accept the positive verdict of science when its evidence declares against the implication of paternity to a given individual. It is indeed remarkable—and the Committee commented on the fact—how great was the preponderance of opinion among medical and legal witnesses in favour of the use of blood-tests as evidence in affiliation cases; while, of such criticisms as were offered, none disputed the validity of blood-tests as evidence.

Blood Groups and Paternity

A FURTHER refinement in the use of blood groups as a test of paternity was indicated by Dr. V. Friedenreich of Copenhagen at the seventh International Congress of Genetics which was held in Edinburgh immediately before the outbreak of war. Dr. Friedenreich, as reported in the *Lancet* of September 16, described the division of the A group into three varieties; A_1 is dominant to A_2 and A_3, and A_2 to A_3; A_3 is very rare. The distinction between A_1 and A_2 is already employed medico-legally on the Continent, thereby increasing the proportion of cases in which false accusations of paternity can be disproved. Reference to the important work of Dahr indicated a still further possibility of discrimination in that persons of constitution AA may soon be distinguished from those of constitution AO, a point of very considerable evidential value in the legal sense. From the anthropological point of view, the occurrence and distribution of groups A and B in both anthropoid apes and man constitutes a problem—so much so, indeed, that Dr. G. Montandon, of Paris, goes so far as to deny on this ground that it has any evidential value whatsoever as a criterion of race in man. Prof. Ruggles Gates, however, in a communication to the Congress at Edinburgh, argued that while gene A probably arose in the common ancestors of anthropoid apes and man, gene B in all probability arose much later by parallel mutation in both stocks.

Prehistoric Indian Village, New Mexico

AN expedition of the American Museum of Natural History of New York, under the leadership of Dr. Paul S. Martin, has been engaged in the examination and excavation of a number of Indian village sites in the mountainous region of western New Mexico. The villages are situated just off the route followed by the Spanish conquistador Coronado in his unsuccessful search for the legendary wealth of the "Seven Cities of Cibola". According to a preliminary report from Dr. Martin, of which certain particulars have been issued through Science Service of Washington, D.C., there was little surface indication of the existence of any of the sites; and it was only the occurrence of scraps of Indian pottery, no larger than a thumb-nail, which directed the attention of the members of the expedition to one site which has been excavated. Even local pottery-hunters had failed to detect the existence of the villages. On this site the walls and floor of a large subterranean pit-house, presumably used by the inhabitants for ceremonial celebrations, has been uncovered. It measures 33 ft. in diameter, and is the largest of its kind hitherto excavated in this area. The objective of the expedition is the identification of sites belonging to the little-known Mogollon culture, one of the three cultural divisions into which American archæologists now classify the prehistoric cultures of the south-west, preceding and leading up to the great development of the Pueblos. Dr. Martin reports that he has found important evidence relating to the age and development of the Mogollon culture. He estimates that the site excavated was abandoned seven hundred years before Coronado's expedition of about the middle of the sixteenth century.

Archæological Reconnaissance in Roman Scotland

ALTHOUGH by this time the value of the aeroplane in archæological investigation stands in little need of further testimony, a record of recent discovery in Roman Scotland not only renews, as it were, the wonder at its achievement, but also affords striking evidence of how its use, and intensive examination of a terrain from the ground itself, combine with and supplement one another. The occasion of the demonstration was a survey from the air made in June last by Mr. O. G. S. Crawford, editor of *Antiquity* and archæological officer of the Ordnance Survey, to supplement previous work in preparation for archæological maps of Roman Scotland to be published by his department. The survey from the air was amply justified. It solved a number of knotty problems standing over from previous investigation, even after intensive field work, and in addition it added fresh data in the form of previously unrecorded native and Roman forts and fortlets, as well as a number of other discoveries of interest along the lines of the Roman roads in Annandale. Flying farther afield to the north, Mr. Crawford identified a Roman fort farther north of the Antonine Wall than any previously recorded, and on the return the modern method of reconnaissance was able to authenticate a site that has long been on record. Not only was it possible to make out the remains of rampart and road, both by observation and photograph, but also it can now be stated with complete certainty that it is a Roman fort, and further that a Roman road ran north-east from the gate in the rampart on that side of the fort—a fact of which certain implications for Roman dispositions in Scotland are made the subject of preliminary discussion in *Antiquity* of September by Mr. Crawford in his account of the reconnaissance.

Medicine in Ancient Ireland

IN a recent address before the Irish Free State Medical Union (*J. Irish Free State Med. Union*, 5, 22; 1939) Dr. T. P. C. Kirkpatrick stated that, like many other peoples, the Irish had a traditional god of healing, named Dianecht, who fitted the silver hand to King Nuada about the year 1272 B.C. According to the genealogies of MacFirbis, there were other physicians such as Eaba, the female physician, the second doctor who came to Erinn, and Fingen, who was physician to Conchobha MacNessa, whose hand he sutured with golden threads to match his hair. There is also some evidence of medical education in the country, as Josina, the ninth King of Scotland, came to Ireland about the second century B.C. to study medicine. There were, moreover, numerous schools in ancient Ireland, such as those at Clonard, Armagh, Clanmacnoise, Monasterboice and Portuma, in all of which medicine was probably taught. The Brehon or Ancient Laws of Ireland, which according to tradition were written down about the time of St. Patrick but had been in force for some time previously, show that the status of the leech or physician was well defined. In an ancient law tract an elaborate account is given of "Othrus" or "Sick Maintenance", which enacted that a person who had received physical injury from another should be given by his assailant not only the ordinary legal fine but also certain medical expenses. The position of the leech corresponded with that of the smiths, builders, gold-workers and Brehons, who were all high up in the social scale. The fees were fixed and depended on the social position of the patient and the nature of the disease. In addition to medical schools there were also hospitals, such as the "House of Sorrow" attached to the Red Branch at Emania where sick and wounded persons were treated, and the "Forus Tuatha" or territory house which is mentioned in the law tracts as a sort of hospital. Dr. Kirkpatrick concludes that medicine in ancient Ireland was probably as well developed as in any other contemporary country in western Europe.

Alcoholism and Mental Disease

IN his inaugural thesis (*Thèse de Paris*, No. 489; 1939), which is based on his experience at the Lesuellec Psychiatric Hospital, Dr. André Le Gall deals with the subject of alcoholism and mental disease in the Morbihan Department of Brittany. He points out that during the period 1910–37, since when the number admitted to the hospital each year has remained almost stationary, the admissions increased from 149 to 335, while the percentage of alcoholic patients rose from 7·52 in 1920 to 44·77 in 1937. The consequence has been that the total number of patients under treatment at the hospital rose from 778 in 1920 to 1,474 in 1938. There has also been a considerable increase in alcoholism among women, as is shown by the fact that while in 1911 they formed only 18·90 per cent of the total number of alcoholics, in 1937 this figure rose to 43·33 per cent. For several years the average age of the alcoholic patients has shown a tendency to fall, young persons of 20–30 being more numerous than formerly. Alcoholism was found to be as frequent among the married as among celibates, but was more liable to affect the rural than the urban population. In 1936, for example, only 15·73 per cent of the alcoholic admissions were manual labourers, as compared with farm labourers who formed 47·25 per cent of these admissions. The measures suggested by Dr. Le Gall for the control of alcoholism in Morbihan include suppression of the privileges allowed to home distillers, limitation of the number of public houses, the creation of dispensaries of mental hygiene, special homes for inebriates, especially for relapsing cases, the promotion of sport, and the encouragement of propaganda in favour of non-fermented apple juice, which has yielded excellent results in some countries, especially Switzerland.

Earthquake near the New Hebrides

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentre of the earthquake of August 12 to be provisionally latitude 13° S., longitude 169° E. The instrumental reports from Manila, Sitka, Weston, St. Louis, Fordham, Pasadena, Honolulu and Philadelphia also suggest that the depth of focus from which the shock originated was of the order of 150 km., thus making a deep focus earthquake. The epicentre is to the north of the New Hebrides and north-west of Fiji, being submarine in character. No damage has been reported, either directly due to the shock or to any abnormal sea waves. The region concerned is particularly liable to earthquakes and it is also noticeable that the frequency of earthquakes having deep focus is greater than normal in the whole of the region extending from Japan to the south of Fiji and including the area in question. A new Milne-Shaw seismograph and high-precision clock with seconds regulator have recently been sent on loan to Fiji by the British Association Seismological Committee at the suggestion of the Seismological Committee of the Australian and New Zealand Association for the Advancement of Science to replace the old Milne instrument there. This new seismograph will be particularly valuable for obtaining data for the study of deep focus earthquakes similar to the one mentioned above.

Mathematical Reviews

THE American Mathematical Society has founded a new international mathematical abstracting journal to be known as *Mathematical Reviews*. The first number is to appear late in 1939 or early in 1940; the material to be reviewed begins with the latter half of 1939. It is proposed to review all fields of pure mathematics and also those of applied mathematics and mathematical physics which are of pronounced interest to mathematicians. The new journal, which will be issued approximately once a month, will contain several thousand reviews annually and will run to approximately eight hundred large double-column pages. Prof. J. D. Tamarkin and Prof. Otto Neugebauer will be the first editors. The Carnegie Corporation has appropriated 60,000 dollars as a reserve for the new journal. The Rockefeller Foundation has made a gift of 12,000 dollars to cover some of the initial costs. Brown University is housing the project and aiding in the editorial work. The American Mathematical Society and the Mathematical Association of America are each beginning with a subsidy of 1,000 dollars for the first year. Annual subsidies are being sought from other organizations, and plans for the permanent financing of the project are being considered. On account of the generous subventions, the subscription price will be set drastically below actual cost.

PARTLY with the view of aiding indirectly in the support of this journal, the Rockefeller Foundation has made a handsome gift to Brown University for an experiment in the dissemination of mathematical publications through the distribution of microfilm. This money is to be used to augment the mathematical library at that University, a collection which is already internationally known as outstanding. Out-of-print journals will be put on film and made available to mathematicians; rare books of general use will be filmed; on request from a subscriber to the new journal, any article reviewed will be sent on film or as film-print. This service will be extended to all parts of the world at a price not exceeding cost. It should be of greatest value to mathematicians in the smaller universities and colleges, and should be a factor in encouraging young men to continue with their investigations.

Matter and Radiation

No. 704 of Hermann's "Actualités" series is by Prof. Louis de Broglie, editor of the volumes on theoretical physics, and is entitled "Le Principe de Correspondance et les Interactions entre la Matière et le Rayonnement". It extends to 170 pages (Paris: Hermann et Cie. 50 francs). The first 48 pages give an account of Maxwell's equations and their extension by Lorentz to cover electrons; the electromagnetic theory of dispersion; the theory of quanta; the correspondence principle introduced by Bohr in 1916; and Heisenberg's representation of the atom by a matrix of quantities all of which are directly observable. Then the principle of wave mechanics is introduced according to which the movement of material corpuscles is based on a certain equation of waves developed from the Hamiltonian function of classical mechanics. It is then shown that wave mechanics includes the correspondence principle and leads to a theory of the interaction of radiation and matter which, though not strictly logical, may be regarded as a first approximation. Later sections deal with the diffusion of light energy by matter, first without change of wave-length, then with such changes as are illustrated by the Compton and the Raman effects. The volume concludes with a study of photo-electricity in which the light quantum passes completely to matter, that is, the photon is annihilated. As one would expect from the author, wave mechanics is treated with great clearness and there is no attempt to represent the theory as having resolved all difficulties; on the contrary, at each partial success its incomplete nature is commented on and the requirements of a more complete solution are specified.

Egg Storage

A DESCRIPTION is given in the *Electrical Review* of September 15 of the Chelmsford Egg Supply Co. (1934). This company utilizes a process for the preservation of eggs which, it is claimed, keeps them fresh indefinitely. It is said that, if eggs are frozen below 28° F. they crack, so that storage by freezing is impracticable. Storage in gas is better, but it takes time for the gas to percolate through the shell. The company has, however, overcome this difficulty. Every egg has a small air space at the top. This increases as the egg ages. By means of a pump the air is extracted and replaced by carbon dioxide and nitrogen under a pressure of 250 mm., this pressure being maintained all the time the eggs are in storage. The eggs are stored in large cylinders each holding 234,000 eggs and are kept at a temperature of 30° F. Each refrigerating unit is driven by a 6 h.p. motor, and in addition, two extra motors are employed, 5 h.p. and 2·75 h.p. respectively, for circulating the water and ammonia. The gas-tight cylinders in which the eggs are stored look like large boilers. An additional chamber held at a much lower temperature is used for freezing liquid eggs, that is, those which have been accidently cracked, and are sold to local bakeries. The factory is also a national mark packing station capable of dealing with a million and a half eggs a week. The electricity taken per annum from the public supply is nearly 60,000 units. As this load is very nearly constant, and is heaviest during the summer months, the load factor is excellent and an attractive tariff is available. The seasonal difference in the price of eggs practically makes up for the cost of storage.

Extensions of Carrier Telephone Systems

IN the quarterly edition (No. 17) of *Nippon Electrical Engineering*, published in English by the Institute of Electrical Communication Engineers of Japan, there is an important paper on carrier telephone systems which make use of lighting and power distribution lines. It is written by N. Shinohara, Y. Hirano and M. Yoshioka, and contains many useful experimental and theoretical results. They point out that the economies effected by using existing power and lighting circuits as part of the carrier system make it possible to extend communication to out-of-the-way districts, as, for example, farming districts, fishing villages, lighthouses, etc. This will make possible the rapid cultural development of these places. They consider first of all the use of high-tension distribution lines as part of the carrier frequency transmission circuit. In the past this has been done by two systems; the first is called the metallic circuit system and the second the ground return circuit system. Although the first system excels the latter so far as low attenuation and noise are concerned, the second is the system which is more commonly employed owing to its greater economy and trustworthiness. The authors state that in utilizing the high-tension distribution line it is best to employ the ground return circuit system. The most commonly employed types of high-tension systems are the single-phase two-wire type and the three-phase three-wire type. The height of the wires above the ground is not uniform, but, where the line is even, the average height is about seven metres. By considering a single copper wire 5 mm. in diameter at a height of 7 metres above the ground and at a temperature of 20° C. and a frequency of 50 kc., they compute that the speed of the carrier waves is nearly equal to the speed of light and that the attenuation constant is very small. They conclude by describing a method of designing a circuit by a new telephone system which they state will be the most suitable for a rural district. They show how much more economical the new system would be than the one at present in use.

Oceanographical Results from Central America

IN July and August 1938, the President of the United States, the Honorable Franklin D. Roosevelt, undertook an inspection cruise and fishing expedition from San Diego, California, to Pensacola, Florida, by way of the Panama Canal, aboard the U.S.S. *Houston*. Between July 16 and August 9 some 5,888 miles were covered and fourteen different collecting stops were made, distributed among the possessions of five different nations: Mexico (Lower California and Socorro Island), France (Clipperton Island), Ecuador (the Galapagos Islands), Costa Rica (Cocos Island), and Colombia (Old Providence Island in the Caribbean). Dr. Waldo L. Schmitt of the United States National Museum accompanied the expedition as a naturalist. The results are published in a series of papers of which four are before us: "Decapod and Other Crustacea" (with Introduction and Data) (Smithsonian Miscellaneous Collections, 98, No. 6, Pub. 3531) by Waldo L. Schmitt; "Mollusca" (Pub. 3535) by Paul Bartsch and Harald Alfred Rehder; "A New Holothurian of the Genus Thyone" (Pub. 3537) by Elisabeth Deichmann; and "Two New Gobioid Fishes" by Isaac Ginsburg (Pub. 3539), May–June 1939. A number of new species of Mollusca are described, and lists of species given from the various collecting grounds.

Grass Drying

A REPORT on fodder conservation with special reference to grass drying by E. J. Roberts has been published by the Agricultural Research Council (H.M. Stationery Office. 2*s*.). This is the third report on the subject, and embodies the results of the most recent experiments carried out with the co-operation of agricultural organizers, colleges and experimental farms in Great Britain. A detailed account of grass-drying machinery and equipment is given, and comparison made with the various processes of artificial drying in other countries. There seems to be little doubt that the conservation of young grass is sound in principle, as it is then at its maximum nutritive value, and feeding trials show that it can largely replace concentrates. The question of the profitableness of grass-drying, however, cannot be answered so simply, as it depends both on the quality of the product and also on other matters such as the market value of the concentrates which it is to substitute, and whether the grass would have been utilized in some other manner or wasted through occurring at a time of surplus growth. The indirect advantages of the process, such as improvement of the sward, control of thistle, etc., must not be overlooked, nor the fact that the lower grades of dried grass are of higher value than the best hay. Profit-making, however, in this as in many farming enterprises, depends to a very large extent on the skill of the individual.

Agricultural Libraries

THE International Institute of Agriculture in Rome has just published a useful book of reference entitled "International Directory of Agricultural Libraries" (25 lira). The information consists of a list of all general agricultural libraries of more than two thousand volumes, libraries specialized in particular subjects, agricultural collections in general libraries, and centres of agricultural documentation. So far as possible, the history and size of the library and the subjects represented therein, the cataloguing and classification systems employed and regulations for the use of the library are stated. Relations with other libraries (exchange of publications, etc.), a bibliography of writings on the library and any publications edited by it are also mentioned. 1,200 libraries arranged according to country are described, and the text is written in both English and French.

Theodor Langhans (1839-1915)

THEODOR LANGHANS, an eminent German pathologist, who with the physician Sahli and the surgeon Kocher formed a triumvirate which made the Berne medical school famous, was born at Usingen, Nassau, on September 28, 1839. He received his medical education at Heidelberg; Göttingen, where he was a pupil of the celebrated anatomist Henle; Berlin, where he studied under Virchow, Trauber and Frerichs; and Würzburg, where he qualified in 1864 with a thesis on the structure of tendons and served as assistant to von Recklinghausen until 1867. He then went to Marburg, where he collaborated with Lieberkühn and Wagner in anatomical research. In 1868 he described the giant cells in tubercle to which his name has been given, and it was during his stay in Marburg that he carried out some important investigations on the absorption of extravasations and the formation of pigment. In 1872 he was appointed professor of morbid anatomy at Giessen, but in the same year succeeded Klebs in the corresponding chair at Berne, where he did valuable work on the morbid histology of the female breast, the histology of the placenta, the distribution of glycogen in normal and diseased organs, and described the cellular layer of the chorionic epithelium to which his name has been given. He also collaborated with Kocher in a study of diseases of the testicle. His later years were mainly devoted to researches on the morbid anatomy of goitre and cretinism. He retired from his chair two years before death, which took place on October 22, 1915.

Announcements

WE have been asked to state that the Geological Society of London is carrying on as usual at Burlington House. An announcement relating to meetings will be made in due course.

THE annual exhibition of the Royal Photographic Society is being held at the Society's House, 16 Prince's Gate, South Kensington. The exhibition is open from 10 a.m. until 5 p.m. daily (Sundays excepted) until October 7.

MR. JOHN RYMILL, the arctic and antarctic explorer, has been awarded the David Livingstone Centenary Gold Medal of the American Geographical Society in recognition of his leadership of the Graham Land Expedition. Mr. Rymill, who is an Australian, was a member of the British Arctic Air Route Expedition to Greenland in 1930-31, and took over the leadership when Mr. H. G. Watkins was lost. He led the Graham Land Expedition to the Antarctic in 1934.

THE Council of the Institution of Naval Architects has awarded the Martell scholarship in naval architecture (1939) to Mr. Norman W. Honey, of H.M. Dockyard, Sheerness; the scholarship is of the value of £130 per annum, and will be held at the Royal Naval College, Greenwich. The Earl of Durham Prize has been awarded to Mr. Peter E. Bish, of H.M. Dockyard, Devonport.

WE have received from the British Drug Houses, Ltd. (Graham Street, London, W.1.) the new catalogue of B.D.H. laboratory chemicals and testing outfits, which comprises nearly six thousand separate items and is provided with a general index. Section I has been enlarged by more than five hundred new items, mostly organic chemicals, and Section 2 contains an increased number of reagents and solutions for analytical and clinical purposes, and there is a new section of culture media. The products listed are normally held in stock for immediate delivery.

DR. ALBERT B. SABIN of the Rockefeller Institute of Medical Research has received the Theobald Smith award of 1,000 dollars from the American Association for the Advancement of Science in recognition of his rapid method of typing in pneumonia and for a quick bedside test of a patient's probable resistance to the disease.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 555.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Deuteron Bombardment of Silver

We have bombarded pure silver with a few microampere-hours of 9 Mv. deuterons from the Cavendish cyclotron and have used a Geiger counter for investigating the radioactive radiations. The activities observed are listed below in order of prominence.

(1) A negative electron activity of 2·4 min. is found by analysis of the composite decay curve given by irradiated silver foil, the corresponding intensity for a control sample measuring only the background neutron effect being negligibly small. This activity is to be ascribed to ^{108}Ag formed by the reaction: ^{107}Ag (d,p) ^{108}Ag.

(2) Chemical separation into silver and cadmium fractions has been performed, and the latter portion has been found to contain a 6·8 hour body emitting a soft negative electron radiation (absorption limit 15 mgm. per sq. cm. of aluminium), X-rays and a very weak γ-radiation. A body with corresponding properties has been found as a product of proton capture in silver[1], and arguments have been adduced suggesting that the activity is due either to a metastable excited state of one of the isotopes, ^{108}Cd or ^{110}Cd, electrons and cadmium X-rays resulting from an efficient internal conversion of the de-excitation γ-rays, or to K-electron capture in an unstable isotope ^{107}Cd or ^{109}Cd, giving rise to silver X-rays together with photo-electrons. Favouring the validity of the former interpretation in our case are the apparent entire absence of the positron emission which would probably accompany K-capture, and also a significantly closer correspondence of the X-ray absorption coefficient in aluminium to the value for cadmium K-radiation than to that for the silver line. The appropriate reaction is: ^{107}Ag (d,n) ^{108*}Cd, or ^{109}Ag (d,n) ^{110*}Cd.

(3) The silver fraction contains a 26-min. body emitting positrons with an absorption limit corresponding to 1·8 Mv. This body thus has properties similar to those attributed to ^{106}Ag [2]; we are, however, unable to find any trace of the 8-day period belonging to the other isomer of ^{106}Ag, and, in any event, the mechanism of the formation is obscure. A control sample given the same chemical treatment as the positive sample shows the background neutron effect to be negligible.

(4) The silver portion gives also a negative electron activity which decays with a half-life of at least several weeks.

(5) Short-lived activity in the silver foil has been sought by beginning measurements within a quarter-minute of a short bombardment, but no half-life less than the 2·4 min. can be detected.

A comprehensive account of this and cognate work will be published elsewhere.

R. S. Krishnan.
D. H. T. Gant.

Cavendish Laboratory,
Cambridge.

---

[1] Delsasso, Ridenour, Sherr and White, *Phys. Rev.*, 55, 113 (1939).

[2] Pool, Cork and Thornton, *Phys. Rev.*, 52, 380 (1937). Pool, *Phys. Rev.*, 53, 116 (1938). Pool and Campbell, *Phys. Rev.*, 53, 272 (1938). Feather and Dunworth, *Proc. Roy. Soc.*, A, 168, 566 (1938).

Through the kindness of Messrs. Krishnan and Gant, I have been able to examine the radiations from a silver foil of 20 mgm./cm.^{2} bombarded with 9 Mv. deuterons, using the method of critical absorption previously adopted in the case of the fission products of uranium[1]. For the quantum radiations from the 6·8-hour body, a palladium foil of 24 mgm./cm.^{2} was considerably more transparent than a foil of molybdenum of only 14 mgm./cm.^{2}. This is in agreement with the findings reported above, although it does not allow a decision to be made as to whether the K-radiations of silver or cadmium are involved (it is hoped, later, to use an absorber containing ruthenium in order to examine this point more closely).

Concerning the long-period activity (4, above), the method of critical absorption likewise indicates an intense quantum radiation much more strongly absorbed by molybdenum than by palladium, and a harder γ-radiation is also present. The negative electrons of the long-period activity have been examined in a special low-absorption counter arrangement, and an absorption limit of about 12 mgm./cm.^{2} has been found for them.

It will obviously be interesting to examine all these radiations in more detail to see if any reason can be found why they are so closely similar to those emitted by the 6·8-hour cadmium isotope.

N. Feather.

Cavendish Laboratory,
Cambridge.
August 25.

---

[1] Feather and Bretscher, NATURE, 143, 516 (1939).

Fission of Thorium by Neutrons

Since March 1938, we have been engaged in the study of artificial radioactivity induced in thorium by fast neutrons. We have already reported[1] the production of uranium Y, which was obtained in the course of this investigation.

At that time we had examined the barium and lanthanum fractions from activated thorium and obtained nearly all the periods which Meitner, Strassmann and Hahn[2] found in their study of the artificial radioactivity of thorium, and which Hahn and Strassmann[3] and other authors later identified with those for fission products of uranium and thorium, although our agreements were not exact in some cases and some other periods were obtained in our experiments.

We did not, however, follow closely these lines of investigation, since our attention was directed to a radioactive substance, which was precipitated with bismuth and lead as carriers from hydrochloric acid solution by hydrogen sulphide. We spent much time on the chemical identification of this substance. Its chemical properties were not easy to ascertain, but it was still more difficult to understand the nuclear reactions concerned. Chemical properties suggested that either 'transuranic' or elements of lower atomic number than bismuth were involved, but both these alternatives were difficult to accept at that time. Then, however, came Hahn and Strassmann's discovery of fission processes, and the problem became easier, at least in principle.

From this point of view we have been working on the chemical identification of elements for several months, but have not come yet to final conclusions. In the meantime, results on similar work were published by Bretscher and Cook[4] and by Meitner[5], but exact identification of elements was not given. Although our experiments are still in a very preliminary stage, we should like to give here the results so far obtained, since we are obliged to interrupt our work for some time.

Thorium nitrate, carefully freed from mesothorium as well as from other disintegration products except radiothorium, was exposed to fast neutrons which were produced by bombarding lithium with 3 Mv. deuterons of several microamperes from our cyclotron. The exposure ranged from one to five hours, after which the sample was subjected to chemical separations. Examination of radioactivity showed the production of the following active substances: Bi, Hg, Sb, Sn and Ag. Besides these elements, the following fractions were found to be radioactive: alkali fraction, halogen fraction, Mo-fraction, Se + Au-fraction, Cu + Cd-fraction. Identification of elements in these fractions requires further investigation.

We tested for radioactive lead and arsenic and proved their definite absence. Our chemical separations, however, took at least two or three hours and all radioactivities of short periods must have escaped our detection.

We tried similar experiments also with uranium, and so far have obtained the following radioactive precipitates: Bi, Hg, Ag, Sb + Sn, and Cu + Cd-fraction.

More thorough identification of radioactive elements both from thorium and uranium, and determination of their periods will be made in the future. Chemical procedures and details of the experiments will be given elsewhere.

We should like to acknowledge the assistance given by Messrs. N. Saito and N. Matuura in connexion with the chemical separations.

Y. NISHINA.
T. YASAKI.
H. EZOE.

Nuclear Research Laboratory,
Institute of Physical and
Chemical Research,
Tokyo.

K. KIMURA.
M. IKAWA.

Chemical Institute,
Faculty of Science,
Imperial University of Tokyo.
July 29.

---

[1] Nishina, Y., Yasaki, T., Kimura, K., and Ikawa, M., NATURE, 142, 874 (1938).

[2] Meitner, L., Strassmann, F., and Hahn, O., *Z. Phys.*, 109, 538 (1938).

[3] Hahn, O., and Strassmann, F., *Naturwiss.*, 26, 756 (1938); 27, 11 (1939); 27, 89 (1939).

[4] Bretscher, E., and Cook, L. G., NATURE, 143, 559 (1939).

[5] Meitner, L., NATURE, 143, 637 (1939).

The Meson and Cosmology

THE mean life τ_0 ($\tau_0 \sim 2 \cdot 5 \times 10^{-6}$ sec.) of a meson at rest gives us a new fundamental constant of the dimension of time which lies intermediate between the 'atomic constant' τ_e (say, $\tau_e = \frac{R_0}{c} \sim 5 \cdot 5 \times 10^{-26}$ sec.) and the 'cosmological constant' t_0 ($t_0 \sim 2 \times 10^9$ years). R_0 denotes the 'classical radius' of the meson, $R_0 = \frac{e^2}{\mu c^2}$, where the symbols have their usual meaning. We shall take $\mu = 170\, m$, where m is the mass of an electron. We can construct from these basic time units (τ_e, τ_0, t_0) three dimensionless 'large numbers',

$$\frac{t_0}{\tau_e} \sim 1 \cdot 1 \times 10^{42},\ \frac{t_0}{\tau_0} \sim 2 \cdot 5 \times 10^{22},\ \frac{\tau_0}{\tau_e} \sim 4 \cdot 6 \times 10^{19},$$

and if, following Dirac and others, we make the hypothesis that 'large numbers' are interrelated, we have

$$\frac{t_0}{\tau_0} = \frac{\tau_0}{\tau_e} = \left(\frac{t_0}{\tau_e}\right)^{1/2}, \text{ or } \tau_0 = (\tau_e \,.\, t_0)^{1/2}. \qquad (1)$$

In comparing such large numbers any differences by factors of about 10^2 are to be ignored, as these could be easily taken account of by introducing the dimensionless numbers such as the fine-structure constant $\hbar c/e^2$, μ/m and H/m, H being the mass of a proton. Further, on this hypothesis we can connect the above large numbers with the (familiar) large number $e^2/G\mu^2 \sim 1 \cdot 4 \times 10^{38}$ formed from the gravitational constant G and the atomic constants e, μ. We have:

$$\frac{t_0}{\tau_e} = \frac{e^2}{G\mu^2}, \qquad (2)$$

$$\frac{\tau_0}{\tau_e} = \left(\frac{e^2}{G\mu^2}\right)^{1/2}, \qquad (3a)$$

$$\frac{t_0}{\tau_e} = \left(\frac{e^2}{G\mu^2}\right)^{1/2}. \qquad (3b)$$

Equation (3*a*) in the form

$$L_0 \equiv c\tau_0 = R_0 \left(\frac{e^2}{G\mu^2}\right)^{1/2} \qquad (4)$$

has already been given by Blackett[1].

It is of interest to note, as equation (1) shows, that in a system of measurement in which the atomic units remain constant the mean life of the meson is proportional to the square root of the epoch t_0, and as the mean life of the meson is intimately connected with β-decay, the mean life of a radioactive substance (β-activity) would vary as $t_0^{1/2}$.

D. S. KOTHARI.

Department of Physics,
University of Delhi.
July 28.

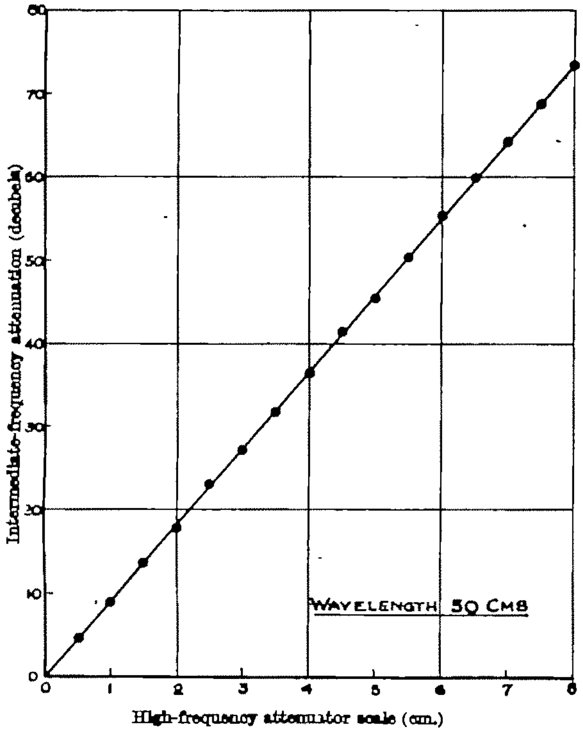
---

[1] NATURE, 144, 30 (1939). This has suggested the present communication. It may be noted that if in (4) μ be replaced by the electron mass, L_0 becomes the maximum radius possible for a body composed of *degenerate* matter.

The Diode as a Frequency-Changer for Measurements at Ultra-High Frequencies

THE increasing use of ultra-short wave radio communication has created a need for the measurement of oscillating electric currents, potential differences, and field strengths, at very high frequencies, up to at least 300 megacycles per second. The difficulty of measuring these quantities can be greatly reduced by converting the original frequency to a much lower 'intermediate' frequency by the well-known heterodyne process, provided that the law is known which connects the amplitudes of oscillation at the two frequencies. Theory suggests that the diode frequency-changing circuit as described, for example, by Strutt[1], possesses a linear conversion law if it is used with a heterodyning oscillation of sufficiently large amplitude. The linearity of this law has now been demonstrated by experiments carried out in the Radio Department of the National Physical Laboratory at frequencies between 4 and 600 megacycles per second for amplitudes between about 10 and 30,000 microvolts.

A variable high-frequency attenuator was constructed on the principle of the 'piston' attenuators described by Harnett and Case[2] and by George[3]. It depends on the space rate of decay of an oscillating electromagnetic field inside a conducting tube. Maxwell's theory, as developed by Rayleigh[4] and others, indicates that under the conditions of these experiments the amplitude decreases exponentially with distance along the tube, with a decay constant sensibly independent of frequency. This attenuator was used in conjunction with a frequency-changer containing a commercial diode of ultra-short wave type, together with an intermediate-frequency amplifier (1·2 mc./s.) fitted with an attenuator and an output measuring instrument[5]. The intermediate-frequency attenuator was calibrated against a standard capacitance voltage-divider constructed in the laboratory. A high-frequency signal was applied to this system and the attenuations at the high frequency and at the intermediate frequency were adjusted simultaneously in opposite senses so that a constant reading was obtained on the output instrument. Measurements were made using oscillations of various frequencies and amplitudes within the limits mentioned above. The results were expressed graphically for each frequency by plotting scale readings of the high-frequency attenuator in centimetres of tube length against the corresponding scale readings of the intermediate-frequency attenuator in decibels. The graph, which is reproduced, was obtained at 600 megacycles per second and is typical.



The points lie closely about a straight line in each case, and the slope is independent of frequency. This would occur in the improbable circumstance that any departure from exponential attenuation should be exactly complementary at each frequency to the deviation from linearity of the frequency-changer law, but otherwise the result establishes the calibration of the high-frequency attenuator and its independence of frequency, and the linearity of the relationship between the amplitudes of the high-frequency and intermediate-frequency oscillations.

It is possible, as a result of these experiments, to compare with confidence the amplitudes of high-frequency oscillations by making observations at intermediate frequency after frequency-conversion in the manner previously described.

The above work was carried out as part of the programme of the Radio Research Board, and this letter is published by permission of the Department of Scientific and Industrial Research.

G. F. GAINSBOROUGH.

Radio Department,
National Physical Laboratory,
Teddington,
Middlesex.
July 9.

---

[1] Strutt, M. J. O., *Wireless Eng.*, **13**, 73–80 (1936).

[2] Harnett, D. E., and Case, N. P., *Proc. Inst. Rad. Eng.*, **23**, 578–593 (1935).

[3] George, R. W., *R.C.A. Rev.*, **3**, 431–440 (1939).

[4] Rayleigh, Lord, *Phil. Mag.*, **34**, 125–132 (1897).

[5] Colebrook, F. M., and Gordon-Smith, A. C., *J. Inst. Elect. Eng.*, **84**, 388–398 (1939).

Study of Diffusion Processes by Electrolysis with Micro-electrodes

THE diffusion of an electro-oxidizable or -reducible substance in solution can be studied by measuring the current obtained using suitable electrodes in an electrolysis cell under such conditions that the amount of electro-oxidizable or reducible material reaching one of the electrodes is determined only by the rate of diffusion of the material to the electrode. The concentration of the diffusing material at the electrode is maintained at a value practically equal to zero by applying a potential to the electrode such that the diffusing material is immediately oxidized or reduced upon reaching the electrode surface.

The theory of the diffusion process in the vicinity of an electrode depends upon the geometrical arrangement of the electrode and solution in contact with it. Two extreme geometric cases are represented by a flat electrode, to which diffusion can occur from only one direction (linear diffusion), and a spherical electrode, to which diffusion can occur from all directions (spherically symmetrical diffusion).

In the case of linear diffusion it can be derived[1,2] that

$$i = -A\sqrt{\frac{D}{\pi t}}\, nFC, \qquad (1)$$

in which i is the current at the time t, A is the area of the electrode, nF is the number of coulombs per mole of reacting substance, C is the concentration, and D the diffusion coefficient of the diffusing material. For spherical diffusion, the current-time equation is[2]

$$i = -4\pi RnFDC - A\sqrt{\frac{D}{\pi t}}\, nFC, \qquad (2)$$

in which R is the radius of the spherical electrode.

In testing both equations, we have studied current-time curves of different substances at potentials

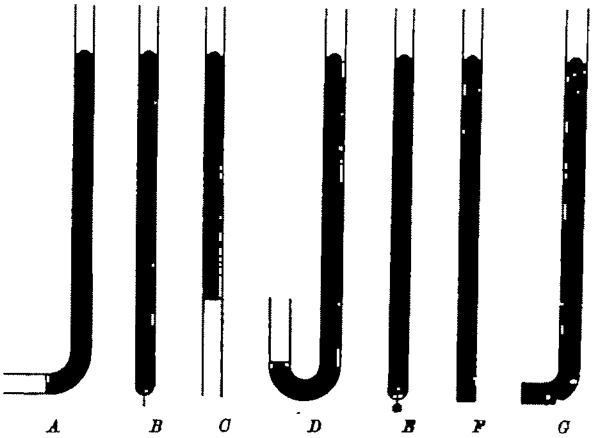


Fig. 1.

VARIOUS SHAPES OF PLATINUM ELECTRODES.

corresponding to the middle of the so-called diffusion current regions. Various electrodes of shapes shown in Fig. 1 were used. Current-time curves obtained in the electrolysis of 0·001 *M* potassium ferrocyanide in 0·1 *N* potassium chloride at 25° C. ± 0·02° are given in Fig. 2. A large 0·1 *N* silver - silver chloride served as a reference electrode. In all these experiments the potential of the platinum electrodes was 0·7 volt as referred to the silver - silver chloride electrode.

From the results presented in Fig. 2 and subsequent experiments to be reported elsewhere in detail, the following statements can be made:

(1) Theoretical current-time curves in the case of linear diffusion of potassium ferrocyanide were obtained only when using electrode *C*. In the cases of the electro-oxidation of ferrocyanide ions and of electro-reduction of silver ions at electrode *C*, where the linear diffusion was such as to produce a density gradient in the downward direction, the quantity $i\sqrt{t}$ (see equation 1) was found to be constant to ± 0·5 per cent over a period of twenty minutes. When the density gradient was in the upward direction (electrode *D*) abnormally large currents were obtained which did not give a smooth current-time curve. In the latter case, convection currents due to slight density gradients cause a greater supply of diffusing material to reach the electrode than by diffusion alone. This is the reason that in the electro-reduction of potassium ferricyanide in 0·1 *N* potassium chloride in air-free solution, theoretical current-time curves were obtained with electrode *D* but not with electrode *C*.

(2) Theoretical conditions were never attained with spherically symmetrical diffusion, due to localized convection currents as a result of density gradients in aqueous solution.

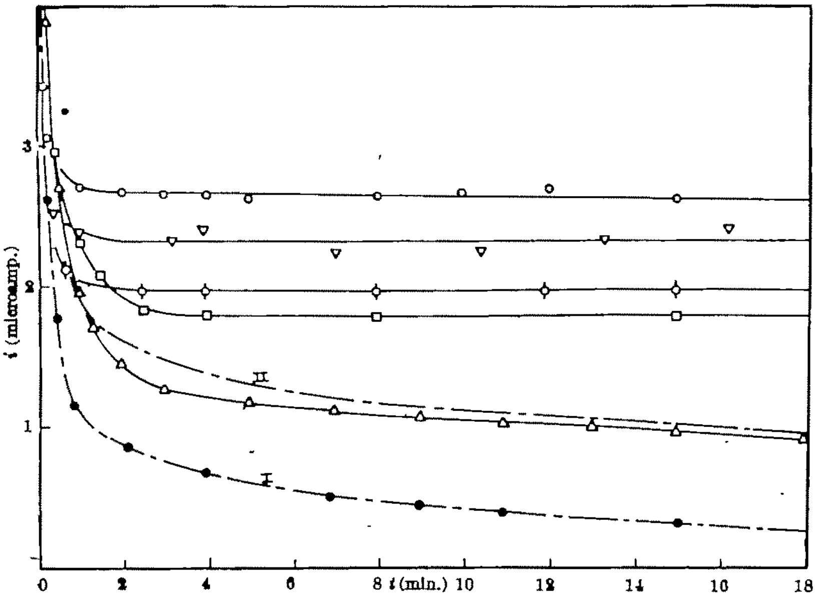


Fig. 2.

CURRENT-TIME CURVES FOR ELECTROLYSIS OF 0·001 $M.K_4Fe(CN)_6$ in 0·1 N.KCl with VARIOUS SHAPES OF PLATINUM MICRO-ELECTRODES.

● Electrode C; △ Electrode A; □ Electrode F;
ϕ Electrode B; ▽ Electrode E; ○ Electrode G.

Dashed curves: theoretical curves for (I) linear diffusion; (II) spherically symmetrical diffusion.

H. A. LAITINEN.
I. M. KOLTHOFF.

School of Chemistry,
Institute of Technology,
University of Minnesota.
Minneapolis, Minn.
July 20.

---

[1] Cottrell, F. G., *Z. phys. Chem.*, **42**, 385 (1902).

[2] MacGillavry, D., and Rideal, E. K., *Rec. Trav. chim.*, **56**, 1013 (1937).

Solar Variation and the Weather

IN NATURE of April 29, p. 705, Dr. C. G. Abbot refers to the probability of weather periodicities in 274 months and factors of that interval. In this connexion it may be of interest to point out that there seems to be a periodic variation in the height of the barometer in Great Britain with a mean interval of 27·31 days.

Out of several stations examined, Greenwich had the longest series of records, and an analysis of these back to 1847, using the method of dropped days and a mean interval of 27·31 days, gave a peak averaging 0·03″ above the mean level for the 1,230 intervals between 1847 and 1938 inclusive. This peak is found to occur in all parts of the period examined but is most pronounced around 1890. In the solar cycle 1890–1901 it averages 0·054″ above the mean and consequently it is very noticeable.

The peak tends to be of a conical shape and covers about ten days of the graph. This departure from the sine curve appears to denote a complex origin, but a competent mathematician who examined the figures informs me that they are not inconsistent with a real force. On the other hand, the amplitude is about ten times that produced by the moon's tidal forces, and there seems to be nothing at present known that could account for it.

An examination of the probability of such a peak occurring by chance showed that it was very unlikely, but of course it cannot be a matter of certainty without further supporting evidence, which is being sought. It may, however, be said that Mr. F. E. Dixon examined the reported occurrences of aurora in Great Britain for about eighty years, and finds a tendency to periodicity in about 27·3 days[1].

Greenwich records go back long before 1847, but the barometer was not then read on Sundays and holidays; this introduces a further factor of uncertainty, and it was not considered that results obtained in these circumstances would be of sufficient value to justify the work involved.

The near approach of 2,731 days to a definite factor of 274 months makes some relation with Dr. Abbots' work a possibility, and from internal evidence, such as occurs when carrying out an extended analysis of this kind, I believe that there is some probability that further examination of the data, and other meteorological phenomena, may show that it is not another manifestation of the vagaries of chance.

W. R. PRISTON.

10 Salisbury Road,
Edinburgh, 9.
August 3.

[1] *Terr. Mag.*, 44, 335-338 (1939).

Condensation of the Hexapeptide Ester of Glycine into the 96- and Higher (3×2^n) Peptide Esters

FOR a long time it has been known that heating under various degrees of the ester of glycine[1], glycylglycine[2] and diglycyl-glycine[3] results in the formation of certain condensation products with liberation of alcohol. If the hexapeptide ester of glycine would undergo the type of condensation exhibited by the dipeptide ester, then the simplest model of a 'cyclol 6' postulated by the Wrinch theory[4] could be prepared. The formation of such 'cyclo-hexapeptide' of glycine could then be considered as evidence for the hexagonal folding by hydrogen bonds of the polypeptide chains.

Experiments were carried out by heating the pure hexapeptide ester at a constant temperature (102° ± 1°) and samples were withdrawn for methoxyl estimation at certain intervals of time. It was found that, instead of cyclization, the hexapeptide ester underwent the type of condensation characteristic of the tripeptide ester in a series of subsequent bimolecular reactions yielding the 12-, 24-, 48-, 96-peptide (3×2^n peptide) ester of glycerine with a calculated methoxyl content of 4·33, 2·21, 1·12, 0·56 per cent and (0 per cent), respectively. When n was limited to 4 (OCH_3, 1·12 per cent) the average rate of the reaction, with the hour as the unit of time, was $10^4 K = 150$, calculated from the methoxyl content of the samples. At a temperature 10° higher, the rate of condensation was 3·7 times faster, corresponding to an activation energy of about 38 kcal. When the hexapeptide ester was heated at 130° ± 1° for six days, the methoxyl content (0·58 per cent) indicated the presence of the 96-peptide ester of glycine with the empirical formula of $C_{193}H_{292}O_{97}N_{96}$ and a molecular weight of 5504. From the nature of this type of condensation reaction, it follows that the reaction products necessarily represent a mixture of polypeptide esters. Such mixtures cannot be separated by chemical or simple physical methods.

In order to prove, first, that a hexapeptide ester does not combine with a tripeptide ester, and secondly, that the reaction products do not consist of mixtures of 'cyclol 6' and unchanged starting material, samples of diglycyl-glycine methyl ester were heated at 100° for different lengths of time and then analysed. The methoxyl content of the insoluble residues clearly indicated that, after two hours of heating, the tripeptide ester gave rise to almost pure dodecapeptide ester (found, OCH_3, 4·1 per cent; calc. OCH_3, 4·3 per cent) as the highest condensation product, and neither nonapeptide ester nor 'cyclol 6' was formed during the reaction.

All the polypeptide esters of glycine obtained in the present work are colourless substances of amorphous appearance, insoluble in alcohol but slightly (0·1–0·5 per cent) soluble in cold water. They all give the biuret reaction very strongly and dissolve completely in cold concentrated hydrochloric acid, but only partly in dilute alkali solution. They are strongly reminiscent of denatured proteins, and like many of the latter substances they are soluble in concentrated urea solution.

Although the inability of the hexapeptide ester of glycine to form a 'cyclol 6'-peptide by this method would seem strongly to favour the conception of unfolded polypeptide chains, yet, the important fact must not be overlooked that the tetrapeptide esters do not undergo[5] any type of condensation at all. This would indicate a fundamental difference between the shape of the molecules of the mono-, di-, tri- and 3×2^n-peptide on one hand, and that of the tetrapeptide and probably of the penta-, hepta-, etc., peptide on the other.

An extensive investigation by application of both chemical and physico-chemical methods is being started in this laboratory. A detailed account of the present work will be published elsewhere.

Acknowledgment is made to Dr. S. M. Trister, research assistant in this Department, for the numerous methoxyl estimations carried out in this investigation.

EUGENE PACSU.

Frick Chemical Laboratory,
Princeton University,
Princeton, New Jersey.
July 5.

[1] Curtius, Th., *Ber.*, 37, 1289 (1904).

[2] Fischer, E., and Fourneau, E., *Ber.*, 34, 2868 (1901).

[3] Fischer, E., *Ber.*, 39, 453 (1906).

[4] Wrinch, D. M., NATURE, 137, 411 (1936), *et seq.*; *Proc. Roy. Soc.*, A, 160, 59 (1937).

[5] Fischer, E., *Ber.*, 39, 2893 (1906).

Catalase

Sumner and Dounce[1] have recently observed that on splitting with acids crystalline ox liver catalase yields a 'blue substance', which remains in the aqueous acetone mother liquor after the hæmin crystals have come out. This mother liquor contained approximately the same amount of iron as the hæmin crystals. The authors concluded from these observations that catalase has two bile pigment hæmatin groups in addition to two protohæmatin groups in a molecule of the weight 248,000, and that the blue substance, though not identical with the original prosthetic group in catalase, still contains iron and differs from biliverdin.

The blue-green pigment has been previously isolated by Stern[2] from horse liver catalase preparations and has been identified by Lemberg (cf.[3]) as biliverdin (dehydrobilirubin). We have now isolated crystalline biliverdin hydrochloride from a crystalline ox liver catalase of the catalase-factor 31,000, prepared by the method of Sumner and Dounce. To 25 c.c. of the catalase solution 50 c.c. of glacial acetic acid were added and the green-blue solution was poured into 300 c.c. of peroxide-free ether. After shaking with a few drops of saturated sodium acetate solution, the ether solution is poured off from the denatured protein which remains only slightly coloured. From the washed ether solution 5 per cent hydrochloric acid extracts iron-free biliverdin hydrochloride, which soon precipitates. Recrystallization from a mixture of methyl alcohol and aqueous hydrochloric acid yields the typical straight, fine needles of biliverdin hydrochloride. The compound was also characterized by transformation with zinc acetate and iodine into the biliviolin zinc complex, which possesses a typical absorption band at 637 mμ.

In a paper[3] probably inaccessible to the American authors, I have already brought forward spectroscopic evidence that biliverdin does not occur in catalase as such, but is liberated by acid from a bile pigment hæmatin-protein. One would, therefore, expect that the mother liquor of the hæmin crystals contains iron in addition to biliverdin. The preparation described above shows that iron and bile pigment are no longer combined after the treatment with acid, and that the 'blue substance' is biliverdin.

Sumner and Dounce based their conclusions as to the number of bile pigment hæmatin groups in the molecule on the equal division of iron between the hæmin and the blue mother liquor. It is, however, difficult to free catalase from an accompanying iron protein compound[6] and from inorganic iron. Keilin and Hartree[4] claim to have obtained a horse liver catalase preparation with a ratio total iron to hæmatin iron as low as 1·2. We have, therefore, studied whether there is a constant ratio biliverdin to hæmatin after acid splitting. Horse liver catalase was prepared by the method of Agner[5] followed by crystallization as described by Dounce and Frampton[6] and also by the method of Keilin and Hartree[4]. 0·5–3·0 c.c. of the catalase solutions were treated as described above. The biliverdin hydrochloride was determined colorimetrically with a standard of pure biliverdin hydrochloride; the hæmatin was determined spectrophotometrically as pyridine-hæmochromogen after extraction from the ether by dilute ammonia. 60–70 per cent of the total catalase hæmatin was thus recovered. With all crystalline preparations and in the great majority of less pure catalase preparations from ox and horse livers, the ratio biliverdin to hæmatin was close to 1 : 3. While the fractionated ammonium sulphate precipitation of Agner removed much of the accompanying iron protein, the biliverdin-hæmatin ratio remained quite unaltered. It seems also significant that only one preparation of horse liver with an abnormally low biliverdin content (biliverdin-hæmatin ratio 0·15) had an abnormal quotient activity constant over hæmatin iron ($k/F_{ep} = 770$, while we found normally 2,300). While these observations support the claim of Sumner and Dounce that bile pigment hæmatin is an essential part of the enzyme molecule, they indicate that catalase contains one, rather than two, groups of bile pigment hæmatin and three, rather than two, groups of protohæmatin. The hæmatin content of our purest ox liver catalase preparation was indeed 0·73 per cent (2·8 mol. hæmatin per molecule).

This conclusion is supported by a quantitative spectrophotometric study of the pyridine-hæmochromogen obtained from catalase. The band at 650 mμ[3] accompanying the protohæmochromogen bands is no longer observed after acid splitting and is, therefore, that of a bile pigment hæmochromogen similar to verdohæmochromogen. Its maximal extinction is only about a quarter of that of the first protohæmochromogen band at 557 mμ, while the maximal absorption of pyridine-verdohæmochromogen is more than half as high as that of this band. Although the identity of the bile pigment hæmatin in catalase with verdohæmatin is not yet established, it is very likely that the maximal absorption should be rather similar.

Since Keilin and Hartree[4] have shown that catalase undergoes reduction to the ferrous form during its action on H_2O_2, and since ferrous hæmatin compounds are easily oxidized by H_2O_2 to bile pigment hæmatin[7], it might be assumed that the bile pigment hæmatin arises during the action of the substrate on the enzyme. We have, however, failed to discover any evidence of an increase of the amount of biliverdin obtained by splitting, or of the absorption maximum at 650 mμ, subsequent to a prolonged action of catalase on its substrate.

The bile pigment hæmatin is, therefore, an essential part of the catalase molecule. The impossibility of splitting catalase reversibly into protein and prosthetic group is now explained by the lability of this prosthetic group to acid.

This investigation was carried out under a grant of the National Health and Medical Research Council of Australia.

R. LEMBERG.
M. NORRIE.
J. W. LEGGE.

Institute of Medical Research,
Royal North Shore Hospital,
Sydney.
July 25.

---

[1] Sumner, J. B., and Dounce, A. L., *J. Biol. Chem.*, **121**, 417 (1938); **127**, 439 (1938).

[2] Stern, K. G., *J. Biol. Chem.*, **112**, 661 (1936).

[3] Lemberg, R., and Wyndham, R. A., *J. and Proc. Roy. Soc. N.S.W.*, **70**, 343 (1936–7).

[4] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **124**, 397 (1937–38).

[5] Agner, K., *Biochem. J.*, **32**, 1702 (1938).

[6] Dounce, A. L., and Frampton, O. D., *Science*, **89**, 300 (1939).

[7] Lemberg, R., Cortis-Jones, B., and Norrie, M., *Biochem. J.*, **32**, 171 (1938).

Growth of the Mandible in the Pig

GROWTH of the mandible has been a controversial problem since the days of John Hunter, notwithstanding that he, John Tomes the elder and George Humphry in turn performed crucial experiments which showed that growth took place at the posterior border of the mandible and absorption at the anterior border, thus providing room for the eruption of the developing permanent molars.

Radiographic examination of a 'runt', the small starveling pig, shows evidence of arrested growth in the skeleton. In the scapula (Fig. 1) the successive checks to growth are displayed by lines of arrested growth, along which bony deposition is well marked. The lines are best seen at the vertebral border of the scapula, particularly at the postero-inferior angle. These lines of arrested growth have been studied in detail by me[1] in the long bones of children.

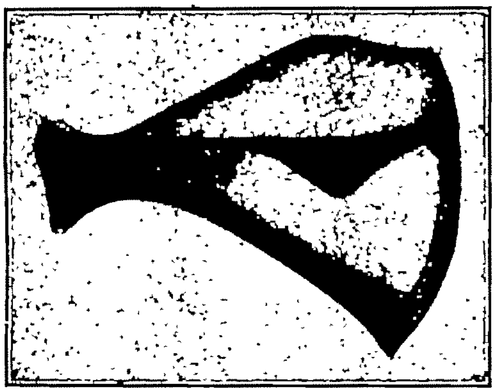


Fig. 1.

Radiograph of the left scapula of a young pig showing lines of arrested growth at the vertebral border.

In the mandible of this pig (Fig. 2) the lines of arrested growth are well marked at the posterior border, at the insertion of the temporal muscle on the coronoid process, and at the superior and posterior border of the condyle. These are the sites of alternating active growth and arrested growth.

Lines of arrested growth are absent from the anterior border of the mandible and coronoid notch. These are the sites of active absorption of bone.

The third molar, at present buried in the mandible, will erupt later by reason of the upward movement of the crown consequent upon the growth of the roots, but it will also be uncovered and laid bare by the absorption of bone at the anterior border of the mandible.

This radiographic proof of the accuracy of John Hunter's description of the growth of the mandible is in accord with the recent descriptions of madder-fed pigs by Brash[2].

The radiograph of the mandible also shows the danger, in the animal or person who is not fully grown, of making a forecast as to whether an unerupted wisdom tooth (third molar) will or will not erupt satisfactorily at a later date. Until growth in the mandible ceases at 21–25 years of age in the human, female or male, there is little justification for interference with a third molar which gives rise to no active symptoms. On the other hand, the continued refinement of the face and reduction in the size of the mandible in passing from ancient man to modern man suggests that the wisdom tooth in the future will give rise to more anomalies than in the past.

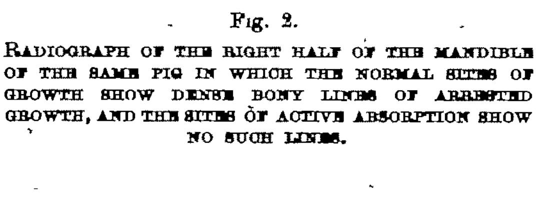


Fig. 2.

Radiograph of the right half of the mandible of the same pig in which the normal sites of growth show dense bony lines of arrested growth, and the sites of active absorption show no such lines.

H. A. Harris.

Anatomy School,
University of Cambridge.

---

[1] Harris, H. A., "Bone Growth in Health and Disease" (Oxford University Press, 1933).

[2] Brash, J. C., "Growth of the Jaws, Normal and Abnormal, in Health and Disease" (Dental Board of the United Kingdom, London, 1924).

Production of Intercellular Hormones by Mechanical Injury

Previous papers from this laboratory have demonstrated the production of proliferation-promoting factors (intercellular wound hormones) by cell aggregates subjected to lethal ultra-violet or X-rays[1], heteroauxin[2], and carbon dioxide[3]. These factors are evidently produced by living cells as a response to injury, since the maximum production of the hormones precedes the maximum rate of killing[3].

It has been of interest to determine whether mechanical injury would also lead to the formation of these factors. Yeast suspensions in isotonic salt solution were subjected to several types of mechanical agitation. These included various shaking devices and the rotation of bottles of the suspensions on a wheel. Very low killing of the cells was observed, and the cell-free fluids from the suspensions had slightly greater proliferation-promoting activity than the unshaken controls. The degree of increase in activity was usually small and the results were subject to considerable variation. The addition of glass beads to the suspensions in the rotating bottles gave cell-free fluids of very high activity. However, although very few intact cells were killed, many cells were completely disintegrated. It was therefore uncertain how much of the increased activity was due to intercellular hormones and how much to cellular disintegration products.

The following procedure was finally adopted. The yeast was agitated by placing it in a stoppered glass tube 1¼ in. × 3½ in. attached to the voice coil of a loud speaker, the cone of which was in the horizontal plane. The voice was actuated by a beat-frequency audio oscillator and audio amplifier. In the experiments reported, the voltage across the coil varied from 1 to 4, corresponding to a power input of 0·1–1·6 watts. A vibration frequency of 50 cycles was employed. Three and one half to 7 gm. of crumpled cake yeast were placed in the tube and vibrated for 5 hours. After the addition of 35 c.c. of isotonic sodium chloride solution the vibration was continued for another hour. Preliminary experiments showed this treatment to be more effective than vibration of a suspension for the whole period. The growth potencies of Berkefeld filtrates of the suspensions were compared with those of controls which were treated in the same way except that vibration was omitted. In later experiments increased potency was obtained by adding sand to the yeast during agitation. This did not markedly increase the amount of killing as determined by methylene blue staining, nor was fragmentation of the cells observed. About 25 per cent of the cells were killed. The experimental filtrates were one and one half to two and one half times as potent as the controls on a volume basis, and one and one half to four times as active on the basis of equal weights of solid in the filtrates.

Preliminary experiments indicate that the active materials, like those from ultra-violet injured yeast cells[4], are characterized by ultra-violet absorption at 2600 A.

JOHN R. LOOFBOUROW.
ELTON S. COOK.
SISTER CECELIA MARIE DWYER, S.C.
SISTER MARY JANE HART, O.P.

Institutum Divi Thomæ,
Cincinnati, Ohio.
July 21.

---

[1] Fardon, Norris, Loofbourow and Ruddy, NATURE, 139, 689 (1937); Sperti, Loofbourow and Dwyer, *ibid.*, 140, 643 (1937); *Studies Inst. Divi Thomae*, 1, 163 (1937); Fardon, Carroll and Ruddy, *ibid.*, 1, 17 (1937), Loofbourow, Dwyer and Morgan, *ibid.*, 2, 137 (1938).

[2] Loofbourow and Dwyer, *Science*, 88, 191 (1938); *Studies Inst. Divi Thomae*, in the press.

[3] Loofbourow and Dwyer, NATURE, 143, 725 (1939).

[4] Cook, Loofbourow and Stimson, 10th Internat. Congress of Chemistry, Rome, May 1938; Loofbourow, Cook and Stimson, NATURE, 142, 573 (1938).

Exfoliation of Vermiculite by Chemical Means

SPECIMENS of vermiculite from different localities have been examined in the laboratories of the Mineral Resources Department of the Imperial Institute in the course of an investigation into possible Empire sources of supply, and an interesting phenomenon has been observed in connexion with the expansion of the mineral, a property on which its commercial value depends. This expansion is usually brought about by heating the material, and a record of an instance in which it has been effected by chemical treatment appears to be of scientific interest.

It has been noticed that in the mechanical analysis of soils, the preliminary treatment with hydrogen peroxide causes some alteration in the appearance of weathered mica particles present in the soil. This suggested that hydrogen peroxide might have some action on vermiculite, and in order to ascertain its effect a number of small pieces of the mineral, about ¼ inch in diameter and less than 1/10 inch in thickness, were covered with the reagent (20 vol. strength) and allowed to stand. Complete exfoliation takes place after some time in the cold and can be hastened by gentle heating. A preliminary drying of the mineral at 100° C. was found to accelerate the action in one instance. The treated specimens have a concertina-like appearance, the lamellæ forming the bellows, and with one specimen alternate light and dark coloured zones were observed parallel to the direction of expansion, which is curved. The material treated with hydrogen peroxide is of a paler colour than that exfoliated by heat, and provided that it is kept moist, is also very soft, requiring only gentle rubbing or stirring, rather than grinding, to reduce it to a fine state of subdivision. The mechanical strength of the treated and still moist product is low, but after drying in a steam oven, its properties are similar to those of the heat-treated material.

The exact cause of this effect has not yet been ascertained. It has always been considered that the exfoliation of vermiculite on heating is due to the separation of individual lamellæ by the evolution of combined water, but this would not explain the similar effect obtained with hydrogen peroxide. The effect obtained may possibly be due to evolution of oxygen between the flakes of the mineral, but this does not explain the asymmetric expansion or the zones of different colour.

Various other oxidizing and reducing agents (potassium permanganate, potassium dichromate, chromic acid, sodium hypobromite, chlorine generated from permanganate and hydrochloric acid, water saturated with sulphur dioxide) have been tried, but none of them has given an expansion at all comparable with that obtained with hydrogen peroxide, although some effect was observed in certain instances after long standing. Chlorine from permanganate and hydrochloric acid, for example, causes a certain amount of exfoliation and separation of the lamellæ but not to the extent given by hydrogen peroxide.

R. C. GROVES.

Mineral Resources Department,
Imperial Institute,
London, S.W.7.
August 16.

Technique of the Painting Process in the Bagh Caves in Gwalior State

THE Bagh caves (lat. 22° 22′ N., long. 74° 48′ E.) are situated among the southern slopes of the Vindhya Hills, seventy miles from Mhow, a town on the Rajputana-Malwa section of the B.B. and C.I. Railway. The caves were at one time fully decorated with paintings. But there are remains of them[1] only in caves III and IV. The caves, which are of sandstone, have crumbled, due to the excessive weight of the superimposing band of claystone with moisture percolating through it. Consequently many of the paintings have disappeared. The paintings probably belong to the early seventh century A.D.[2], being contemporaneous with the paintings in Caves XVI and XVII at Ajanta.

The paintings of Bagh and Ajanta form a class by themselves. They belong to the golden age of Indian classical art, which inspired more than half the art of Asia. They will bear comparison with the best that Europe could produce down to the time of Michelangelo[3].

In the course of my studies[4] on Indian paintings, I recently investigated the methods and materials used by the classical artists at Bagh. The paintings are done on the sandstone wall of the veranda lining Caves IV and V. The painted stucco, consists of rough plaster of ferruginous earth or of lime. The earth plaster has a thin smooth coat of a mixture of gypsum and lime. The lime plaster has a thin coat of limewash. These thin coats support the layer of paint. The rough plasters of earth and of lime vary in thickness from 7·9 mm. to 20 mm. and from 3·4 mm. to 6·5 mm. Their average thicknesses are 17 mm. and 4·9 mm. respectively. With the earth stucco, the gypsum-lime layer and the paint layer are each 0·1 mm. thick. In the lime stucco, the limewash and the paint film are each 0·2 mm. thick. 48 per cent of the deep red plaster is composed of particles the sizes of which vary from 200 μ to 700 μ, while 16 per cent of them are less than 200 μ and 36 per cent greater than 700 μ. The corresponding figures for the light red earth plaster and the lime plaster are 40, 20, 40 per cent and 40, 60, 0 per cent respectively.

The results of analyses of the rough plasters are as follows:

	Earth plaster Deep red Per cent	 Light red Per cent	Lime plaster Per cent
Moisture	0·27	0·42	0·91
Carbon dioxide, CO_2	1·25	0·65	12·68
Combined water and organic matter	0·65	1·03	9·34
Silica, SiO_2	87·22	87·10	51·18
Iron, Fe_2O_3	6·12	3·11	2·23
Alumina, Al_2O_3	0·44	5·29	
Phosphoric acid, P_2O_5	0·12	0·10	
Titanic acid, TiO_2	0·09	0·07	
Lime, CaO	2·11	0·75	22·41
Magnesia, MgO	0·56	0·44	nil
Manganese, MnO	0·75	0·39	nil
Sulphuric anhydride, SO_3	nil	nil	0·04
Alkalis	0·44	0·62	1·21
Nitrogen	0·13	0·09	nil

The consolidation of the earth plaster is due to the plasticity of clay[5] present in it. It has also been reinforced and bound with vegetable fibres[6]. The firmness and strength of the lime plaster is due to the lime present and to the considerable quantities of long vegetable fibres originally added.

The pigments employed at Bagh are yellow and red ochres, carbon, lime and gypsum, terre verte and lapis lazuli. Animal glue has been added to the pigments to serve as the binding medium on the earth plaster, while the pigments have been employed in *lime medium* on the lime plaster.

Full details of the investigation will be published elsewhere.

S. Paramasivan.

Chemical Laboratory,
Government Museum,
Madras.
July 5.

---

[1] Rowland, Benjamin, and others, "The Wall Paintings of India, Central Asia and Ceylon" (Merrymount Press, Boston, 1938), 79–81.

[2] Marshall, Sir John, and others, "The Bagh Caves" (India Society, London, 1927), 22.

[3] *Ibid.*, 4–6.

[4] Nature, 137, 867 (1936); 139, 114 (1937); 140, 196 (1937), 142, 757 (1938). Technical Studies (Harvard University), 5, 221–240 (1936–37): *Proc. Ind. Acad. Sci.*, 7, 282–292 (1938).

[5] Searle, "The Chemistry and Physics of Clays and other Ceramic Materials" (London: Benn, 1924), 262–63.

[6] "Encyclopaedia Britannica", 14th edn., 18, 39–40.

Points from Foregoing Letters

R. S. Krishnan and D. H. T. Gant have bombarded silver with deuterons from a cyclotron. They find a negative electron activity of period 2·4 min. Chemical separation of the irradiated silver into silver and cadmium fractions has been carried out. The cadmium fraction contains a body of 6·8-hr. period emitting soft negative electrons, possibly due to a cadmium isotope; the silver fraction contains a body of 26-min. period emitting positrons. N. Feather has confirmed some of the previous workers' findings, using the method of critical absorption.

A group of Japanese workers report on their investigations on the fission of thorium by neutrons. They bombarded thorium nitrate with fast neutrons for periods of one to five hours and attempted the chemical identification of the radio-elements produced.

D. S. Kothari derives a set of equations connecting the mean life of the meson τ_0, the cosmological constant t_0 and the gravitational constant G.

Experiments with a diode frequency-changer are described by G. F. Gainsborough which demonstrate the linearity of the relationship between the amplitudes of the high-frequency and intermediate-frequency oscillations, thus permitting comparisons of ultra-high-frequency alternating potential differences to be made after frequency conversion. The calibration of the high-frequency attenuator used was shown to be valid at frequencies up to 600 megacycles per second.

H. A. Laitinen and I. M. Kolthoff show quantitatively the disturbing effects of convection currents on diffusion studies with micro-electrodes and indicate the conditions under which theoretical diffusion conditions can be realized in electrolysis with micro-electrodes.

Barometer readings at Greenwich for the last 92 years seem to show a periodic variation with an interval of 27·31 days. A similar tendency has been observed in the reported occurrences of aurora. W. R. Priston suggests this may have a connexion with Dr. Abbots' period of 274 months (Nature, April 29, 1939) in meteorological phenomena.

E. Pacsu finds that condensation by heat of the hexapeptide ester of glycine gives 12-, 24-, 48-, etc., peptide esters, the number of glycine molecules being expressed by the general formula of 3×2^n. The condensation at 102° proceeds through a series of successive bimolecular reactions with $10^4 K = 150$ and has an activation energy of 38 kcal. Analysis shows that neither 'cyclol 6' nor nonapeptide is formed in the reaction. The substances are reminiscent of denatured protein and give strongly the biuret reaction.

R. Lemberg, M. Norrie and J. W. Legge find that catalase contains one bile pigment hæmatin group, similar to verdohæmatin, in addition to three protohæmatin groups. By splitting with acids, biliverdin is isolated from crystalline catalase. Evidence is brought forward in support of the view that the bile pigment hæmatin is an essential part of the enzyme molecule.

That the sites of active growth and of active absorption of bone are displayed by a radiograph of the lower jaw of a young pig which had grown irregularly is submitted by H. A. Harris. The satisfactory cutting of the wisdom tooth depends largely on the degree of absorption of bone at the anterior border of the jaw.

It has been shown by J. R. Loofbourow and coworkers that proliferation-promoting factors (intercellular wound hormones) are produced by cell aggregates on subjection to ultra-violet light or X-rays, heteroauxin or carbon dioxide. Loofbourow *et al.* have now examined the effect of mechanical injury, in this respect, by subjecting yeast cells to vibration induced by the voice coil of a loud speaker. Increased growth potency of the filtrate was observed in those subjected to agitation compared with the controls.

Miss R. C. Groves states that vermiculite, a mineral used commercially for heat- and sound-insulating purposes, can be exfoliated by means other than the usual dry heat treatment, and records an instance in which the effect is produced by the action of cold hydrogen peroxide.

RESEARCH ITEMS

Excavations at Brundon, Suffolk

THE gravel pit at Brundon, near Sudbury, Suffolk, affording a rare opportunity of examining a true interglacial bed, a research committee was appointed by the British Association for the purpose of its excavation. The actual work of conducting the examination was carried out under the supervision of the committee by J. Reid Moir in 1935–37, by whom a report on the work of excavation and the archæological material has been prepared, while A. Tindell Hopwood has reported on the fossil mammals. (*Proc. Prehist. Soc.*, 5, 1; 1939). The Brundon section, the base of which lies approximately at 100 ft. O.D., is composed of Upper and Lower Glacial deposits separated by fluviatile beds. The geological, archæological and palæontological evidence points to the probability that the basal Boulder Clay at Brundon was laid down by the Upper Chalky Boulder Clay glaciation. The age of the upper glacial deposit remains uncertain; but it may be that of the Brown Boulder Clay of Hunstanton, Norfolk. At the base of the fluviatile gravel (Stratum 3) at Brundon are traces of an ancient land surface, rich in mammalian remains and non-marine Mollusca. At this level occur unabraded and unpatinated flint implements and flakes of Crayfordian types. The evidence of the fossil bones and shells also points to the deposit being of the period named, post-dating the glaciation responsible for laying down of the Upper Chalky Boulder clay, a conclusion supported by the discovery of Baker's Hole type of implements with the unabraded artefacts. The former are patinated, abraded and striated, suggesting that they had experienced glacial conditions before reaching the Brundon ancient land surface. In the fluviatile gravel implements of various ages have been found—Early Clactonian, Early and Late Acheulean, Baker's Hole and Crayfordian. The upper glacial deposits have yielded a few indeterminate flakes only. There is good reason to believe that the climate during the laying down of the fluviatile deposits was warmer than that of to-day, and that the Brundon section represents a true interglacial accumulation, resting upon and surmounted by deposits laid down during a period of extreme cold.

Ancient House Types in Arizona

INVESTIGATIONS by Dr. Frank H. H. Roberts, jun., on behalf of the Bureau of American Ethnology and the Laboratory of Anthropology, Santa Fé, on archæological sites in eastern Arizona, mainly on the ridge of mesas west of Whitewater Creek, near Allantown, in three successive seasons in 1931–33, have produced valuable information relating to one component of the prehistoric sedentary Indian culture pattern, of which that bearing on house-types is now published (Smithsonian Inst. *Bur. Amer. Ethnol.*, *Bull.*, 121, 1939). The remains belong to several stages of the Anasazi cultural pattern. There are traces of Modified Basket-maker, and large ruins represent the Great Pueblo period; but most of the digging was done in Developmental Pueblo remains, in which twenty pit structures with their accompanying granaries and surface shelters, and three unit-type ruins were examined. They clearly show the growth from small single-roomed pit-dwellings, with brush- and plaster-covered truncated pyramidal superstructures, supported by four upright posts set in the floor of the chamber, to above-ground houses with several contiguous rooms, masonry walls, and flat roofs. Correlated with this is the shift in function of the semi-subterranean domicile from secular to ceremonial purposes. This change is accompanied by comparable changes in other features, particularly in the lesser objects of the material culture, such as pottery, stone, and bone implements, which will be considered in a later report. Charred beams indicate by the dendrological method an occupation of the remains excavated extending over a period of two centuries, dated from A.D. 814–1014.

Excavations at Mas d'Azil, France

EXCAVATIONS by Marthe and Saint-Just Péquart at Mas d'Azil, on the left bank of the Arize, although not yet completed, call for an interim report on four seasons' work (*L'Anthropologie*, 49, 3–4, 1939). The stratigraphic evidence reveals three occupations by Magdalenians, separated from one another by sterile layers of soil, varying in depth respectively from 2 metres to 1 metre. The Azilian layer of occupation, however, except for certain traces which the excavators have succeeded in isolating, had virtually disappeared, and with it the neolithic stratum. In a second terrace under examination, the neolithic people had settled on a layer of clay which seals the Magdalenian, no evidence of Mesolithic occupation intervening. At its greatest thickness this neolithic layer is four metres deep, but has yielded little in the way of artefacts. The Azilian finds include three bone harpoons representing the two Azilian types. In the second Magdalenian horizon—the first provided few relics—a quantity of material in bone includes some sixty blade-bones, of which one half were unused while the other half was scored or in many instances engraved with recognizable figures of animals—reindeer, horses, etc., while in a hunting scene are rudimentary human figures. On the right bank in excavations by M. and Mme. Mandement four galleries have been opened up in the cave, of which the existence was previously unsuspected. Of these one was found to be rich in Magdalenian deposits, including some remarkable examples of Magdalenian art, now in the St. Germain Museum.

Elements in Nutrition

A SURVEY of up-to-date knowledge of elements which appear to be essential when present in traces in human and animal foods is given by W. Godden (*J. Soc. Chem. Ind.*, 58, 791; 1939). Copper in small amounts appears to be necessary in preventing anæmia in animals, the food of which nevertheless contains adequate amounts of iron; its role is not concerned with the assimilation of iron but with the mobilization of iron in the body and with the formation of hæmoglobin. Milk is very low in copper as well as in iron, but copper is present in most other foods. Manganese plays no part in hæmoglobin formation, but appears to be necessary for fœtal development. Cobalt is in some cases essential to iron metabolism, and diseases of farm animals in Australia and New Zealand have shown it to be an essential element in the cure of bush-sickness; traces of nickel may possibly supplement deficiency of cobalt. Zinc does not play any part in iron metabolism; it is present in higher percentage than copper or manganese in human and cow's milk and is a constituent of crystalline insulin. Fluorine is present in bones and the enamel of teeth, but when present in more than mere traces it affects the enamel of teeth; this may be caused by drinking waters containing more than 1·5 parts per million of fluorine. Iodine deficiency has long been recognized as a probable cause of goitre. Selenium is a harmful element, and its presence in soils of the Great Plains of the United States, from which it finds its way into herbage and cereal grains, causes diseases of animals which were formerly regarded as due to the alkali present in the waters of these regions. The paper includes a short bibliography.

Genetics of Man

ONE of the valuable contributions of Mendel was to show that the dominant individuals in an F_2 generation consisted of homozygotes and heterozygotes in a definite ratio. This has now been shown for the first time in man by J. B. S. Haldane and U. Philip (*J. Gen.*, 38, 193–200; 1939). They have analysed the data of relatives of hæmophilic patients listed in Birch's monograph. From daughters of hæmophilics there were 15 normal and 13 hæmophilics. Twenty-six sisters of hæmophilics were definitely heterozygous and forty-four could have been homozygous or heterozygous. Mathematical analysis shows that these figures are entirely reasonable and in accordance with the expectation that 50 per cent of the sisters of hæmophilics are heterozygous.

Genetics of the Rex Mouse

THE rex mouse has a coat somewhat similar to that of the same character in the rabbit. F. A. E. Crew and C. Auerbach (*J. Gen.*, 38, 341–343; 1939) show that rex is an autosomal dominant to normal. The caracul coat discovered by Dunn has very similar characters, but the authors show that caracul and rex are not controlled by allelomorphic genes. The similarity in the phenotypical characteristics of rex and caracul suggests that caution is necessary in assuming that parallel mutation in related species lies at the root of phenotypical similarity.

Sterility in *Drosophila melanogaster*

BERG showed that sterility mutations were more frequent in the X-chromosome of *D. melanogaster* than in all the other chromosomes put together. S. Prabhu (*J. Gen.*, 38, 177–191; 1939) has shown that in the X-chromosome the vast majority of sterility mutations occur in a small region between garnet and forked on the X-chromosome. This region had previously been identified as a locus probably related to sex determination by Goldschmidt and by Patterson and Suche. Whether the region is that of a sex gene is debatable, but the locus may be one containing several allelomorphs of sterility mutations.

The Avian Sternum

LARGELY due to the authority of Rathke and Parker, it is generally stated the avian sternum originates from rudiments derived from the ventral ends of the ribs. This view has not always been received without question, and the other point of view, put forward by Bruch so early as 1852, is that the ends of the ribs only secondarily fuse with the paired sternal plates. The matter has been reinvestigated experimentally by Honor B. Fell (*Phil. Trans.*, B, 563; 1939) using as material the embryos of the budgerigar. The sternum originates from paired rudiments which arise independently of the ribs and can be grown *in vitro* apart from either ribs or coracoids. It is suggested that the sternum should be regarded as related to the appendicular skeleton since its rudiments arise in close association with the wing buds. If a single rudiment is grown *in vitro*, it produces a half-keel but set at a wrong angle, and the presence of its fellow of the other side is necessary for the normal development of the keel. Even then, however, its growth-rate is slower than under non-experimental conditions and it never reaches its normal form. For this to occur development must take place with the normal relations of the surrounding tissues undisturbed. The junction of the two sternal plates is not due solely to their own expansion but to their displacement in a median direction.

Giant Fibres in Squids

IT is thirty years ago since L. W. Williams reported the presence of two giant nerve cells in the squid Loligo, but little attention has been paid to this observation since. Now, however, John Z. Young (*Phil. Trans.*, B, 504; 1939) has examined the structure of the nervous system of this animal in detail. It is found that the nerve fibres vary in diameter from $1\,\mu$ to nearly 1 mm., so that it is difficult to separate giant fibres from ordinary fibres. The author has paid particular attention to certain large fibres directly concerned with mechanism employed by the animal in shooting rapidly through the water. These fall into three groups, termed those of the first, second and third orders respectively. The fibres of the first order are two in number and arise from a pair of giant cells which may possibly represent the ventral portion of the pericesophageal ring of the ancestral mollusc. Each gives off a single axon which passes backwards to the palliovisceral ganglion, where it fuses with its fellow. Such an axonic fusion is a most unusual feature in animals. Fibres from this union make synaptic contacts with fibres of the second order. The fibres of the third order are syncytia formed by the processes of numerous neurons in the stellate ganglion. They receive numerous synaptic contacts from collaterals from the fibres of the second order. It is suggested that such a system is adapted for producing rapid movements rather than tonus. It is absent in the octopods, where the method of locomotion is entirely different.

Entomogenous Fungi

A RECENT paper by Mr. T. Petch (*Trans. Brit. Mycol. Soc.*, 23, Pt. 2; July 1939) makes a further contribution to knowledge of the fungi which attack insects. The present paper is one of a series which brings the total number of entomogenous fungi described by Mr. Petch up to 160. It has the usual yield of newly described species, this time nine in number. One of these, *Stemphyliopsis ovorum*, is not strictly entomogenous, but attacks the eggs of a snail in Ceylon. Other new kinds include *Entomophthora reticulata* from Great Britain, but the geographical range of the new records extends from Mauritius to Florida, and from the Gold Coast to Ceylon. One might, however, express a little disappointment at the provision of the two names *Hypocrella glabrescens* and *Aschersonia fimbriata* for two stages in the life-history of one of the new species. The first name denotes the ascigerous condition, and would seem to be adequate.

Santorin and Crete

N. A. CRITIKOS, of the Seismological Institute of the University of Athens, considers that the key to the downfall of the Minoan civilization in Crete and the "Descent of the Doriens" about the twelfth century B.C. is to be found in volcanic and seismic phenomena (*Bull. Volcanol. Ser.* (II), 4, 39–49; 1938). Between 2000 and 1500 B.C. it is thought that Santorin was in violent eruption accompanied by earthquake phenomena and sea waves on a large scale and that the original crater was then formed. (A repetition of this for which there are eye-witness accounts took place in September and October 1650.) Nor were Santorin and other areas in the eastern Mediterranean any more quiet in 1220 B.C. In the spring a violent earthquake was felt near Port Said and in the summer a shock was experienced at Wâdi-el-araba. In the spring of 1180 B.C. there were several shocks, including one felt at Jericho. It appears probable that at about this time Santorin again erupted and the sea flowed into the crater forming the large island and ring of small islands now visible. All this would be accompanied by the rain of ashes, sulphurous fumes, earthquakes and sea waves which would reach as far as Crete, destroying property and causing the deaths and injuries of numerous people. Repeated occurrences of this type would profoundly affect the life on the island. Critikos is further of the opinion that these natural phenomena were all part of a prolonged and more profound movement which resulted in the break up of the 'Egéide', forming the Cyclades, and which had repercussions on the whole of the eastern Mediterranean.

Periodic Comet Tuttle

JEFFERS and Moore observed this comet on August 12d. 11h. 20·2m. U.T. Its position was R.A. 5h. 55·8m., Dec. + 57° 22′; magnitude 18. In the *Handbook of the British Astronomical Association*, 1939, p. 32, there is an ephemeris computed by Dr. A. C. D. Crommelin; the true time of perihelion is 1·1 day later than that assumed by Dr. Crommelin. The positions in R.A. and Declination can be found by multiplying the correction coefficients by 1·1 and applying the results to the ephemeris.

Comet Kamensky

ON July 24d. 22h. 00m. U.T., Kamensky observed a comet. Its position was R.A. 20h. 55·0m., Dec. – 7° 00′. The object was described as diffuse, with central condensation, its magnitude being 7. An orbit has not been computed.

Law of Error and the Combination of Observations

H. R. HULME and L. S. T. Symms (*Mon. Not. Roy. Astro. Soc.*, 99, 8; June 1939) have developed a method which allows a system of continuous weighting to be found for a series of observations. When a comparison is made between experimental results for the distribution of errors and a Gaussian curve of the same probable error, it is frequently found that the large errors are much more numerous than the normal law indicates. This subject was treated fully by Simon Newcomb more than half a century ago, and quite recently Jeffreys has shown that the normal law is also defective from the theoretical point of view. Another defect of the normal law is that it affords no satisfactory criterion for retaining or rejecting apparently bad observations unless the observer has noted that the observation is not expected to be as good as the others. In the present paper the authors assume that they are dealing with a set of observations which are all of equal weight, so far as the observer knows. The problem is of a twofold nature: (1) the actual error law which best fits the residuals must first be found; (2) the system of weighting which corresponds to this law must then be obtained. Newcomb and Jeffreys have both solved the problem by different methods, and the paper shows that both of these lead to the same result in actual practice. A description of their method of weighting is followed by the results obtained. The residuals chosen for analysis are those found from the measurements of the variation of latitude made at Greenwich with the Cookson floating zenith telescope from 1927 to 1936. The method of weighting described has also been applied to the results of the measurement of parallax. While the improvement in the results of the latitude observations is small it is nevertheless appreciable, and no doubt the method will be applied in other lines of investigation.

A New Member of the Ursa Major Cluster

W. M. SMART (*Mon. Not. Roy. Astro. Soc.*, 99, 8; June 1939) shows that the star Gr. 1970 (G.C. 17919), apparent magnitude 6·74, spectral type *G* 0, is a member of the Ursa Major cluster. Hertzsprung suggested about seven years ago that the star was probably connected with the cluster, and Smart's calculations substantiate the view. The co-ordinates of the star for 1950·0 are R.A. 13h. 11m. 34s., Dec. + 56° 58′, and the proper motion components are μ_α 0·0135s., μ_δ – 0·035″. The total proper motion is 0·115″ in position angle 107·6°, the probable error of the latter being ± 1·6°, which is derived from the probable errors of the proper motion components. From his values of the co-ordinates of the convergent point Smart finds that the angular distance of the star from the convergent point is 132·3°. The calculated position angle is 99·9°, the difference of 7·7° between observed and calculated being only slightly greater than the largest difference found for stars belonging to the Ursa Major cluster. On the supposition that the star belongs to the cluster the calculated parallax is 0·039″, and the observed value, given in Schlesinger's "Catalogue of Parallaxes", is 0·045″ ± 0·009″. The calculated absolute magnitude is 4·70, which is the normal value for a *G* 0 dwarf, and the calculated radial velocity is – 12·8 km./sec., as compared with – 7·9 ± 0·9 km./sec. according to Moore's Catalogue and – 11·1 km./sec. determined by J. S. Plaskett at Victoria. The close agreement in all cases shows without doubt that Gr. 1970 is a member of the Ursa Major cluster.

INTERNATIONAL CO-ORDINATION OF DOCUMENTATION

THE growing realization on every hand of the importance of documentation to undertakings of every kind continues to be reflected in the attendance, papers and discussions at the International Conferences of the International Federation for Documentation. Founded as the result of an International Conference on Bibliography at Brussels in 1895, the Federation has become the recognized international organization for the discussion and co-ordination of methods and means for making available on demand the recorded facts relating to any and every subject of special study.

Although the Conference held at Zurich during August 10–14 last was one of the smaller so-called conferences of experts, which are held in alternate years between the full conferences of the Federation, some hundred and seventy members attended from seventeen different countries and thirty-nine papers were communicated, larger numbers than at many full conferences of the Federation in its earlier years. In expressing the welcome of the Swiss Government, Vice-Chancellor Dr. Leimgruber referred to the special importance of administrative documentation as a means of rationalization. Dr. Alingh Prius, president of the International Federation for Documentation, in reply appreciated the suitability of Switzerland, with its four languages, as an example of collaboration, and Zurich, as an industrial town, as meeting places for the Conference.

Four subjects were selected for special study at this Conference, and administrative documentation was one of them. In a paper entitled "La documentation administrative en Belgique", M. Daniel Warnotte gave a detailed account of the state of official documentation services in Belgium. He was followed by M. A. B. Boutillier du Retail of Paris, who referred specially to the French decree of 1938 creating a national centre of documentation at the Bibliothèque nationale for co-ordinating the whole of French administrative documentation. In his paper, "Notice sur l'unification des methods de classement dans les administrations publiques Belges," M. O. Molle of Brussels stressed the importance of the general adoption of a standard system of classification.

A typical paper was that by MM. E. Mathys, E. Rickli, C. Frachebourg and R. Calame of Berne, entitled "La documentation dans les Administrations Suisses des Chemins de Fer Federaux, des Postes, Telegraphes, Telephones et des Douanes," which gave a striking account of the advantages of co-ordinating the work of a number of administrative libraries. Documentation proceeds from the need of an organization to put in order the processes of collecting, abstracting, preserving and supplying books, articles, data, reports, public documents and archives. It has taken a long time to realize that, when such documents are properly collected, abstracted and made available, they are capable of affording invaluable assistance in administration. The existence of the gap between the making of a record in any sphere of work and the placing of that record in the hands of the individual who may need it, is proved by the number of individuals who set themselves to make notes of information that may be useful to themselves. There is as great a step between this and the creation of a special organization for the purpose, as there was for our ancestors, when they decided to give up baking their own bread and to let the baker do it for all. For good or for evil, the need has brought the means, and documentalists, like the bakers, have come.

The medium for distributing the records of progress is the periodical press, but it speaks in so irregular and incoherent a manner that it is impossible, without documentation, to obtain a clear and concise view of any particular branch of knowledge. Documentation is the remedy for the disorder that reigns in the production of documents. It enables a small country like Switzerland to avail itself of advances in knowledge and experimental results from all parts of the world.

In Switzerland, besides the National Library, there are some forty-nine libraries belonging to the Federal administration. The highly favourable results of co-ordinating the work of four of the larger of these libraries, namely, those of the Swiss Railways Department, the Post Office, the Telegraphs and Telephones Department and the Customs Department, has led to the serious consideration of a scheme for the co-ordination of all the administrative libraries in the country. For these four libraries, the acquisition, care and manipulation of books and periodicals is centralized in one library. Thus all the material of documentation, within the scope of the administrations concerned, is collected and dealt with in one place according to the best principals of librarianship and documentation. Each official knows where to go without delay for his material and information. Purchases are made systematically, without duplication. There is economy of cost, staff, furniture, apparatus and material. A community of work between the libraries is recognized, about which there is constant consultation, mutual advice and help. Each library retains its own special character and borrows books freely, as required, from the associated libraries. Periodicals pass from one library to another, or to local branches, sometimes at the rate of thirty an hour.

Since officials usually require documents relating to a particular topic rather than by a given author, a subject catalogue is needed, which must be very minutely subdivided. The Universal Decimal Classification has been adopted by all four libraries as being the most appropriate, thus becoming the basis of mutual co-operation. There are also author and various special catalogues.

In recent years the Swiss Government has realized the inefficiency and costliness of making a documentation of each subject as it arises, and a central documentation service has been organized for these Departments. Periodicals necessarily form the basis of this service. As these come in, data and other useful information are abstracted from them and entered on cards, which also are classified by the Decimal Classification. The cards are retained by the individual libraries, the Post Office having

10,000, the Telegraphs and Telephones centre 80,000 and the Railway Department 200,000. Mutual interchange is facilitated by the utilization of standard methods. The good results obtained could not have been achieved otherwise than by such a rationalization and are such that the same principles are likely to be extended to all the Swiss administrative libraries.

The Section devoted to the Division of Work between Libraries and Documentalists attracted some very interesting papers. Mr. A. B. Berthold gave a survey of work on Union Catalogues in the United States in a paper entitled "Union Catalogues and Documentation". There are now forty-six such catalogues in various stages of completion in the United States. One is national in scope, with approximately 10,000,000 cards; 22 catalogues relate to library holdings in various regions; and 23 are devoted to works in large subject groups. The Federal Government's policy of providing free labour has been the chief factor in their growth, and microphotography has become the unchallenged basis for all such work. Besides indicating the location of books, union catalogues are useful in tending to standardize cataloguing procedure. But, as all such catalogues are arranged under authors, they are unable to provide any answers to inquiries for books on particular topics.

An able paper, "Aufgaben der Bibliotheken in Rahmen der Dokumentation", was contributed by Herr C. Walther of Aix-la-Chapelle. The library problem is to collect systematically the literature within its scope as completely as possible and to make it as fully available as possible to its users. For purposes of documentation, a complete collection of the world's output of useful literature, especially periodicals, is most important. The best aid to users that a library can provide is a complete catalogue of its holdings, with exact information of every part received. A detailed subject catalogue is also necessary. For the utilization of the material in the library, bibliographies and abstracting journals must be added. Since many librarians are born bibliographers, libraries can also serve their users by preparing bibliographies on special subjects within their scope.

In a paper entitled "Bibliotheken und Dokumentation", M. S. Dahl of Copenhagen stressed the need of the investigator for efficient documentation, and showed the difficulty of drawing a sharp line between the work of the librarian and the documentalist. In a similar strain, M. Henri Lemaître of Paris referred in his paper on 'La documentation et les bibliothèques", to the address to the International Committee of Libraries at Brussels last year by M. Marcel Godet, president of the International Federation of Associations of Librarians, who had pointed out the close relationship between the work of librarians and documentalists. Librarians are concerned more with intellectual culture, while documentalists are interested more particularly in utilitarian considerations. Theoretically, documentation includes all, and librarianship is only a part; actually, documentation is a young movement, while librarianship is already full grown and can contribute much to the assistance of documentation.

Mr. Lancaster Jones, London, discussed the part libraries can play in the task of technical documentation, showing how an elaborate organization is needed to discover even the existence of a considerable portion of the world's technical literature. By making its collections as complete as possible within its scope and issuing periodical catalogues, classified by subject, of its accessions, a library can perform an invaluable service to documentation. To this can be added a contribution towards a co-operative scheme for the complete subject-indexing of articles in the periodical literature.

The discussion in this Section led to the conclusion that, while the work of librarians is more passive and that of documentalists more active, no sharp line can be drawn between them, and the solution can be found only through the most complete collaboration.

Space does not permit mention of the papers of equal value that were contributed to the other two sections of the Conference, dealing, respectively, with Documentation in Industry and Photographic Reproduction Methods for Documentation Purposes. The whole are published in a volume and supplement entitled "Rapports: Fédération internationale de Documentation, XVième Conférence, Zurich" (10 Swiss francs) and obtainable from the International Federation at Willem Witzenplein 6, The Hague, Netherlands. These should certainly be studied by all librarians and documentalists as well as by all those who are interested in the accessibility of information.

Finally, it must be mentioned that not the least factors in the success of the Conference were the delightful hospitality and kindness shown by its organizers.

RHYTHMIC PROCESSES IN BIOLOGY

THE second conference of the Internationalen Gesellschaft für Biologische Rhythmusforschung was held in the "Stads.-en Academische Ziekenhuis" in Utrecht (Holland) on August 25–26. In spite of the international situation the meeting was very successful, and papers were read by members from Holland, Germany, Sweden, Russia and Britain. The German language was used for the most part, but communications were also made in English and French.

The conference was opened by Dr. E. Forsgren, of Stockholm, the president of the Society. On the first day the papers covered a wide range of subjects. Prof. F. Linke (Frankfort) dealt with the different rhythmic processes measured by the meteorologist and which may be important to the biologist. Prof. R. Stoppel (Hamburg) described her work on leaf-movements in plants in relation to time and other factors. F. H. Stieltjes (The Hague) discussed some interesting examples of rhythmic activity. Prof. van der Pol (Eindhoven) considered the mathematical aspects of certain phenomena, and showed by means of a most ingenious electrical model how it is possible to produce artificially the electrical changes associated with normal and abnormal heart beat. K. Mellanby (Sheffield) described the periodic activity of two insects, the bed-bug and the cockroach, under natural conditions. P. Schoorl (Bennekom) spoke on the curious way in which the rate of increase in weight of pigs fluctuates in an apparently rhythmic manner.

The second day of the conference was devoted mainly to papers dealing with the importance of rhythmic processes in medical physiology and medical practice. Communications were made by Hj. Holmgren (Stockholm), A. Jores (Hamburg), F. Gerritzen (Lunteren), J. Möllerström (Stockholm), Prof. R. Hopman (Cologne), W. Menzel (Tübingen), M. Arborelius (Halmstad), and E. von Philipsborn (Oberstdorf). Lively discussion followed every paper.

It has been arranged that the papers given at the conference will be published in a special supplement to the *Acta Medica Scandinavica*. The future of the Society was discussed at some length. Most of its members are mammalian physiologists or practising physicians, and some zoologists and others were in doubt as to whether their work was of real interest to these medical workers. It was almost unanimously decided that all investigators whose problems dealt with questions of rhythmic activity would be likely to learn a great deal from discussion of each other's work, and it was decided to make an attempt to increase the membership of the Society. It is particularly hoped that more British workers will join; further particulars may be obtained from the secretary, Dr. Hj. Holmgren, Karolinska Institutet, Stockholm.

The local arrangements for the conference were made with great efficiency by Dr. F. Gerritzen of Lunteren, and excursions, dinners, etc., were all greatly enjoyed. Members of all nationalities, including those which are now unhappily at war, were able to discuss their work in a particularly friendly atmosphere.

KENNETH MELLANBY.

PROBLEMS OF GROWTH AND DIFFERENTIATION

AT North Truro, a small village near the extreme end of Cape Cod in Massachusetts, a remarkably successful conference on problems of growth and differentiation was held during August 7–11. Sponsored by the editorial board of *Growth*, members of which also carried out the excellent local arrangements, it brought together about seventy workers from the fields of genetics, embryology, biochemistry, morphology, and botany. Many were accommodated in the wooden cabins of Whitman House, at the edge of a pinewood, not far from excellent sea-beaches, and the delegation from England, at any rate, appreciated to the full the hot weather and the sunshine. The meetings took place in the village school, a building in the attractive wooden New England style, admirably adapted for the purpose. Some informal discussions also took place in the Marine Biological Laboratory of the Lankenau Hospital, about half a mile away.

Each morning and afternoon began with a lecture lasting about an hour, and followed by unhurried discussion and comment. The opening session was devoted to a lively discussion of the proper definitions of growth, differentiation and determination, following a paper on growth and cell-division by Dr. Warren Lewis (Bar Harbor), who illustrated his points by a number of films. In the afternoon Dr. P. W. Gregory (Berkeley) gave an account of the body of work which has shown a relationship between hereditary size in mammals and glutathione content of the tissues, though the connexion does not seem to be so clear in the case of birds. As regards its meaning, an action of sulphydryl groups on synthetically acting proteases seems the most probable hypothesis. The general connexion of $-SH$ and growth or cell-division also came in for discussion.

The second day was given over to the relations between genetics and embryology. In the morning Prof. Curt Stern (Rochester) contributed a masterly description of the present position, dealing with the time of action of genes, dependent and self-differentiation, nuclear induction, etc. He pointed out that dependent differentiation may not always be due to the diffusion of substances; but that in some cases the migration of cells themselves may be involved. Particular interest was aroused by his summary of recent work showing that, in plants also, transplantation experiments reveal nuclear inductors. In the afternoon, Dr. C. H. Waddington (Cambridge, England) took up the story in relation to *Drosophila* development. After making a distinction between form and matter which later gave rise to some argument, he developed the interesting fact that when in a mutant organism, an organ develops in the 'wrong' place, genes which normally act upon such organs can act just as well though the relation of part to whole is abnormal; or in a 'monstrous' part, such as a structure which is proximally a leg and distally an antenna, leg-genes and antenna-genes still exert their characteristic effects. The meeting closed with an animated discussion of the problem whether the 'deployment of competences' of the English school is really the same as the 'segregation of potencies' of the Americans or not.

On the third day, biochemical problems were taken up. Dr. J. Needham (Cambridge, England) described the progress which has been made during the last ten years in our knowledge of the chemical aspects of organizer phenomena. For reasons of time, the discussion was almost entirely confined to the Amphibia. The basic difficulty in these investigations, he said, which had not been at all anticipated at their beginning, is that the competent ventral ectoderm, on which alone the power of a substance to evoke neural differentiation can be tested, itself contains the natural evocator in masked or inactivated form, as can readily be shown by denaturing its proteins in any way and implanting it into another embryo. That adult tissues probably all contain the primary evocator can be shown by the fact that in many cases denaturation of their proteins is not necessary. Recent work on the metabolism of the different regions of the gastrula, which should throw light on the liberation of the primary evocator, was also considered in detail. In the afternoon, the chemical aspects of later growth were described by

Dr. Otto Glaser (Amherst) who introduced the conference to a new method of formulating the growth of organisms and their chemical constituents.

The last full day opened with a highly stimulating paper from Dr. Schotté (Amherst) on regeneration. After briefly reviewing the old question of the origin of the material of the regeneration blastema in invertebrates and vertebrates, he went on to deal with the vexed but important problem of the 'totipotency' of the regeneration blastema in Amphibia. Admitting that limb-competence in the tail-blastema or vice versa has not as yet been definitely proved, he went on to describe his remarkable experiments which indicate that lens-competence, though long absent from the body epidermis, reappears in the material of the tail blastema. It seems also to reappear in regenerating epidermis over the eye. Notochord implanted in tail blastema has also induced pronephric and neural tissue. Should these findings be further confirmed and generally received, a new word will be needed to describe the return of competence after its ontogenetic disappearance. From the floor of the house the word 'recuperation' was suggested, and this seemed to find some favour. In any event, as Ross Harrison has pointed out, there are undeniable instances of reversals of determination, as in tunicates, so the return of competence in vertebrates would not be quite unexpected. The afternoon session on this day was devoted to the studies of Dr. Sinnott (New York) on gene-controlled shape in cucurbitaceous fruits; this led to a vigorous discussion of field-concepts, which had been brewing during former sessions.

On the last morning Dr. Woodger (London) explained the advantages which would accrue to biologists in framing their theories if use was made of logistic technique, of which he gave some examples. He also directed attention to certain points of interest for biological theory which had arisen during the meetings.

On the whole, the meetings were remarkable for the degree of unanimity of thought on fundamental problems which prevailed, as perhaps must be the case when there is enough time to explain individual points of view in a spirit of moderation and candid sincerity. Apart from those who contributed lectures, the discussions were greatly enlivened by the presence of such workers as Dr. Berrill (Montreal), Dr. Hoadley (Harvard), Dr. Thimann (Harvard), Dr. Paul Weiss (Chicago), Dr. Frank Daniel (Berkeley), Dr. Barth (New York), Dr. Reimann and Dr. Hammett (Philadelphia) who showed a film illustrating differentiation and dedifferentiation in Obelia, Dr. L. C. Dunn (New York), Dr. Samuel Brody (Missouri), Dr. Hamburger (St. Louis) and Dr. Frank (New York). At the end of the conference suitable steps were taken to form an organization able to call together similar conferences on growth and differentiation in future years.

TABOO*

THE use of the word 'taboo' in anthropology for customs all over the world, which resemble in essentials the reference adopted from Polynesia, seems undesirable and inconvenient. For such customs the terms 'ritual avoidance' or 'ritual prohibition' are proposed, defining them by reference to two fundamental concepts, 'ritual status' and 'ritual value'. A ritual prohibition is a rule of behaviour which is associated with a belief that an infraction will result in an undesirable change in the ritual status of the person who fails to keep the rule; that is, it involves the likelihood of some minor or major misfortune which will befall the person concerned.

Anything which is the object of a ritual avoidance or taboo may be said to have ritual value. The ritual value is exhibited in the behaviour adopted towards the object or occasion in question—not only in the negative ritual, but also in the positive ritual. A large class of positive rites, those of consecration or sacralization, have for their purpose to endow objects with ritual value.

The word 'value' as thus used always refers to a relation between a subject and an object. It may refer to the act of behaviour towards an object. A social system can be conceived and studied as a system of values. A society cannot exist except on a basis of a certain measure of similarity in the interests of its members. In terms of values the first necessary condition of the existence of a society is that the individual members should agree in some measure on the values that they recognize. To avoid misunderstanding it is necessary to add that a social system also requires that persons should be objects of interest to others.

The study of ritual may be approached by the consideration of the purpose or reasons for the rite, or by a consideration of its meaning. A third method is by consideration of the effects—the direct effect on the person concerned, which may be termed the psychological effect, and the secondary effect on the social structure, the network of social relations binding individuals together in an ordered life—the social effect. By consideration of these we may succeed in defining the psychological function, and in discovering the social function of a rite.

The rites are readily perceived to be symbolic. The immediate psychological effect can to some extent be observed by watching and talking to the performers. The ostensible purpose is present in their minds, but so also is that complex set of cosmological beliefs by reference to which the rite has a meaning. In the performance of the rite the native has made a contribution to the maintenance of the order of the universe, of which man and Nature are the interdependent parts.

Assuming that the act is symbolic, what method, other than that of guessing, is there of arriving at its meaning? We may start with a general working hypothesis that when in a single society the same symbol is used in different contexts, or on different kinds of occasions, there is a common element or meaning, and that by comparing the various uses of the symbol we may be able to discover what the common element is. Thus taking certain customs of avoidance in the Andaman Islands, it would appear that the common element is that the individual affected is in an abnormal ritual status and is likely to suffer some misfortune unless certain prescribed ritual precautions are observed, such as the avoidance of certain foods, while friends or others avoid the use of the individual's personal name. By means of these taboos the occasion acquires a certain social value. But while these rites give men confidence, comfort, and a sense of security, they might equally cause fear, that is, from black magic or spirits. It is largely by the sharing of hopes and fears that human beings are linked together in temporary or permanent associations.

---

* From the Frazer Lecture, 1939, by Prof. A. R. Radcliffe-Brown. Cambridge: At the University Press, 1939. Pp. 48. 2s. 6d. net.)

The symbolic rites of the Andamanese are the obligatory recognition of a standardized symbolic form of the significance and importance of the event to individuals and the community at large. They serve to fix the social value of occasions of this kind. So with the food taboos, they attach a definite social value to food, and it is in the activities connected with the getting and consuming of food, with their daily instances of collaboration and mutual aid, that there continually occur those inter-relations of interests which bind the individual men, women, and children into a society. This may be generalized under the formulation that the primary basis of all ritual, and therefore of all religion and magic, is the attribution of ritual value to objects and occasions which are either themselves objects of important common interests linking together the persons of a community or are symbolically representative of such objects.

ECONOMIC BOTANY IN THE TROPICS

SIR FRANK STOCKDALE, in his interesting address, on "The Application of Economic Botany in the Tropics", which had been prepared for the Dundee meeting of the British Association but was not delivered owing to the cancellation of the meeting, points out that many of the economic crop plants now commonly grown in the tropics were distributed when new lands were discovered in Elizabethan times. Tobacco, for example, from tropical America; sugar cane and the banana from the Old World; cacao from Central and South America, and rubber from Brazil. Coffee is indigenous in tropical Africa, and China and Cochin China appear to be the original home of the citrus group.

Following early haphazard distribution came the introduction of Cinchona to India by Markham and Ledger and of rubber to Ceylon by Wickham, both through the auspices of the Royal Botanic Gardens, Kew.

The introduction of coffee to Ceylon and the outbreak of coffee-leaf disease there resulted in arousing scientific interest in tropical crops. Had Marshall-Ward, who went out to investigate the disease, had available the important research work on the rooting systems and the effect of light on the stomatal mechanism in *Coffea arabica*, which Nutman has recently done at Amani, it is possible the Ceylon coffee industry might have been saved.

The West Indian sugar cane industry was similarly faced with disaster through disease, but, thanks to the work of Harrison and Bovell in raising seedlings from different varieties of *Saccharum officinarum*, new types—'noble canes'—were introduced and disease-resistant strains raised. This work, continued by Barber at Coimbatore, India, has been carried on successfully there under Venkataraman and by the Dutch workers in the Netherlands East Indies. *S. spontaneum* has been used in crossing, as well as other allied species, and valuable canes have resulted, notably the well-known *P.O.J.* 2878 which came from a third 'mobilization' of *S. spontaneum*. Types of cane suitable for different types of soil have also resulted from these cross-breeding researches.

Sir Frank then deals with the cotton crop and the valuable work which has been done in Egypt, the Sudan, India and the United States, etc., which have resulted in marked improvements in yield, lint length and fineness, and strength of lint, while disease resistance has also received much attention with valuable results.

Both Cinchona and rubber have been subjected to careful scientific investigation which has led to the recognition of high- and poor-yielding strains, and the selection of high-yielding 'mother-trees' for budding. Hybridizing work on rubber is now being carried out and a search is being made also for strains resistant to the Oidium mildew which is causing serious damage to rubber in the East.

The work now in progress in Trinidad with cacao is fully dealt with and the important discovery of incompatibility in cacao is referred to. Unfortunately it has now been found that some of the best yielding strains are self-incompatible, which upsets some of the earlier work, though the discovery has enabled the work to be prosecuted on fresh lines.

Sir Frank finally deals with the work that is in progress in the improvement of rice and other crop plants and with the work at Amani on raising strains of Cassava immune to mosaic disease.

He concludes with the following very apposite remarks:

"The breeding of resistant forms is the most effective method by which to overcome the difficulties facing producers, and co-operative work by plant breeders and pathologists is required if a satisfactory solution of the present-day problems is to be found.

"Improved types of crop plants, however, demand higher standards of agriculture and whilst it is to be expected that improvements may be achieved from further collections of wild forms for special breeding work and from the interchange of strains which have already been evolved, sound developments are likely only to be secured by a general advance in methods of husbandry designed to ensure soil conservation and the maintenance of its fertility, and by the adoption of those agricultural systems which are suited to the particular environment. In this field much work still remains to be done and additional teams of research workers with specialized training are required in the approach to the problems which are presented to those who are responsible for the welfare of the Colonial Empire."

SCIENCE NEWS A CENTURY AGO

Steam Navigation to the West Indies

A FURTHER step in the promotion of trans-Atlantic steam navigation was taken on September 26, 1839, when the Government granted a charter to the Royal Mail Steam Packet Company which was formed to connect Great Britain and the West Indies by steam. By a contract made in 1840 with the Admiralty, the Company agreed for the sum of £240,000 per annum "to provide, maintain, and keep seaworthy, and in complete repair and readiness, for the purpose of conveying all Her Majesty's mails, a sufficient number (not less than fourteen) of good, substantial and efficient steam-vessels, of such construction and strength as to be fit and able to carry guns of the largest calibre now used on board of Her Majesty's steam-vessels of war, each of such vessels to be always supplied with first-rate appropriate steam engines of not less than 400 collective horse-power; and also a sufficient number (not less than four) of good, substantial and efficient sailing-vessels, of at least 100 tons burden each".

Climate of Russian Possessions in America

IN a long notice of Von Baer's report on the climate of the Russian possessions in America, the *Athenæum* of September 28, 1839, said: "There is no philosopher of the present day to whom Physical Geography (a branch of knowledge fast rising into vigour) is more indebted than M. Baer. . . . In 1830 the Baron F. von Wrangel, well known for his scientific exploration of the northern coast of Siberia, was appointed governor of the Russian possessions in America. In the course of last year Baron von Wrangel placed at the disposal of the Imperial Academy of Sciences at St. Petersburg, all the papers relating to the north-west coast of America . . . and from these papers the learned academician M. Baer immediately selected the Meteorological Journal for the subject of his comments." The observations were made at New Archangel on the southern Sitka Island (named in some maps Baranov Island) and von Baer made a comparison of the mean temperatures of that place with others in the same latitudes. "As the comparison exhibits in the broadest light that apparently anomalous contrast of climate in which it is the business of the physical geographer to trace the operation of constant laws, we shall here state the problem in the form of an abridged table:

Mean Temperatures

	New Archangel	Middle of the Continent	Nain on coast of Labrador	Bergen in Norway
Lat.	57° 3 N.	57°	57°	60·24°
Long.	135° 13 W.	108°	61·20°	—
Winter	34·7°	−4°	−1·2°	36°
Spring	42·2°	27·2°	21·6°	44·6°
Summer	56·8°	66·2°	45·6°	58·5°
Winter	47·8°	30·7°	36°	47·7°"

Friedrich Mohs (1773–1839)

ON September 29, 1839, Friedrich Mohs, the German mineralogist, died at Agardo, near Bellumo, Italy, at the age of sixty-six. Born at Gernrode in the Hartz Mountains on January 29, 1773, he was educated at Halle and at the Mining Academy at Freiburg, which had been founded in 1765 and of which the famous Abraham Gottlob Werner (1749–1817) was then the inspector and teacher of mining and mineralogy. From Freiburg, Mohs went to Austria to study further and in 1815 became professor of mineralogy at Gratz. In 1817 on the death of Werner he returned to Freiburg as professor of mineralogy, holding the post for nine years, after which he was transferred to the Imperial Academy, Vienna. Mohs was one of the originators of the crystallographic systems. His "Treatise on Mineralogy, or the Natural History of the Mineral Kingdom" was translated into English by William Haidinger and published in Edinburgh in 1825.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

METEOROLOGICAL OFFICER CADETS (Male) in the Department of Industry and Commerce—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (September 28).

ASSISTANT AIRCRAFT INSPECTOR, Grade I, in the Civil Aviation Directorate of the Government of India—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointments 5/1B) (October 14).

HEADMASTER OF HARROW SCHOOL—The Chairman of the Governors of Harrow School, c/o G. F. Finch, Clerk to the Governors, 70 Pall Mall, S.W.1 (October 16).

DIRECTOR OF STUDIES for the Anglo-Yugoslav Institute, Belgrade—The British Council, 3 Hanover Street, W.1 (quoting 'Yugoslavia').

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Battersea Polytechnic. Evening and Afternoon Courses and Classes. Calendar for the Session 1939–1940. Pp. 40. Department of Hygiene and Public Health, Calendar for the Session 1939–1940. Pp. 21. 3d. Domestic Science Department and Training College, Calendar for the Session 1939–1940. Pp. 36. 3d. Technical College for Day Students, Calendar for the Session 1939–1940. Pp. 50. 3d. (London: Battersea Polytechnic.) [318

Tuberculosis in Cyprus (Final Report). By Dr. N. D. Bardswell, (Reprinted from *Tubercle*, December 1938, January 1939, Vol. 20.) Pp. 46. (London: John Bale Medical Publications, Ltd.) [19

Iron and Steel Institute. Special Report No. 27: Ninth Report on the Heterogeneity of Steel Ingots. Pp. ix+84+16 plates. (London: Iron and Steel Institute.) [19

Other Countries

Annual Report of the Auckland Institute and Museum for 1938-39. Pp. 42. (Auckland: Auckland Institute and Museum.) [308

Sudan Government: Agricultural Research Institute. Report of the Government Analyst for the Year 1938. (Chemical Section, Publication No. 83.) Pp. 18. (Khartoum: Agricultural Research Institute.) [308

Tanganyika Territory: Department of Agriculture. Entomological Leaflet No. 17: Entomologist's Report, 1938. Pp. 6. (Dar es Salaam: Government Printer.) 6d. [308

Tanganyika Territory: Department of Lands and Mines, Geological Division. Bulletin No. 13: Explanation of the Geology of Degree Sheet No. 18 (Shinyanga). By Dr. G. J. Williams and N. W. Eades. Pp. 23+2 plates. (Dar es Salaam: Government Printer.) 2s. 6d. [308

Colony and Protectorate of Kenya. Forest Department Annual Report, 1938. Pp. ii+36. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 1s. [308

U.S. Department of Agriculture. Technical Bulletin No. 678: A Chemical Study of some Soils derived from Limestone. By Lyle T. Alexander, Horace G. Byers and Glen Edgington. Pp. 28. (Washington, D.C.: Government Printing Office.) 5 cents. [318

Smithsonian Institution: Bureau of American Ethnology. Bulletin 101: War Ceremony and Peace Ceremony of the Osage Indians. By Francis La Flesche. Pp. vii+280+13 plates. (Washington, D.C.: Government Printing Office.) 35 cents. [318

Prospectus of the Imperial College of Tropical Agriculture. Pp. 35+2 plates. (Trinidad and London: Imperial College of Tropical Agriculture.) [19

Canada: Department of Mines and Resources. Report of Mines and Geology Branch for the Fiscal Year ended March 31, 1938. Pp. ii+11–60. Mines and Geology Branch, Bureau of Geology and Topography. Geological Survey Memoir 213: Geology and Mineral Deposits of Bridge River Mining Camp, British Columbia. By C. E. Cairnes. (No. 2443.) Pp. ii+140+6 plates. 50 cents. National Museum of Canada. Bulletin 93 (Anthropological Series No. 24): Assomption Sash. By Marius Barbeau. Pp. ii+51 (18 plates). 25 cents. (Ottawa: King's Printer.) [19

Editorial & Publishing Offices
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

Telegraphic Address:
Phusis, Lesquare, London

Telephone Number:
Whitehall 8831

Vol. 144 SATURDAY, SEPTEMBER 30, 1939 No. 3648

SCIENCE AND SOCIAL PIONEERING

THE first British and American Association Lecture was to have been delivered at Dundee on September 5 by Dr. Isaiah Bowman, who had chosen the title "Science and Social Pioneering" for his lecture. Circumstances prevented its delivery, but it is available in printed form, and it provides a thoughtful analysis of views on the contribution of science to social welfare and to that process of continuously planned advance across the threshold of experience which may well be called social pioneering.

The opinions as to the extent to which science has added to man's cultural possibilities, given him a better way of thinking through his difficulties, or raised his hopes for a more ethical civilization, which Dr. Bowman has collected from American sources outside the ranks of science, are largely to be met in Great Britain and in France also, both within and without the ranks of scientific workers. Science, it is at last being realized, is a part of human life, not something separate and distinct As human experience, it is not universal, a summation of knowledge applicable and useful to the whole of life; it is rather a thing of limited categories, a special form of human interests.

To most men of science, science is only a specialized form of experience, but the study of the background of social life against which science has developed raises problems foreign to this outlook. Any serious attempt to probe back to the social origins and social consequences of scientific discovery demands that scientific workers shall at least make an effort to guard against the dangers of their own specialization. To be fully scientific, they must be aware not only of their own point of advance but also of the advancing front of science.

We should not indeed despise specialization, and Dr. Bowman points out that specialization has increased the satisfaction of many of our fundamental material needs. If the spiritual gains at the moment seem in deplorable contrast to the material benefits, it should be remembered that one of the greatest achievements of science is its emphasis upon free inquiry—the mind itself in command, driven by curiosity and the sense of adventure. Civilization itself can well be considered an adventure in change, and science has become one of the greatest adventures of our time, partly because it deals with the edge of the possibilities. Man is changing his own possibilities as well as those of his world as he goes along. He is at the centre of his own creative experiment. What science supplies is not at all an addition, positive and beneficial, until men have proved it so, and with the addition of things and forces, social and natural, good and bad, ever new possibilities are emerging.

This insistence on the spirit of adventure is indeed one of the keynotes of Dr. Bowman's address. The new frontiers opened up by science in old communities make demands on the spirit of man not less than those made in the pioneering days in a new continent. The play of forces involved in the far-reaching movements and cultural changes of a scientific age, whether self-initiated and free or guided by government, represents a development of high interest in the social field. Vital leadership, courage and local pride as well as equipment and the experimental point of view are required.

Moreover, we have to remember that what we gather of scientific knowledge concerning society and how it might be improved form one set of data; to persuade or to exercise control to bring about desired ends is quite another. Society is built upon beliefs, traditions, prejudices, suppositions and philosophies as well as facts, institutions, inventions and material—all supported by power or force exercised through time. Every advance in applied science calls for a tighter and more inclusive social organization, and while in democratic countries the adoption or rejection of ideas may be freely debated or contested, it is premature to suppose that even democracy ensures continued freedom.

What Dr. Bowman terms social pioneering is concerned with culture in the making, with environment that becomes understood through thinking about the conditions of trial and the effects of error. It deals with new social forms or old forms adapted to new situations, and becomes ever more complex and overpowering for the individual. Such conditions naturally make planning more uncertain, because of unpredictable turns and their effects, unforeseen impacts or disturbances; and the risks in social planning are accentuated if attempts are made to accelerate it, as in an emergency, without due regard for the time-factor.

None the less, the first duty of an intelligent society in this age is to seek out the causes of things. The scientific method is nowhere needed so much as in the sorting-out of causes and the recognition of the action of the forces supposed to be at the root of our troubles; the first step, however, must be the scientific study of the field of science itself and the conscious planning of policy and research with regard to the social needs of the period and the social functions of science. We cannot be sure that more scientific knowledge will resolve the conflicts between classes, reduce the arrogance of nationalism and diminish the chances of war, but we can at least hope that it will assist in providing a more even-tempered attitude and greater readiness to accept findings even when they involve the disturbance of sectional interests.

Social forms, as Dr. Bowman reminds us, cannot keep pace with creative thought. A time lag is inevitable, because we have found no way to teach and test ideas except through time-consuming and often inconclusive experience, and no one branch of study can solve the whole array of problems of a people. Much more could be done, however, by combined effort on the lines of the team-work which in industrial problems, for example, has yielded brilliant results through the efforts of workers in different branches of physical science concentrated on a single objective. The realization by an increasing number of scientific workers to-day that social action is imperative if freedom of thought and investigation are to be preserved for science itself already provides a stimulus This consciousness is gradually overcoming the reluctance of those who fear the introduction from politics of bias or prejudice, for the pace at which events move demonstrates that even inaction has political consequences.

The formation of the new Division for the Social and International Relations of Science is one of the most significant recent expressions of this urge to advance science beyond the mere study of Nature at the level of inanimate Nature to the level of men in their group activity. Dr. Bowman's address attempts no positive and final answers as to the solutions of many of the problems thus opened up before us, but his presentation of man's endless adventure in progress reminds us that science is our greatest inspirer of hope. Even in these sombre days of anxiety, it holds out the rational hope that the triumphant methods that have given us deeper understanding and increased efficiency as biological and social mechanisms, will one day give us a still deeper insight into the nature of man and what he may become under rational control.

What gives special pertinence to Dr. Bowman's insistence on this element of pioneering and invention is the change in the nature or emphasis of scientific method. Just when concern with the impact of science on society and with the effect of society on science itself is growing within the ranks of science, scientific workers are coming to realize that there are limits to the extent to which the scientific method of isolation in experiment can be even approximately used. The widening front of science synchronizes, as Prof. H. Levy has pointed out, with the necessity for a drastic change in scientific method itself. It is not merely in social science that the experimenter must become an integral part of the process itself.

The wider view of scientific method, which recognizes the limits within which even a statistical validity can be given to simple repetition, and admits that every scientific experiment is a piece of scientific history and therefore a piece of social history, compels us also to recognize the inter-relation of all phenomena and to see the role taken by each element in relation to every other. In scientific work, failure to appreciate fully dialectical change may have comparatively slight consequences; the social repercussions of failure to appreciate the dialectical changes produced by and on science in its interaction with society may be almost catastrophic.

Because we do not in general take a scientific view of the processes of change that are manifested in society, and because men of science themselves fail to see that the scientific method requires qualitative transformation before it can be applied to the active handling of those issues, we tend to become mere passive onlookers in a course of events which it should be the first scientific duty of all men to control as they ultimately would control any laboratory process.

The address prepared by Dr. Bowman appeals to the characteristic scientific spirit, which cannot rest with unexplored fields before it. The realm of social action itself is the new laboratory, and the steps towards the control of social processes—the taking of political action and the making of social history—are, first an understanding of the interplay of cause and effect in the sense of the new statistical and dialectical method, and then a decision on the new processes which are to be brought into play to transform the situation qualitatively. In this new and wider field, science will yet forge new and appropriate techniques and wield them as effectively as in the physical domain itself.

FISH MOVEMENTS AND FISHPASSES

La mécanique du poisson de rivière
Qualités nautiques du poisson; ses méthodes locomotrices, ses capacités; ses limites; résistances du fluide; effet de la vitesse, de la pente; résistance de seuil. Par G. Denil. Pp. 395. (Bruxelles: Goemaere, Imprimeure du Roi, 1938.) n.p.

SOME thirty-two years ago, G. Denil, at that time chief engineer of Belgian Public Works, stood by a new weir, 3·5 m. in height, and lacking a fishpass of any kind whatever. As he watched the tail water of the dam, he was struck by the frantic and necessarily unsuccessful efforts of many salmon to surpass this obstacle by leaps, and also their wholesale destruction following exhaustion, by their overcrowding in a restricted channel, and at the hands of fishermen who had no difficulty in capturing their helpless prey.

On thinking over the complex problems which were involved, Denil resolved to seek a full understanding of the conditions necessary for the protection of migratory fishes, and to construct fishpasses so economically that they might become integral parts of all weirs which interrupt the upstream passage of the migrants. So early as 1909 he was able to describe in a long and exhaustive paper his first new successful fishpass, based on the principle that the obstacles involved are oblique to the main waterflow and are spaced so closely that, instead of creating alternate pools and waterjets, they derive secondary streams from the main flow, so that the abrupt re-entrance of these streams causes an energy dissipation of considerable intensity.

Subsequent to the publication mentioned above Denil constructed and controlled a number of fishpasses of exactly the same type and proceeded to improve his system, keeping always in mind the combination of theoretical considerations and of laboratory experiments with observations of the successful control of the passes already in operation. Until 1936 he published very little on the subject of his work. In that year he began a long series of articles published in the *Annales des Travaux Publiques de Belgique*. These articles are brought together in the present book, the title of which, though long, still gives an inadequate indication of the contents.

The first chapter relates to structural features of salmon-like and elongated white fish. The second contains an analysis, depending to a large extent on the basic work of Breder, of their various types of locomotion; swimming against the stream; jumping; and driving with the stream being particularly considered. In the third chapter, the eel and its locomotion are discussed, comparisons being made with matters already considered and also with the sea lampreys. In the fourth chapter, the author describes his own experiments on the velocity-resistance of fish-like bodies. In his fifth chapter, he reports on his own measurements and on those of Kreitman and others regarding the greatest *relative* velocity of fish swimming against a stream, that is, on the 'limit of swimming velocity'. He adds, however, that to attribute *direct* and decisive importance to this limit, is to accept by implication the hypothesis—never previously stated explicitly, but certainly not questioned either—that the swimming ability is adequately defined by the relative velocity V, or, that the longitudinal component of the weight G of a fish is, in so far as its locomotive effort is concerned, neutralized by the corresponding component of its buoyancy. The three succeeding chapters are devoted to the difficult task of disproving this hypothesis and to proving that the actual locomotory effort or force F_1 is equal to the velocity-resistance plus the resistance directly due to the slope, and

$$F_1 = Z\,\frac{V^2 F}{2g} + G \sin\alpha, \text{ where } \alpha \text{ is angle of slope.}$$

It would lead far afield to review in detail the author's experimental and theoretical arguments in support of his surprising thesis. Suffice it to state that his evidence, though challengeable on several points, appears on the whole to be fairly convincing. In any event, even the most doubting critic would have to admit that the thesis deserves thorough and systematic study*. Until this has been done, the thesis as a whole must be accepted as a 'working hypothesis' in the practical tasks of fishpass design and in preference to the older one. These three chapters offer particularly stimulating reading, because a number of very different problems of hydraulics and geophysics relating to a steep water surface are employed in analogy.

In the ninth chapter the author turns from discussing a fish as a 'body' in the purely mechanical sense of the word to considering a fish as a living creature. He analyses questions both of the biology and the psychology of fish migration, showing that different species have marked differences in the conditions and 'motives' for their migratory efforts. This chapter will be of much interest to ichthyologists. Some of the views which it expresses may also lead to useful discussions.

Following these preparatory chapters, the author tackles the main problem around which his work is centred, namely, the quantitative study of the mechanical force or locomotory effort, F_1, of which a fish is capable when swimming continuously for a period of about one minute. It is obvious that if one knows the total resistance which a fish encounters in some particular steep channel, and that if one notes which fish pass the channel without difficulty, which pass after a struggle, and which entirely fail to pass, the full data required for the determination of the limiting value of F_1 are known. This is exactly what Denil does in Chapters x and xi. In addition, he makes some less exact but still fairly reliable inquiries into the limiting force F_2 which a fish is able to develop over a very short distance (for example, in jumping, or in facing a local pitch-velocity). The result of these inquiries is to show that the limiting value of F_1 varies between 0·5 G and 0·7 G; that of F_2 varies between G and 1·4 G. These latter results may be compared with those of Houssey; and although the agreement proves to be very rough, it is nevertheless remarkable, not only in view of the difficulty of the question and the complete independence of their work, but also by reason of the fundamental difference in the mode of approach of these two investigators.

These two chapters are probably the most important in the book because the author, having inquired into the limiting force F_1 for fishpasses constructed by himself according to his old but now improved principle of energy-dissipation, now gives a short account of these newer designs. Their distinctive feature, as compared with his earlier models, is that both the normal cross-section of the channel and the 'obstacles' are so shaped that the pressure losses of the secondary streams, both at their beginnings and along the secondary channels, are reduced as much as possible so that *vigorous* secondary streams, at their re-entrance, dissipate the energy of the main stream. It is regrettable that only summary information is given by the author on his theoretical ideas and on the very extensive experimental studies on which his designs are now based. In these chapters also the question of arranging the downstream end of a pass is touched upon, and an original contribution is made towards the solution of this difficult matter

Chapter xii discusses the reduction of slope necessary if the single 'flight' of a steep fishpass between two resting pools is of greater length than that which may normally correspond to a one minute passage.

Chapters xiii and xiv are concerned with the difficult task of offering a rational theory for the choice of dimensions for the ordinary pool-and-jet fishpasses in accordance with the rules laid down in Chapters x–xii for Denil and similar fishpasses. The basis of this theory, which is the computation of the resistance encountered by a fish when it passes through an orifice, is fundamentally at variance with the usual assumptions, the variance being analogous to that concerning fish resistance in steep channels

The penultimate chapter contains original suggestions for the design of fishpasses. On one hand, an improved form is proposed for the pool-submerged orifice pass, in which the orifice is replaced by a converging tube. Here the author makes one of his interesting excursions into another field of hydraulic engineering, and gives his ideas on some of the important aspects of the problem of turbulence. On the other hand, he indicates how the Denil principle of energy-dissipation may be adapted to the needs of open channels of very variable depth as well as to closed conduits of rectangular cross-section, and as to how the ordinary Denil channels may be combined with these special conduits in the construction of fishpasses with marked headwater fluctuations. Most of the original and clearly well considered suggestions given in this rather long chapter have not yet been put to the practical test; some of them have not yet been studied under laboratory conditions.

---

* A preliminary experimental contribution to this detailed study by the reviewer and Dr. C. M. White, of the Imperial College of Science, has led to results decidedly in favour of Denil's formula. A joint publication is being prepared for the *Journal of the Institution of Civil Engineers, London.*

The final chapter deals with the unscientific use, or rather abuse, of the Denil principle of energy-dissipation and with the total failures which naturally result from this cause.

To sum up the contents of this book, the author contributes to the following distinct, though overlapping fields of work: (1) fish biology (mainly mechanics, physiology and psychology of fish migration); (2) practical fish protection (mainly fishpass design); (3) hydraulic engineering in general; (4) fluid mechanics.

I consider Denil's contributions of the greatest importance to fishpass design and to hydraulic engineering in general, and this mainly because of the great value of the Denil principle of energy-dissipation for the economy of fishpasses and probably of some other hydraulic structures such as timber-floating channels, spillways, ship canals and perhaps surge tanks as well. Because of the value—partly actual, partly potential—of the author's fishpass designs, it is regrettable that many of his illustrations regarding these designs are difficult to understand. A few are quite unintelligible or are ambiguous. It is to be hoped that an English translation, which will be awaited anxiously by investigators in widely different fields, will not only be devoid of this minor and disconcerting fault, but will also provide more of the wealth of material from laboratory experiments and velocity measurements for actual fishpasses which Denil has made during his exceptionally thorough investigations.

Even so, the present book, valuable as it is for the number of well-supported experimental results it contains, will be still more valuable for its suggestions of problems to be followed by independent investigators in different fields of work. In particular, research in the field of fluid mechanics will have to concern itself with two important problems raised in Denil's book. These are the deeper physical cause of the extremely efficient energy dissipation given by the Denil system, and the resistance problem of swimming bodies in channels of very varied type.

PAUL NEMENYI.

THE CULTURAL HISTORY OF MANKIND

A History of World Civilization
By Prof. James Edgar-Swain. Pp. xix+615. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 15s.

IN six hundred and fifteen pages the author of this book surveys the whole cultural history of mankind, tracing the development of politics, art, religion, science, literature, economics and social life through the ages. Broadly speaking, his classification of topics under periods is—prehistoric and early empires, classical civilization, taking in, in addition to Greece and Rome, early India, China and Central and South America, the Middle Ages, the development of national cultures, and subsequent history down to the close of the War of 1914-18 and "Beginning of an International Culture". In the survey of each section the story of the course of events under each topic is followed by an evaluation of the contribution of the period or people under review to progress.

It is very doubtful whether a survey of this ambitious scope, even of the most elementary character, can be undertaken at the present time by any but a syndicate of experts. Prof. Swain is not unconscious of the difficulty; but his equipment for the task he has so boldly undertaken is open to question. Much of his work reads like notes for lectures to students, who may be expected or required to supplement them by more extended study. For the reading public the treatment is too factual and, notwithstanding the evaluating summaries, too little concerned with the broader aspects of trends and movements in development. This, however, is a matter of method and treatment on which opinion may differ; but in other respects, the book shows serious defects. Apart from errors of fact, which are too numerous, statements are made which, when not categorically erroneous, are gravely misleading.

These defects are especially apparent in the early sections of the book, which deal with prehistory and protohistory down to the close of the 'classical' section. The table of prehistoric civilizations is ludicrously inadequate, as well as inaccurate, omitting mesolithic entirely; while owing to the treatment of protohistoric civilizations—"ancient empires"—in water-tight compartments on a topographical basis, the whole implication of modern research is missed.

The author would appear here to have used sources which either are out of date and now need supplement and correction, or to have no first-hand acquaintance with the material. He is twelve or fourteen years behind current knowledge. The important archæological discoveries of the prehistoric civilizations of India and China, and the later work in Sumeria of Sir Leonard Woolley (whose name is misspelled), with their influence on outlook and study of the development of the respective cultures are ignored. In another field the same neglect of recent development is shown when in the account of the British constitution the term 'colonies' is still used, and the constitutional relations of Britain and other constituent members of the British Commonwealth of Nations are described in terms which ceased to be applicable after the passing of the Statute of Westminster.

Prof. Swain does not seem invariably to be too well acquainted with the authorities he cites. He refers to the single volume edition of "The Golden Bough" as entitled "Leaves from the Golden Bough" and as "selected by Mrs. Frazer".

THEORIES OF HEARING

Hearing

Its Psychology and Physiology. By Dr. Stanley Smith Stevens and Dr. Hallowell Davis. Pp. xv+489. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 22*s*. 6*d*. net.

IN spite of all the work which has been done on the ear, it is common knowledge that we still do not know precisely how the ear works. When Weaver and Bray first announced their discovery of the electrical potentials produced by the ear, it looked as if the resonance theory of Helmholtz would have to be finally abandoned. It was found, however, that an incorrect interpretation had been placed on these researches, so that to-day there are probably more believers in the resonance theory than ever before.

It is particularly interesting, therefore, to read this book by Stevens and Davis, since they do not believe in the resonance theory, but in a travelling bulge theory. Now there is nothing particularly new in travelling bulge theories, for they have been proposed from time to time by several experimenters. The evidence put forward by Stevens and Davis is the work of Békésy, who made large-scale physical models, measured the velocity of transmission of the bulge in them, and applied the data thus obtained to the human ear. He also did experiments in which a click and a steady tone are presented simultaneously to the ear.

Now, so far as evidence of models is concerned, a large number have been made. Some of them demonstrated strictly localized vibrations, such as one would expect to find according to the resonance theory of hearing; others, such as those made by Ewald, showed the development of a number of affected regions for single pure tones, thus suggesting the sound pattern theory. Békésy's models, on the other hand, demonstrated a travelling bulge. It seems to me that until we know more about the physical properties of the cochlea, and the physical properties of these models, we are really not justified in drawing any conclusion from them at all, except that the makers of the models are extremely ingenious. With regard to the evidence provided by the click and steady tone presented simultaneously, the experiments should be repeated and varied in different ways before they can be held to refute categorically any theory.

With regard to the book itself, much may be said in its favour. It states in a precise but easily understood way a large number of the facts which are at present known concerning the ear. Specially good are Chapters vii and viii on combination tones, masking, etc. Practically all the figures are well illustrated, the only unsatisfactory ones being such photomicrographs as Figs. 113, 132 and 134. Fig. 113 is particularly misleading. It shows Reissner's membrane very bent, the tectorial membrane displaced upwards away from the hair cells, and the basilar membrane seriously kinked with distorted arches of Corti attached to it. Now that histological technique can produce sections of the cochlea which show none of these defects, one of these sections should be used as a basis for this illustration in future editions of this book. This is a matter of detail only. The book as a whole is excellent and is strongly recommended to all those whose interests lie in the border line between physiology and physics.

H. HARTRIDGE

INTERPRETATION OF PLANT STRUCTURE*

BY PROF. D. THODAY
UNIVERSITY COLLEGE, BANGOR

STRUCTURE AND FUNCTION

UNDER the influence of Darwin's concept of 'survival of the fittest', a tendency to assume all structural features to be adaptive was strengthened. It is, of course, essential that the structure of plant organs should enable them to carry out their functions adequately; but perfect adaptation of tissues to their functions would be difficult to define.

The study of xerophytes provides an instructive example.

Before the physiological adaptation of plants to their environments can be properly assessed, we need far more exact knowledge regarding the quantitative relations of their different functions to the environmental factors, and regarding the balancing of those functions.

The question to be answered is not how an organ is adapted to its function, but rather *how its form and structure affect its functioning*.

Quantitative investigation of the effects of minute structural features is often beset with great difficulty. We have not even yet reached finality in the solution of problems presented by stomatal diffusion, as affected by wind and other external conditions and by the size and proximity of the stomatal pores, although much intensive work has advanced our knowledge considerably; nor do we know just how much effect to attribute to the sinking or raising of stomata, or other special devices.

While the exact laws of the diffusion of gases through stomata are difficult to establish, it might be thought that the *distribution* of stomata at least would lend itself readily to adaptational interpretation. Actually, the facts point very largely in the reverse direction. Salisbury's statistical studies in particular have shown that, on the whole, plants in more exposed places have a higher stomatal frequency, and that for a given species the proportion of stomata to epidermal cells is more constant over a range of moisture conditions than stomatal frequency, variations in which are to be interpreted largely as the consequence of different degrees of expansion subsequent to the initiation of the stomata.

This turns the attention away from adaptation to the process of development. Salisbury's results indicate that stomatal frequency is determined by factors at work in two phases of leaf development. The first is the formative phase in which the position and number of stomata are determined in relation to the epidermal cells, mainly by internal influences depending on the hereditary make-up of the plant. The second is the expansion phase, in which the degree of separation of the stomata, already initiated, is determined.

Goebel has shown how problems of development may be attacked inductively in his "Gesetzmässigkeiten im Blattaufbau". The general result of his studies of leaf development was to bring out the repetitive nature of the patterns that are laid down, the units of a pattern showing, at the time of initiation, remarkable constancy of scale. Thus at the growing edge of a fern frond bifurcation of the veins keeps their spacing within certain limits, just as the size of cells in meristems tends to remain more or less constant owing to division when an upper limit is reached. The uniformity of size of the meshes in a net-veined leaf is a similar phenomenon which has been studied by Schuster. Stomata and also root-hair initial-cells show an approximation to uniformity of spacing at their initiation, however much the fact may afterwards be obscured by expansion of cells between the initials, or inhibition of their further development. Küster has emphasized the correlational aspect of such regularities, as depending upon mutual relations between the different tissues or structural elements that make up the pattern.

Another example of a quantitative approach to problems of adaptation is afforded by attempts to correlate the dimensions of parts served and tissues serving them. It is obvious that as the foliage of a tree increases in extent the amount of conducting tissue in the stem increases too; and that from the small twig through branches to the main trunk the amount increases parallel with the increasing number of leaves to be supplied. Jaccard directed attention to the quantitative aspect of this relation; and his pupil Rübel examined it in greater detail for the herbaceous plant, *Helianthus annuus*. Salisbury had already correlated the vascular structure of petioles with the dimensions of the leaf blades, with special reference to the xylem and transpiration.

The correlations displayed were not exact and showed considerable variations. Yet they are remarkable enough, and specially worthy of note when we begin to inquire how such correlations come about. An interaction between one part and another is implied. This aspect has been investigated both experimentally and by anatomical analysis.

---

* From the presidential address to Section K (Botany) of the British Association, delivered at Dundee on September 1.

Jost's classical experiments on Phaseolus seedlings (1893) showed that severance of leaf-trace bundles in the middle of an internode interrupted their development below the point of severance, but not above it, although neither part could function normally.

In herbaceous plants, cambial activity at any given level often exhibits local variations which are related to active development of different leaves above. In the sunflower this is conspicuously shown.

That the developing organs actually influence the growth of the stem below them, to considerable distances, is a natural inference.

Strong support for the reality of such influences has been forthcoming from one of the most spectacular advances in knowledge in recent years—the discovery of chemical agents controlling growth, which was an outcome of investigations on the curvature of shoots in response to light. The growth-promoting substances, called auxins, are highly active. One fifty-millionth of a milligram produces a measurable effect on the oat coleoptile. They are produced especially by actively growing parts of shoots—sprouting buds, shoot-tips and young expanding leaves. They not only influence growth in length, but also produce other effects which are of greater interest in the present connexion.

It has been shown experimentally by Snow and confirmed by others that auxin stimulates cambial activity. Söding has actually detected auxin in the cambium of trees in spring and summer. He states that it appears there a little in advance of the resumption of cambial activity in the spring. Since it is produced by developing buds and young leaves and travels downwards, the downward spread of cambial activity from the base of the awakening buds in spring is thus accounted for in terms of an effect of auxin which is experimentally demonstrable. The basipetal conduction combined with tangential localization exhibited in this instance gives strong support to the interpretation, already suggested, of the localized cambial activity in the intact sunflower stem, as indicating a causal influence proceeding downwards from the actively growing leaves.

Evidence has also been adduced of stimulating agents of a chemical nature liberated from wounded tissues.

The demonstration that such hormones exist and are effective in influencing plant development is of far-reaching significance. It is a challenge to students of plant structure to view their data dynamically. The statement that one part of a plant influences another is no longer to be understood merely as a convenient way of expressing a correlation, in a figurative sense, but is a legitimate hypothesis in a causal sense.

THE PHYLETIC OUTLOOK

The evolution theory gave a new meaning to natural relationships, as revealed by the systematist, and a new aim to the systematist himself. Previously a natural system was conceived as a system of classification depending on the balance of similarities, estimated from a consideration of all the characters of the species, as compared with an artificial system depending on particular characters selected for their convenience. The ancestry of species now became, in theory, the main basis for a natural classification.

It was soon realized that, as similarities in some features are often accompanied by dissimilarities in others, similarity might not always signify relationship. Fossils themselves, moreover, provided clear evidence that similar organs or structures have been evolved independently along different lines, by different phyla, so that the possession of seeds, for example, is not evidence of common ancestry for all seed-bearing plants.

Modern genetics reveals, as the most prolific cause of variation, irregularities in the process of nuclear division and the behaviour of the chromosomes, and changes in the substance or structure of the chromosomes, which appear to be entirely erratic and haphazard.

If, however, we turn from the minor variations which differentiate species and horticultural varieties and survey the major events that have marked the evolution of plants, it is difficult to regard these as haphazard. Besides seeds, already mentioned, a number of features are found with even wider distribution, common to groups which cannot be traced to a common origin. Such are the alternation of sexual and asexual generations; archegonia; the formation of spores in tetrads, following a reduction division; air-space systems and stomata; vascular tissues; then fertilization, evolved also in the animal kingdom, and the cell as the unit of construction; the nucleus with its chromosomes and their highly organized behaviour in division. The enumeration need not come to an end on the plane of cellular, structural organization, for chemical parallels are quite as remarkable. Consider, for example, the similar enzymes and enzyme complexes responsible for carbohydrate metabolism in yeast, in the higher plant and in animal muscle; the hæmins found in plant and animal cells alike, and the related substances, chlorophyll in the green plant and hæmoglobin in animal blood, with uniquely important functions. Finally, there are the proteins and other important basal constituents of living matter.

The idea was suggested by F. F. Blackman in 1921, in reference to Nef's work on the interchangeability of carbohydrates, that the biologically important carbohydrates are just those which are chemically most likely to arise—most readily formed, most stable, etc. May we not extend this idea to explain the universality of particular chemical compounds or radicals—like the amino-acids, limited in number, found in protoplasm ?

The conditions for an epoch-making event like the arrival of chlorophyll were provided by the previous course of chemical evolution, in common characters of living matter, and by particular variants of them under particular conditions, which may have occurred but rarely in combination, but are scarcely to be envisaged as unique.

If it is legitimate to regard chemical events in this way, as occurring with a frequency concordant with their inherent probability, may we not carry this idea on to the higher plane of cellular organization and structure ? To do so is to direct attention to the nature of that stability and developmental harmony which are so conspicuous a feature of living organisms ; for persistence and occurrence become more and more determined and limited by the pre-existing system through which evolution works. Natural selection of harmonious changes may have been more important than elimination of functionally unfit mature organisms. It is developmental harmony which is important, of which functional efficiency of adult organs is but a part.

We are thus once again led to the consideration of development. If we can obtain light on the laws of harmonious development, we may be in a better position to understand the nature of those major changes which the great pageant of evolution unfolds.

SEEDLING STRUCTURE

As an example of the application of causal principles to old problems, I propose to consider the structure of seedlings.

The broad survey achieved by British workers revealed large differences within closely related groups, which made it more difficult to interpret resemblances as of phylogenetic significance. A high degree of correlation was observed, on one hand, between slender smallness of seedlings and diarch root structure, with two xylem poles extending right up the hypocotyl ; and, on other hand, between large diameter and tetrach or polyarch structure, with stem-like pattern in the hypocotyl. Both Compton and T. G. Hill and de Fraine emphasized seed size as an important factor influencing seedling structure.

Another factor of a similar kind was the influence of the plumule, the traces from which, when precociously developed, shared with the cotyledon traces in the early structure of the hypocotyl. In certain cases, particularly among the Amentiferæ, the traces from the plumular leaves were found to be triads like those from the cotyledons (Davey, 1916), and these with their central xylem strand extend above the cotyledonary node into the epicotylar stem itself. Phylogenists were inclined to interpret this as a more extensive persistence of primitive structure in a relatively primitive group. But the occurrence of a root-like solid core of xylem in the epicotyl of the Viciеæ, an advanced group among the Leguminosæ, scarcely harmonizes with phyletic ideas, as Compton pointed out, and makes phylogenetic interpretations appear less certain.

Bugnon tried to approach the facts objectively, without phyletic aim or preconceptions, from the developmental point of view. As has been recognized since the work of Sanio, the differentiation of the leaf-trace bundles progresses basipetally from the node. Bugnon observed that in *Mercurialis annua*, as in many other plants, they normally fork into two, so avoiding incoming bundles immediately below, before uniting with other bundles lower down. The cotyledon traces likewise fork, though they do this sooner and in relation to the vascular system of the root.

Turning to the radicle, Bugnon notes that the root structure is quite typical. All other roots, however, arise from organs already differentiated. They form their own characteristic pattern of vascular arrangement, and this is linked by commissural elements to the appropriate tissues already present in the parent organ. In the case of the radicle, an exactly similar root apparatus has to be linked up, not with tissues fully differentiated, but with tissues still in a meristematic condition. The connecting tissues are therefore similar to ordinary conducting strands, not special commissural elements.

Bugnon did not, so far as I am aware, attempt to extend the same principles of interpretation to the wider range of facts which have been brought to light, and it appears worth while to see how far this can be done.

In the first place, from a causal point of view, certain principles may be regarded as established. The first is the power of self-determination inherent in growing organs and especially in apical growing points—each developing a characteristic pattern of external form and internal structure. The second is the influence of apical developing organs on the structure of other parts still capable of growth—this applying particularly in the basipetal direction and therefore mainly to the influence of the shoot apex and young leaves on the parts below them.

With regard to the root, a spectacular demonstration of its power of self-determination has been provided by Philip R. White who, following on the pioneer work of Robbins and Maneval, succeeded in 1934 in proving that root-tips cut from the plant can be grown continuously for years in a nutrient solution containing the essential salts, sugar, and a small concentration of an extract of yeast.

In the large adventitious roots of many Monocotyledons, it is particularly evident that no relation exists between the pattern laid down in the root primordium and that already present in the stem to which it has to be connected. The repetitive nature of the pattern and its inherent stability also become more obvious. The alternation of exarch xylem strands with phloem strands, in a ribbon with definite radial polarity, expresses a harmonious balance of influences and developmental processes. The fundamental uniformity of the root pattern throughout the great majority of vascular plants is further evidence of this inherent stability.

To turn to the shoot: it will probably be admitted that the shoot apex is a self-determining and dominant centre of development. It controls the polarity of the shoot, and round it the repetitive pattern of leaf primordia unfolds. The apical bud as a whole controls also primary development and secondary growth in the stem below. There is much in the system of relations exhibited which is reminiscent of the part played by organizers in the development of animal embryos.

In the determination of primary structure in the stem the leaf primordia play a predominant part. The number of vascular strands in the leaf base depends partly on hereditary factors, but partly on size. This is particularly clear in Monocotyledons, where the bundles arise in succession, separated by parenchyma, as the new leaf primordium extends round the apex.

Now, in seedlings the conditions are unique. At two ends of a short meristematic axis are two self-determining centres of different kinds in close proximity, two opposite poles, a shoot pole and a root pole, each of which is capable of impressing its own inherent pattern on the meristematic tissues to which it gives rise. Under these conditions we cannot assume that the spheres of influence of each will be sharply defined, or that they will necessarily be fixed. If the influence of the poles depends on hormones emanating from them, the boundary might well change with changes in relative vigour of the two organizing centres, and differ also from one species to another.

It appears reasonable, therefore, as a working hypothesis to interpret the structure of seedlings in the following way:

(1) The cotyledons and, if the plumule is precocious, the plumular primordia, influence the number of procambial strands in the hypocotyl and its diameter growth at an early formative stage. The form of the cotyledons plays a part. Nutritive and other factors afterwards affect the expansion of the hypocotyl and the degree of separation of the bundles by parenchyma.

(2) Differentiation within the strands of procambium is controlled initially by the root apex in the majority of cases, but to a variable distance upwards. The triad represents the smallest unit of the root pattern, existing as a detached arc, whether in the hypocotyl or a dorsiventral cotyledon.

(3) In the upper part of the seedling, sometimes only in the blade of the cotyledon, sometimes also in the petiole, or even lower, the shoot itself holds sway, and in place of a triad is found a single bundle. The intervening region is one of compromise and accommodation between the two patterns.

(4) With increasing activity of the shoot, further development is stimulated, from above downward, in the formation of centrifugal xylem on the inside of the phloem strands. These appear to be the main channels of the basipetal influence. In Dicotyledons the centrifugal xylem is commonly if not generally the result of cambial activity, which ultimately extends down into the root itself.

One factor in the determination of the relative preponderance of root and shoot is very probably the production of auxin by cotyledons and plumule.

We have seen how a substance of known composition, auxin, acts as an agent in the co-ordination of different parts of a plant, but this does not mean that we can explain the activities that are co-ordinated. Great as have been the advances in biochemistry, we are not yet furnished with the means of expressing in physico-chemical terms the delicacy and subtlety of the adjustments exhibited even in plants.

Take, for example, the adhesive disk and haustorium of a mistletoe seedling. This remarkable organ is the result of a series of co-ordinated responses in the growth of the little green meristematic knob from which it arises. Contact pressure leads to one-sided growth, by which it brings itself face downward on to the surface, to which it adheres with the aid of a special viscous material. There follows further growth of its now dome-shaped outer shell, the edge of which moves slowly outwards as the area of attachment widens. Under the dome, cells of the lower surface grow out as papillæ, which adhere closely to the epidermis or cork of the host twig. By the outward and upward movement of the growing shell and a contraction of tissue within it, the papillæ are lifted sideways and the adhering outer protective layer is torn up. Then new papillæ fasten themselves to the next cork layer and the tearing process is repeated. In this way several such layers may be picked up until a breach is made in the periderm, giving access to the living tissues within. Through this slit the wedge-shaped haustorium grows.

It is strikingly obvious in a specialized organ such as this, where growth is closely and uniquely adjusted in response to a particular environment and in relation to a peculiar, special mode of life, that structure and behaviour are interdependent. There is, however, no logical justification for neglecting to interpret the development of ordinary plant organs on similar lines. The main difference is that the cells respond chiefly to internal influences, though the organ as a whole exhibits tropic curvatures in response to appropriate external stimuli.

It is not possible to pursue this line of thought further; but reference should be made to the work that has already been done by Schüepp, Priestley, Adriance Foster, Helm, Grégoire, Snow, the veteran Schoute, and many others towards the elucidation in detail of the course of differentiation in the shoot of Dicotyledons and Monocotyledons, from which are gradually emerging a better understanding of the principles of their developmental organization.

NUCLEAR REACTIONS IN STELLAR EVOLUTION

By Prof. G. Gamow,

George Washington University, Washington, D.C.

(1). THE question of the sources of energy of stars, and the closely connected question of stellar evolution, have presented for a long time the most important unsolved problem of theoretical astrophysics. The first step towards the understanding of the physical processes leading to the tremendous energy liberation which is responsible for the observed radiation of stars was made about ten years ago. It was shown[1], on the basis of the quantum theory of nuclear transformations, that, at the very high temperatures existing in the interior of stars, the ordinary thermal collisions between the particles possess sufficient energy to produce artificial nuclear transformations. It was also shown that the energy liberation in such *thermo-nuclear reactions* is sufficiently high to explain the radiation of stars only in the case of collisions between the protons and the nuclei of light elements (up to about atomic number 10). It took, however, ten more years before our knowledge concerning nuclear reactions developed to such an extent that it became possible to choose particular nuclear reactions as responsible for the energy-production in different cases and to give on this basis a clear and consistent picture of stellar evolution. The exact formula for the energy production of a thermo-nuclear reaction (per gram per second) can be written in the form[2]:

$$\varepsilon = \frac{4}{3^{5/2}} \rho X_1 X_2 \frac{\hbar \Gamma r_0^2 Q}{m_1 m_2 m e^2 Z_1 Z_2} \exp.\left(\frac{2v_0 m e^2 Z_1 Z_2}{\hbar^2}\right)^{1/2} . \tau^2 e^{-\tau} \qquad (1)$$

Here ρ is the density of the gas, X_1 and X_2 the concentrations (by weight) of the two reacting types of nuclei, m_1 and m_2 their masses ($m = m_1 m_2/(m_1 + m_2)$), $Z_1 e$ and $Z_2 e$ their electric charges, r_0 the combined radius, Q the energy production per reaction, and $\Gamma/\hbar$ the probability of reaction after the penetration through the potential barrier. The dependence upon temperature is given through τ, which is defined by:

$$\tau = 3\left(\frac{\pi^2 m e^4 Z_1^2 Z_2^2}{2\hbar^2 kT}\right)^{1/3}, \quad . \quad . \quad . \quad (2)$$

T being the absolute temperature of the gas and k the Boltzmann constant.

This formula was used[3] in choosing the nuclear reaction responsible for the energy liberation of the sun. The complete list of all possible reactions between the protons and different light nuclei is given in the accompanying table, together with the values of Q and Γ:

Reaction	Q (mMU)	Γ (ev.)	$\varepsilon\left(\frac{\text{erg.}}{\text{gm. sec.}}\right)$
$^1H + {}^1H \rightarrow {}^2H + e^+$	1.53	Ref. 4	2.2
$^2H + {}^1H \rightarrow {}^3He + h\nu$	5.9	1	$1 \times 10^{+17}$
$^3H + {}^1H \rightarrow {}^4He + h\nu$	21.3	10	$3 \times 10^{+16}$
$^6Li + {}^1H \rightarrow {}^4He + {}^3He$	4.1	5×10^6	$1 \times 10^{+16}$
$^7Li + {}^1H \rightarrow 2\,{}^4He$	18.6	4×10^4	$5 \times 10^{+15}$
$^9Be + {}^1H \rightarrow {}^6Li + {}^4He$	2.4	10^6	$3 \times 10^{+10}$
$^{10}B + {}^1H \rightarrow {}^{11}C + h\nu$	9.2	10	$3 \times 10^{+6}$
$^{11}B + {}^1H \rightarrow 3\,{}^4He$	9.4	10^6	$2 \times 10^{+11}$
$^{11}C + {}^1H \rightarrow {}^{12}N + h\nu$	0.4	0.02	1.1
$^{12}C + {}^1H \rightarrow {}^{13}N + h\nu$	2.0	0.6	180
$^{13}C + {}^1H \rightarrow {}^{14}N + h\nu$	8.2	30	$3.6 \times 10^{+4}$
$^{14}N + {}^1H \rightarrow {}^{15}O + h\nu$	7.8	5	30
$^{15}N + {}^1H \rightarrow {}^{12}C + {}^4He$	5.2	10^6	$4.5 \times 10^{+2}$
$^{16}O + {}^1H \rightarrow {}^{17}F + h\nu$	0.5	0.02	7×10^{-2}
$^{19}F + {}^1H \rightarrow {}^{16}O + {}^4He$	8.8	10^6	55
$^{20}Ne + {}^1H \rightarrow {}^{21}Na + h\nu$	10.7	10	7×10^{-3}
$^{24}Mg + {}^1H \rightarrow {}^{25}Al + h\nu$	8.0	10	8×10^{-6}
$^{28}Si + {}^1H \rightarrow {}^{29}P + h\nu$	7.0	10	3×10^{-22}

The last column gives the calculated energy liberation of different reactions for the conditions existing in the interior of the sun (that is, $T = 2 \times 10^{7}$° C.; $\rho = 80$ gm./cm.^{3} and $x_{\text{hydrogen}} = 0{\cdot}35$) with the additional hypothesis that the concentration of the element in question is 0·1 (except, of course, the first reaction, where both X_1 and X_2 are taken to be 0·35).

The observed average energy production of the sun is 2 ergs/gm.sec., which corresponds to an energy production of about 60 ergs/gm.sec. in the central regions. Comparing this value with the numbers in the last column of the table, we see at once that the nuclei ^{2}H, ^{3}H, ^{6}Li, ^{7}Li, ^{9}B, ^{10}B and ^{11}B, if present at all, should have extremely small abundances in the central regions of the sun; otherwise the rate of energy production would exceed the observed radiation of the sun by a factor of several millions. Thus these reactions can scarcely be responsible for the solar energy, because, due to the exceedingly small abundances of the elements in question, the total energy produced would not suffice to explain the long life of the sun required by geological data.

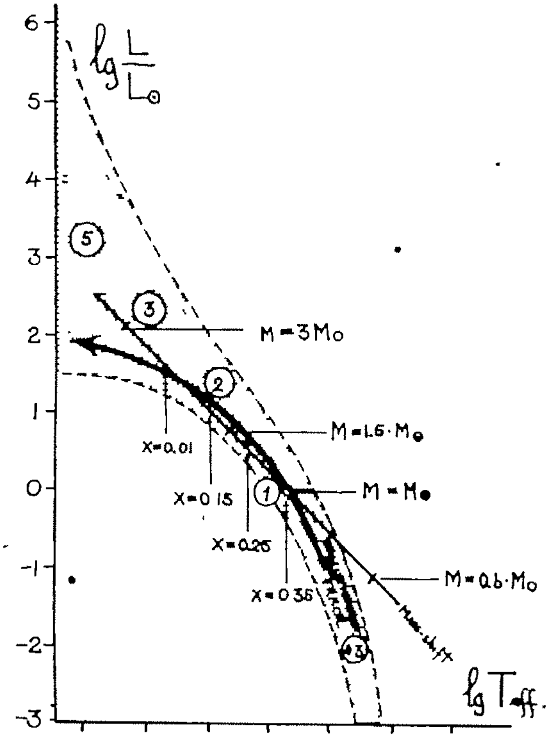


FIG. 1.

On the other hand, the oxygen and all heavier elements (with the possible exception of fluorine, which is present, however, only in minute amounts) cannot give sufficiently high energy production at solar temperatures.

Moreover, the exact calculations show that β-emitting reaction between two protons also leads to an energy liberation which is about thirty times too low for the sun.

The remaining reactions, of carbon and nitrogen nuclei, seem to be therefore the only possibility. It should be noticed first of all that these reactions possess a very important property, forming a *cyclical* chain in which both elements are permanently regenerated. We have in fact the following sequence:

$$\begin{aligned}
{}^{12}\mathrm{C} + {}^{1}\mathrm{H} &\rightarrow {}^{13}\mathrm{N} + h\nu \\
{}^{13}\mathrm{N} &\rightarrow {}^{13}\mathrm{C} + e^{+} \\
{}^{13}\mathrm{C} + {}^{1}\mathrm{H} &\rightarrow {}^{14}\mathrm{N} + h\nu \\
{}^{14}\mathrm{N} + {}^{1}\mathrm{H} &\rightarrow {}^{15}\mathrm{O} + h\nu \\
{}^{15}\mathrm{O} &\rightarrow {}^{15}\mathrm{N} + e^{+} \\
{}^{15}\mathrm{N} + {}^{1}\mathrm{H} &\rightarrow {}^{12}\mathrm{C} + {}^{4}\mathrm{He}
\end{aligned} \tag{3}$$

We see that in this chain both ^{12}C *and* ^{14}N *nuclei play only the rôle of catalysts and that the final result of the cycles is the transmutation of hydrogen into helium.*

The rate of the reaction chain is always determined by the rate of its slowest link which is, in our case, the proton capture by ^{14}N. With this rate and the energy liberation of 4×10^{-5} ergs per cycle, one obtains for the rate of energy production the value 100 ergs/gm. sec., in excellent agreement with the actual value.

Thus there seems to be no doubt that *energy production in the sun is due to the carbon-nitrogen reaction cycles*[3].

(2). We can now answer the question concerning the characteristics of stars with the same energy-producing reaction but different masses and chemical constitution, by comparing them with the sun by means of the so-called *homology transformations* of stellar models. There are *nine* different physical quantities defining the external properties and internal structure of a star: the total mass M, the total luminosity L, the radius R (or the effective temperature defined by $T_{\text{eff.}} = \sqrt[4]{\frac{L}{4\pi R^2 \sigma}}$), the average molecular weight μ, the coefficient of opacity of stellar matter $\varkappa_e$, the product of concentrations of two kinds of reacting nuclei X_1X_2 and the functions of ρ, p and T giving the distribution of density, pressure and temperature in the stellar interior. These quantities are connected by *five* fundamental equations: the definition of mass M through ρ and R; the equation of hydrodynamical equilibrium; the gas law; Eddington's equation for the transport of energy; and the formula giving the rate of thermo-nuclear energy production. Thus, choosing for four independent variables the M, μ, $\varkappa_e$ and X_1X_2, we can determine the relative changes of other variables by simple proportionality relations.

It is customary to classify the stars in the frame of the so-called Hertzsprung–Russell diagram, plotting the logarithms of absolute luminosities against the negative logarithms of effective temperatures.

For these two directly observable quantities we have the following homology transformations[3]:

$$\left(\frac{L^1}{L}\right) = \left(\frac{M^1}{M}\right)^{\frac{4n+13\cdot25}{n+1\cdot75}} \left(\frac{\mu^1}{\mu}\right)^{\frac{5\cdot5n+20\cdot25}{n+1\cdot75}} \left(\frac{\varkappa_0^1}{\varkappa_0}\right)^{-\frac{n+3}{n+1\cdot75}}$$

$$\left(\frac{X_1^1X_2^1}{X_1X_2}\right)^{-\frac{1\cdot25}{n+1\cdot75}} \qquad (4ab)$$

$$\left(\frac{T_{\text{eff}}^1}{T_{\text{eff}}} =\right)\left(\frac{M}{M}\right)^{\frac{10\cdot5n+4\cdot94}{n+1\cdot75}} \left(\frac{\mu^1}{\mu}\right)^{\frac{0\cdot87n+9}{n+1\cdot75}} \left(\frac{\varkappa_0^1}{\varkappa_0}\right)^{-\frac{0\cdot25n+1\cdot25}{n+1\cdot75}}$$

$$\left(\frac{X_1^1X_2^1}{X_1X_2}\right)^{-\frac{0\cdot81}{n+1\cdot75}},$$

where n is the exponent in the temperature dependence of N–C-cycles, which at temperatures around 2×10^{7}° C. is equal to 18.

If we consider stars with the same chemical constitution, the values of L and $T_{\text{eff.}}$ will depend only on M, and this dependence is shown by a straight line in Fig. 1, representing the above-mentioned Hertzsprung–Russell diagram. The numbers along the line correspond to the values of $M/M\odot$. The shaded area represents the so-called *main sequence* in which most of the known stars are located, and the observed masses of stars are indicated by numbers in little circles. The close agreement between the observed and calculated locations brings us to the conclusion that *the main sequence should be interpreted as the collection of stars of different masses with the same chemical constitution and the same energy-producing reaction as in the sun (that is, C–N-cycles).*

Although the agreement between the observed values of M, L and the theoretical relations (4ab) with $n = 18$ is excellent for the stellar masses between 0·5 $M\odot$ and 2·0 $M\odot$[4], there are quite noticeable deviations at both ends of the main sequence. The deviations for very luminous stars of large mass are, most probably, due to the effect of the high radiative pressure, which has to be neglected in the derivation of the homology transformations. On the other hand, the deviations at small luminosities might be due to the fact that for these stars the C–N-cycle is no longer the main energy-producing reaction. We have seen above that in the sun the ^{1}H + ^{1}H reactions give only 1/30 of the total energy production; however, due to its comparatively small temperature dependence, this reaction becomes predominant at temperatures below $1\cdot5 \times 10^{7}$° C., which just correspond to central temperatures of stars on the lower part of the main sequence.

We can now apply the homology transformations (4ab) to the study of evolutionary changes of a star due to the continuous consumption of the hydrogen supply by the energy-producing reaction. The transmutation of hydrogen into helium increases the average molecular weight μ and the opacity $\varkappa_0$ of the stellar substance and decreases the value of X_1X_2 (in which X_1 is now the constant nitrogen content, and X_2 the variable hydrogen content). This defines the changes of the luminosity and the effective temperature and enables one to draw the evolutionary track of the star in the Hertzsprung-Russell diagram. In Fig. 1 such a track for the sun is shown by the heavy line, the numbers along the track representing the hydrogen content at different stages of the evolution. We see that *during the process of the (hydrogen-) evolution the luminosity and the effective temperature of any star, and in particular of our sun, is bound to increase by quite a considerable amount.* But inasmuch as for the sun it would take $1\cdot2 \times 10^{11}$ years to burn all its present hydrogen content, the yearly changes of the luminosity and spectral class are quite negligible and could not be detected by observation.

Here, however, is an important question. If different stars at different stages of their evolution possess quite different luminosities, there should be no correlation between the luminosities and masses of stars; this is, however, in contradiction with the well-established existence of the empirical mass-luminosity relation. The solution of this difficulty is very simple[7]. The rate of consumption of hydrogen at different stages of the evolution is evidently proportional to the total luminosity of the star. Thus the star will stay a much longer time in the lower part of its evolutionary track and pass much more quickly through the stages of high luminosity. *Thus the empirical mass-luminosity relation should be considered as a statistical regularity due to the fact that most of the stars are observed in the lower part of their evolutionary track.* A more detailed survey of stellar masses must necessarily lead to the detection of stars with luminosities considerably higher than those required by the ordinary mass-luminosity relation. It should be noticed, however, that for the stars in the lower half of the main sequence, such late stages of the hydrogen evolution probably could not be observed at all, because the evolutionary life of these stars is considerably longer than the period of time ($\sim 10^{9}$ years) which has passed since their formation.

[1] Atkinson, R. d'E., and Houtermans, F. G., *Z. Phys.*, 54, 656 (1929.)

[2] Gamow, G., and Teller, E., *Phys. Rev.*, 53, 608 (1938).

[3] Bethe, H., *Phys. Rev.*, 55, 434 (1939).

[4] Bethe, H., and Critchfield, Ch. *Phys. Rev.*, 54, 248 (1938).

[5] Gamow, G., *Phys. Rev.*, 53, 59 (1938); 55, 718 (1939).

[6] Gamow, G, *Astrophys. J.*, 89, 130 (1939).

[7] Gamow, G., *Phys. Rev.*, 53, 907 (1938).

(To be continued)

OBITUARIES

Dr. A. C. D. Crommelin

We deeply regret to record the death of Dr. A. C. D. Crommelin which occurred on September 20. Andrew Claude de la Cherois Crommelin was born at Cushenden, Co. Antrim, on February 6, 1865, being the third son of Mr. Nicholas de la Cherois Crommelin, a member of the Huguenot family of that name. Educated at Marlborough College, he afterwards went to Trinity College, Cambridge, where he graduated as twenty-seventh wrangler in the Mathematical Tripos of 1886.

After leaving Cambridge, Crommelin became for a time an assistant master at Lancing College; but his interests lay in astronomy, and it was fortunate for him that in 1891 the appointment of an additional assistant at the Royal Observatory, Greenwich, was sanctioned. Crommelin proved to be the successful candidate and he joined the staff on May 11, 1891. He was given charge of the altazimuth telescope and of the reduction of the observations of the moon which were made with it. He also undertook the reduction of observations of occultations of stars by the moon and of visual observations of the positions of comets made with the Sheepshanks equatorial. This work he continued to do throughout his career at Greenwich, though the programme of work with the altazimuth telescope became more extensive when, a few years after his appointment, the older instrument of Airy was replaced by a larger and more elaborate one.

The character of his work prompted Crommelin to take up the computation of orbits and ephemerides, and his name soon became known as the computer of the orbits of newly discovered comets and minor planets and of ephemerides for them. But his most important contribution to astronomy was the work he did, in collaboration with Cowell, in investigating the motion of Halley's comet and predicting its position on its return in 1910. Their prediction of the date of perihelion passage differed but three days from that actually observed. This research gained for its authors the Lindemann prize offered by the Astronomische Gesellschaft, and the University of Oxford conferred on them the honorary degree of D.Sc.

Crommelin contributed a number of papers of a similar nature to the *Monthly Notices of the Royal Astronomical Society*, and for more than forty years wrote the annual notes on minor planets and comets, a piece of work demanding much care and research on his part. For some years he computed and published ephemerides for the physical observation of Mars, Jupiter, Saturn and the moon, until this work was undertaken by the "Nautical Almanac". In his private capacity he went on several eclipse expeditions, and in 1919 he was chosen to go on the official expedition to Brazil when the results obtained verified the predicted deflection of light by the sun's gravitational field. For very many years he was a valued contributor to NATURE of notes and articles on astronomical subjects.

Crommelin was elected a fellow of the Royal Astronomical Society in 1888. He served as one of its secretaries from 1917 until 1923 and was president during 1929–31. He was president of the British Astronomical Association in 1904–6 and was for many years director of the Comet Section.

Crommelin retired from the Royal Observatory in May 1927, after thirty-six years service, but he continued to be actively interested in the work of his choice. He married, in 1897, Letitia, daughter of the Rev. Robert Noble. Mrs. Crommelin died in 1921, and he lost his elder son and younger daughter in tragic circumstances. He is survived by one son and one daughter.

Commander F. Wild, C.B.E.

COMMANDER FRANK WILD, whose death took place on August 21, was born at Skelton, in Yorkshire, in 1873. His father was clerk of the Eversholt Parochial Charity at Woburn (Beds.) and on his mother's side he claimed descent from the celebrated antarctic pioneer, Captain Cook. He entered the Merchant Service in 1889, receiving his early training in sail in the famous clipper ship *Sobraon*. He entered the Royal Navy in 1900, and was serving as an A.B. in the *Vernon* when he was appointed to the National Antarctic Expedition (1901–4) under Scott. On this expedition, while still serving as a naval rating, he earned the praise and admiration of Scott himself for his coolness and resource under danger and for his qualities of leadership. But even more important for his future career was the attachment which grew up then between him and Shackleton, an attachment which developed into a lifelong friendship.

Wild's subsequent polar career is well known. He returned to the Antarctic with Shackleton in the *Nimrod* in 1907 "in charge of provisions", and took part, along with Shackleton, Adams and Marshall, in that magnificent journey which all but reached the Pole. Almost immediately afterwards he joined the Australasian Antarctic Expedition of 1911–14 under Dr. Douglas Mawson, during which he commanded the Western Base on Queen Mary Land. At the conclusion of this expedition, after a brief interval ashore, he sailed again with Shackleton on the eve of the War of 1914-18 in the ill-fated *Endurance*. After the loss of that vessel in the Weddell Sea, he remained in charge of the expedition on Elephant Island, and there through four and a half months of extreme privation he pulled through to health and safety twenty-one semi-starved and ill-clad men.

After the tragic death of Shackleton at South Georgia in 1922, Wild commanded the Shackleton-Rowett Antarctic Expedition of 1921–22 in the *Quest*. Although the vessel failed to reach her main objective, the Enderby-Coats Land coast, useful work was accomplished, covering a wide scientific field, notably on the islands of South Georgia, Elephant, Gough, Tristan da Cunha and others.

During the War of 1914–18, Wild led a commercial expedition to Spitsbergen and served in the R.N.V.R. with the rank of Commander. He went to South Africa in 1922 and engaged in farming. The venture failed, and, like so many others who have served a great cause with selfless devotion, he fell upon hard times. He was granted a Civil List pension shortly before his death.

Wild was a little man of slight build. Most indeed would have called him frail until they felt the power of his hands or saw him trimming coal in the intense heat of a ship's bunker in the tropics, or swinging back on a topsail halyard. He had bright, piercing blue eyes which twinkled at you when he spoke. They twinkled most—with sheer pleasure—during the headlong rush and excitement of shortening sail in heavy weather, or when, as he often did, he held the steer-oar of a small boat while negotiating a dangerous landing on a lee shore.

Wild was essentially a seaman of high quality, and a leader of men. His scientific achievement can therefore only be fairly judged by the work of those specialists—the surveyors, geologists, meteorologists, zoologists and others—who were placed in his charge and were encouraged by his example. It is perhaps not generally realized, however, that it was Wild who discovered the coal seams in the great Beacon Sandstone formation high up on the Beardmore Glacier in 85° S. His detailed description of these coal measures is incorporated in the publications of the late Sir T. W. Edgeworth David.

As leader of Mawson's Western Party he was responsible for a notable contribution to antarctic exploration and research when he opened up Queen Mary Land by sledge under conditions which have seldom, if ever, been equalled for severity in the history of polar research.

If there was work to do, however hard or unpleasant the task, Wild never spared himself. His devotion to the cause which he served, his unquenchable spirit under severe trial, his cool head in emergency, his complete selflessness and, above all, his ever ready and kindly advice made him loved and respected by all who served with him throughout his long polar career.

JAMES W. S. MARR.

WE regret to announce the following deaths:

Prof. Sigmund Freud, For. Mem. R.S., formerly professor of neurology in the University of Vienna, on September 23, aged eighty-three years.

Dr. J. A. Loeser, author of "Die psychologische Autonomie des organischen Handelns", in which novel views on animal behaviour were put forward, on September 12, aged forty-one years.

Dr. G. M. Murray, emeritus professor of medicine in the Victoria University of Manchester, known for his work on diseases of the thyroid gland, on September 21.

NEWS AND VIEWS

The British Association in War Time

SINCE the Dundee meeting of the British Association was brought to an untimely end, the office at Burlington House, London, has been re-opened for the routine work which always follows upon the annual meeting, and a certain amount of official business is also being carried on at Down House, where the rooms normally open to the public are closed and dismantled, and Charles Darwin's former dining-room serves the valuable if regrettable purpose of an office-refuge. The first number of the new quarterly report, *The Advancement of Science*, will be produced, all being well, probably rather later than the announced date at the end of October, and in smaller bulk than was contemplated. As to its future, and, for that matter, the future of the Association's work generally, obviously nothing definite can be stated. Preparations for the intended meeting next year in Newcastle-upon-Tyne have been suspended, by agreement with the authorities there. It is an unhappy coincidence that the last meeting in that city was the last to be held during the last war, in 1916. Conditions are so far different now that it is impossible to estimate whether any sort of meeting could or should be held next year, whether in Newcastle or anywhere else. Yet it is permissible to dream of the possibility of adapting the Association's very flexible constitution to a meeting of four days or so, with science in war time as the leading theme, with sessions in three or four telescoped sections—physical, biological, anthropological, and economic, for example—and of course the Division for the Social and Economic Relations of Science. No doubt before anything of this sort could be undertaken there would be need of careful and wide inquiry as to the amount of support which might be forthcoming for such an effort. But if this were favourable, such a meeting could be arranged at relatively short notice. "The minor humours of war" may be offered in advance as one subject on the anthropological side.

The Fourth Partition of Poland

DURING the twenty years of its existence as an independent republic, Poland, like Czechoslovakia, fostered science and learning in a manner which gained the admiration of the whole civilized world. Its President, Prof. Ignacy Mościcki, was a distinguished chemist, and many other men of science took leading roles in the country's affairs and were able to ensure that education, science and culture were not neglected. There were thus very flourishing universities at Warsaw, Cracow, Lwów, Poznań, Vilno and Lublin. Almost every important town had its polytechnic high-school and there were special colleges and institutes connected with agriculture (Warsaw, Pulawy and Bydgoszcz), mining (Cracow) and veterinary science (Lwów), in addition to various scientific academies and societies in different centres.

It is doubtful whether these centres of science will function again before the end of hostilities, and even if some attempt were made to utilize them it will not be for Polish science and culture, since the unhappy nation is again witnessing a partition, the fourth, of the State. From what appears to be the intention of Poland's invaders, Germany will gain possession of the seats of learning at Warsaw (the university is in the western half of the city), Cracow, Bydgoszcz and Poznań, whilst those of Lublin and Lwów will pass into Russian hands. The fate of Vilno and its university and cultural institutes is not certain, since the possibility of its return to Lithuania must not be excluded. Our sympathy goes out to the many men of science in Poland whose work has been interrupted and who have to suffer the horrors of a modern war in which they are the victims of unprovoked aggression.

Patents in War Time

Various Acts of Parliament and statutory rules control the issue of patents. They lay down definite time limits within which certain things must be done by an inventor who is applying for a grant. For example, the complete specification must be filed not later than twelve months after the provisional, and the application as a whole must have reached the stage of being "in order for acceptance" not later than eighteen months after the earliest filing date. In the same way renewal fees must be paid promptly as they fall due, or the patent will lapse. Extensions of time varying from one to three months can be obtained on payment of stipulated fees, but after that no extensions are allowed. In the *Electrical Review* of September 22, a "Legal Correspondent" writes an instructive article on the effects of the new patent legislation. The 'intellectual property' which is created by the operation of the patent system, as well as the artistic property which is called copyright, both stand in a class apart from the ordinary trade and business of mankind. It is therefore for the benefit of all that they should be safeguarded even when they come from an enemy source.

The changes to be made in patent procedure, in order to meet the abnormal conditions of war, are set out in the new Patents, Designs, Copyright and Trade Marks (Emergency) Bill, to which the Royal Assent was given on September 21. The first clause of the Act states that any existing license granted under a patent does not become invalid simply because the proprietor or owner of the patent is an enemy. Clause 4 of the Bill preserves the right of an enemy, even during the period of hostilities, to apply for the grant of a British patent. At the end of the war of 1914–18, the sudden release of patents claiming priority-dates, which in some cases went back for five or six years before the specifications were formally accepted and published, naturally created considerable confusion and embarrassment. When the next armistice comes, we may reasonably expect that the experience gained in similar problems twenty years ago will stand us in good stead.

Food Production in War Time

The Agricultural Research Council is to work in the closest co-operation with the Ministry of Agriculture and the Department of Agriculture for Scotland in connexion with research and investigations into problems that may arise from the food production campaign. Since March last a committee of the Agricultural Research Council has had under examination the programmes of research and the qualifications of the staffs of agricultural research institutes from the point of view of an emergency. It will be the function of the Council now to guide the research at these institutes into the special agricultural problems arising out of war conditions. For this purpose the chairman of the Agricultural Research Council (Sir Thomas Middleton) has, with the approval of the Lord President of the Council, appointed a small executive committee, which will keep all members of the Council in close touch with the situation.

The Minister of Agriculture and Fisheries has also constituted an advisory panel the members of which will be available for consultation, as need arises, on the immediate technical problems of war-time food production which do not call for further research. The members of the panel are: Prof. F. L. Engledow (cereals and crops), Prof. J. A. Hanley (soils), Prof. H. D. Kay (dairying), Sir John Russell (plant nutrition), Prof. J. A. Scott Watson (general agriculture), Sir George Stapledon (grassland), Dr. T. Wallace (nutrition of horticultural crops), Dr. S. J. Watson (grass and fodder conservation), and Dr. H. E. Woodman (livestock and nutrition). The Secretary of State for Scotland will consult the agricultural colleges and the research institutes in Scotland on any technical questions on which their advice may be desired.

The Spirit of Adventure

There is no greater need in our time than the development of the capacity to weigh evidence and form sound judgments, and, having formed independent judgments, to have the reliance to stand by them. Although the main objects of Surgeon-Commander G. Murray Levick in leading expeditions of school-boys into uninhabited wilds is to widen outlook and to foster the spirit of adventure, one of the chief results must be the encouragement of independence and self-reliance; and no praise can be too high for the enthusiasm and skilled planning which has induced him to shoulder the responsibility of organizing and conducting seven such expeditions for the Public Schools Exploring Society which he founded in 1932. Three of the expeditions have been to Lapland and four to Newfoundland, which affords just those great areas of unmapped and uninhabited country which suit the needs of the young explorers.

(*Continued on page* 589.)

NATURE

SUPPLEMENT

Vol. 144 SATURDAY, SEPTEMBER 30, 1939 No. 3648

SHORT REVIEWS

Agriculture and Horticulture

Seed and Potting Composts

With Special Reference to Soil Sterilization. By W. J. C. Lawrence and J. Newell. Pp. 128. (London: George Allen and Unwin, Ltd., 1939.) 3*s.* 6*d.* net.

THIS lucidly written and well-illustrated book forms a report of the authors' experimental work designed to overcome difficulties experienced in making mixtures or composts of soil, complicated by the necessity of sterilization to prevent fungal diseases. A close scrutiny of the available materials was followed by tests of various methods and apparatus used for soil sterilization, on a larger scale suitable for commercial purposes, and on a smaller scale convenient for amateur gardeners. The more frequent causes of unsatisfactory results are listed in the text, and the methods are critically evaluated.

Two thoroughly tested standard composts are recommended. By the judicious use of powdered chalk and superphosphates, added after sterilization of the loam, satisfactory growth of the seedlings of numerous plants has been obtained in the first compost; in the second compost, used for many pot plants, nitrogen is provided in organic form by horn and hoof grist, but it has been found necessary to supplement this, especially for pot-bound plants, by the addition of nutrients relatively rich in nitrogen in solution. This solution is prepared from a proprietary general fertilizer with the addition of ammonium nitrate or sulphate.

The success of the author's methods at Merton and the growing and widespread adoption of their procedure in the industry form the best notice of their work, which has already enhanced the reputation of the John Innes Horticultural Institution held by practical growers.

The Study of the Soil in the Field

By G. R. Clarke. Second edition. Pp. 192 + 1 plate. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 6*s.* net.

MANY improvements have been made in the second edition of Mr. Clarke's book. It is unique among English (and most other) books on the soil in treating the subject entirely from the point of view of the student in the field and virtually ignoring the existence of the laboratory chemist and physicist. The true pedologist, says the author, should study the soil as an organism evolving under the influence of its environment, rather than as a subject for very impure chemical experiment.

Mr. Clarke tends to be somewhat dogmatic in his statements, and the inexperienced student will have to exercise care in accepting as facts what are expressions of the author's personal but usually well-founded opinions. Half the book describes the system worked out and used at Oxford for making and recording observations in the field, and the other half various systems of soil surveying and mapping used in different countries. Readers in some of these countries may object that their particular system has not received full justice, but what is lost in justice is gained in the simplicity of description which Mr. Clarke employs.

The book is intended to be carried in the pocket of the field worker, and will form a very valuable addition to his equipment.

Practical Lawn Craft

By R. B. Dawson. (Agricultural and Horticultural Handbooks.) Pp. 300 + 21 plates. (London: Crosby Lockwood and Son, Ltd., 1939.) 15*s.* net.

THE outstanding feature of this invaluable book is the thoroughness with which every detail connected with lawn craft is discussed. The combination of wide practical experience with exhaustive experimental work is evident throughout, and no aspect of the problem is too insignificant to be considered. An important feature is the comparison of the different management necessary for various types of sports grounds and for aerodromes, coupled with diagrams of the lay-out in several cases. The value of the book is much enhanced by the chapter on turf upkeep in other countries, which serves to correlate the various problems and to render the data of more general application. Amateurs and professionals alike owe a debt of gratitude to the author for his masterly presentation of a subject of such general interest.

W. E. B.

Anthropology and Archæology

Catalogue of Demotic Papyri in the British Museum
Vol. 1: A Theban Archive of the Reign of Ptolemy I, Soter. By Prof. S. R. K. Glanville. Pp. lii+73+13 plates. (London: British Museum, 1939.) Paper, 33s.; cloth, 35s.

ALTHOUGH the collections of papyri in the British Museum contained demotic papyri so long ago as 1834, very little from them has been published. The catalogue which has been prepared by Prof. S. R. K. Glanville, using the short catalogue of Sir Herbert Thompson as a basis, will be completed in three volumes, of which the first, now issued, consists of a series from a single archive relating to a property at Thebes; the second will cover the literary documents, and the third will contain business and legal documents.

The collection of documents in the first volume dates from the reign of Ptolemy I Soter, with the exception of four receipts for payments, which fall in the reign of Ptolemy II Philadelphus. All are concerned with the history of a small property (or its owners) over a period of twenty-three years, during which time no less than nine persons successively acquired some sort of legal interest in it. What, however, is especially interesting is that the British Museum texts link up directly with other texts in the Rylands Library, in Philadelphia, and elsewhere, which take back the history of the estate for another quarter of a century, making up a record of its vicissitudes and of those of the family connected with it for just under fifty years. This material which, in addition to its reproduction, has been transcribed, translated and edited with a detailed commentary by Prof. Glanville, not only provides much interesting information in regard to neighbourly relations and the construction of dwelling houses in an ancient Egyptian city, but also affords a glimpse of the Egyptian theory of 'ancient lights'.

Racial Proverbs
A Selection of the World's Proverbs arranged Linguistically. By Dr. Selwyn Gurney Champion. Pp. cxxix+767. (London: George Routledge and Sons, Ltd., 1938.) 35s. net.

Proverbes et dictons Syro-Libanais; texte arabe, transcription, traduction, commentaire et index analytique
Par Prof. Michel Feghali. (Université de Paris: Travaux et mémoires de l'Institut d'Ethnologie, Vol. 31.) Pp. xviii+850. (Paris: Institut d'Ethnologie, 1938.) 187.50 francs.

(1) THE collecting of proverbs and gnomic sayings of the various peoples and nations of the world is an entertaining hobby; it is also an important subject of ethnographical research. For those who find it merely an entertainment it may be said that Dr. Champion's collection, to which he has devoted many years, is wider in scope and geographical distribution than any other of the same character; and it is provided with a full apparatus for the convenience of the reader in tracing any particular saying or phrase desired. Brief statements or analyses by different hands deal with the proverbial lore of each country or people; while Dr. R. R. Marett has some remarks to offer on the question of the proverb as an element in cultural studies. It must be said, however, that while some of these introductions are excellent—that on the Arabian proverb is an instance in point—not all are the work of authors of equal skill and authority. Indeed, one writer makes the remarkable admission that until three months previously to the time of writing he was unaware that the people with whom he deals had any proverbs at all!

Nor is the collection of proverbs itself above criticism. For English readers unacquainted with the original language or with the people, a literal translation is of little value unless the English equivalent, if there is one, is added. The least satisfactory section is the Greek, in which quotations from the poets appear as proverbs without remark, and no distinction is made as to whether the source is ancient or modern Greek. Scientifically, it is to be feared, as Dr. Marett seems to hint, this collection of proverbs can have little value. A proverb without commentary to explain its meaning and the conditions of its use cannot afford the assistance it should to an understanding of the mentality of its users, or throw light on their customs and beliefs.

(2) By way of contrast readers may turn to the second volume mentioned above—a detailed and extensive record of proverbs and sayings current in certain parts of Syria, in which are given original text, translation and detailed commentary. The result is a very complete picture, necessarily unsystematic, of the mentality, daily life, social relations and beliefs of the people.

Biology

Sveriges Skogsinsekter
Av Ivar Trägårdh. Pp. xii+509. (Stockholm: Hugo Gebers Förlag, 1939.) 20 kr.

WE welcome the appearance of a second edition of this standard work on Swedish forest insects. Its author, Dr. Ivar Trägårdh has been, for nearly thirty years, a prolific and enthusiastic student and writer on the subject of forest entomology. In this time he has made a name for himself as an authority of high rank. He is a familiar figure at international congresses, and has thus become known personally to many English entomologists.

The first impression upon looking through this volume is the excellence of its letterpress and the wealth of its illustrations (some 570 in number). These latter are nearly all examples of the half-tone process, and the majority are either original or borrowed from various already-published writings by the author. The book is divided into twelve chapters and, as might be expected, the most extensive is devoted to the order Coleoptera, while in the last five chapters the theory and practice of forest entomology are discussed. At the end there are diagnostic keys to the identification of forest pests under each kind of tree, the insects being quoted under their vernacular names. A reliable, practical and scientific book of this kind, in its new edition, will doubtlessly be welcomed in Sweden in view of the great importance of forestry in the national economy. In other European countries a German translation would be an undoubted advantage. Finally, it may be added, almost all the English forest pests will be found to be discussed within its pages.

A Laboratory Introduction to Animal Ecology and Taxonomy

A Laboratory Guide with Keys prepared with Particular Reference to Freshwater and Terrestrial Habitats of the Deciduous Forest Region in North America. By Prof. Orlando Park, Prof. W. C. Allee and Prof. V. E. Shelford. Pp. x+272. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 10s. net.

THIS handbook is written for the naturalist, and is intended for those taking introductory college courses, interested amateurs and high-school students. Its object is to train the student to identify the terrestrial and freshwater animals of the Chicago area, to study their habits, to experiment with them in a simple way, and to find out what is known about them from books. References are given in each section, and there is an extensive bibliography. Problems are set to stimulate further investigation. There are synoptic keys, carried as a rule only to orders, and the student is encouraged to construct his own key by means of an exercise based on ten species of the local snail Polygyra. Pratt's "Manual of Common Invertebrate Animals" and Ward and Whipple's "Fresh Water Biology" are then used for the identification of genera and species. Statistical methods are lightly touched upon and a section on cave animals is included. A glossary of technical terms used in the keys supplements the explanations found in the text. There are seventeen clear line-drawings, mostly by T. J. Daggy. The pages are threaded on ten metal runners which keep the leaves flat when the book is open, but are somewhat awkward to manipulate. The book gives an admirable presentation of the subject.

Flora of Devon

Phanerogams, Vascular Cryptogams, Charophyta. Promoted by the Devonshire Association. Edited by Rev. W. Keble Martin and Gordon T. Fraser, with the assistance of Rev. Thomas Stephenson and Francis M. Day. Pp. xv+787+8 plates. (Arbroath: T. Buncle and Co., Ltd.; London: Wheldon and Wesley, Ltd., 1939.) 25s.

THE editors of this "Flora of Devon" are to be congratulated on the care and attention they have given to this long-awaited volume. Some seven hundred pages of print are devoted to a detailed study of the distribution of the plants found in the county, which for the purposes of this survey has been divided into two vice-counties (following Watson), eight districts and twenty-three sub-districts. Under each species and sub-species is given a list of the places in which it is or has been found and the records of the species in the district. This has entailed a careful study of the specimens in the herbaria in the county, consultation with the systematists who are specialists in the different groups, and an examination of the relevant literature, of which a bibliography is given.

The result is a very complete and careful record of all the data relating to each species and subspecies, which is grouped in accordance with the "London Catalogue of British Plants" (eleventh edition). For the specialist and the systematist the book should be of immense value. Its appeal and scope would, it appears to the reviewer, have been widened had the details given for each plant been somewhat curtailed, thereby allowing of more than forty pages for the introductory portion, which seems to be of more value to the general reader and student. The meteorological, geological and ecological data which are outlined in these first few pages are of great interest and some portions, at least, might have been expanded, to group, for example, the plants under localities, and not, as is found later in the book, the localities under the plants. Out of some eight hundred pages, more than twenty might, with effect, have been devoted to the ecology of the county. J. C.

Experiments in Plant Physiology

A Laboratory Text-Book. By Dr. Walter E. Loomis and Dr. Charles A. Shull. (McGraw-Hill Publications in the Botanical Sciences.) Pp. xiv+213. (London: McGraw-Hill Publishing Co., Ltd., 1939.) 12s.

THIS book consists of the first part of the authors' "Methods in Plant Physiology", which has been revised and rewritten. There are sections on colloids, water-relationships of the plant, photosynthesis, respiration, reserve foodstuffs, water-cultures, growth and tropisms, while a few experiments on growth substances have also been included. While most teaching physiologists, doubtless, will always prefer to devise their own teaching experiments, the present work is remarkably suggestive of fundamental practical work well within the capabilities of most intermediate and general class students. Two pleasing features are the questions added at the end of most of the sections, and the many references to recent literature (nearly all in English) on which the experiments have been based. The consequence should certainly be that the student will be induced to see beyond the actual experiment he has performed, and will try to relate it to the results of modern research.

One would have wished to see more attention being paid to various tests for reserve foodstuffs. A weakness of the book is the failure to include details of practical work on the physiology of the fungi: experiments on the effects of growing moulds on different carbohydrates, or at different temperatures or on media of various dilutions, should form part of any advanced course on practical plant physiology. But apart from this major criticism, it must be said that the authors have produced a very useful book which can confidently be recommended to university and college teachers.

Chemistry

Mellor's Modern Inorganic Chemistry

Revised and Edited by Dr. G. D. Parkes in collaboration with Dr. J. W. Mellor. Pp. xix+915. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 12*s*. 6*d*.

THIS new edition of Dr. Mellor's well-known book is practically a new work, the arrangement and text having been drastically changed. It is now more systematic and will be found much easier to read by junior students, although some readers who know the original work may regret the omission of the digressions which stamped the book with an original character. The first part now deals with theory, then come seven chapters devoted to hydrogen, oxygen, carbon, nitrogen, sulphur and the halogens, and their principal compounds, and then the remainder of the book discusses the other elements and their compounds in the order of the periodic table. The salts are now described under the metals. Most of the diagrams are new or have been redrawn, and some are not very satisfactory, essential parts being omitted, and in at least one case the diagram does not correspond with the description. In the description of atomic structure, the presence of electrons in the nucleus is postulated in the text.

The new edition of "Mellor" is a straightforward text-book of intermediate and pass standard which will undoubtedly maintain the popularity of the original work. The type is larger and clearer than that of earlier editions.

Casein and its Industrial Applications

By Edwin Sutermeister and Frederick L. Browne. (American Chemical Society Monograph Series, No. 30.) Second edition. Pp. 434. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 32*s*. 6*d*. net.

THIS book tells all about casein—a material which continues to increase in importance as an industrial raw material: there is much progress to record in the twelve years since the first edition. Casein is used in glues, in paper-making, in paints, in the leather industry, in foods and medicines, etc., and there are chapters under each of these headings packed full of information. The importance of casein as a plastic does not lessen in spite of the many alternative plastic materials. A remarkable coloured plate shows objects fabricated from casein.

The chemistry, manufacture, analysis and storage of casein also receive attention. There is a short note on synthetic textile fibres from casein, which concludes with the forecast that artificial wool fibre will eventually attain the commercial importance of rayon.

There are ten contributing authors, including the two whose names are on the title-page.

A Higher School Certificate Inorganic Chemistry

By Dr. E. J. Holmyard. Pp. xii+529. (London: J. M. Dent and Sons, Ltd., 1939.) 5*s*. 6*d*.

BY allocating space to individual topics roughly in proportion to the frequency with which those topics appear in examination papers, and keeping those sections which deal with stock examination questions within such limits as may enable the candidate to reproduce them or their substance in half an hour, and also by omitting or only briefly recapitulating work up to School Certificate level, the author has been able to present the material for Higher Certificate students in a relatively small compass. Examination questions are not given. The book is divided into two parts, the first containing theory and the second an account of the elements dealt with in the order of the Periodic Table. There is a short section on the electronic theory of valency. The tests for the important metals are given. Preparative details are only briefly stated, but manufacturing processes are described in the important cases in some detail. Dr. Holmyard's book is clearly and attractively written and contains a well planned course of the appropriate standard. A good feature is the presentation of equations for all the important reactions.

The Fundamentals of Chemical Thermodynamics

Part 1: Elementary Theory and Electrochemistry. By Dr. J. A. V. Butler. Third edition. Pp. xv+271. (London: Macmillan and Co., Ltd., 1939.) 7*s*. 6*d*.

THE general plan of the new edition of this book remains the same as that of former editions, but some sections have been revised. These include the chapters on electrochemistry, a simplified treatment of gas reactions, and a short section on semiquinones in the chapter on oxidation-reduction potentials. The book is very clearly written, and provides an excellent introduction to the subject for chemical students.

Engineering

Hydraulics

For Engineers and Engineering Students. By Prof. Frederick Charles Lea. Sixth edition. Pp xii+757. (London: Edward Arnold and Co., 1938.) 21*s*. net.

THE issue of the sixth edition of Prof. Lea's "Hydraulics" is a remarkable event in these days, when the pace at which engineering science develops is such as in a few years to put out of date the great majority of treatises. In the thirty years since it first appeared, the author has kept successive editions well abreast of and in close contact with the most recent developments, and this has no doubt been in large measure due to the active part he himself has taken in scientific investigations and in the work of the professional institutions Therefore, while the great body of unchanging hydraulic principles and their general applications constitute the main structure and usefulness of this volume, we find that, further to the previous additions, there have been included discussions on formulæ arising out of the most recent work on the flow of fluids in pipes and channels and over weirs. The tables and charts based on these should prove very useful when a coefficient has to be chosen for a particular case. Additions have also been made to show new designs of turbines and pumps, and a description of the latest type of electric-hydraulic forging press is another of the added features which maintain the repute of the book as one of the foremost treatises on the subject of hydraulics.

Essentials of Alternating Currents

By Prof. William H. Timbie and Prof. Henry H. Higbie. Second edition. Pp. x+378. (London: Chapman and Hall, Ltd.; New York: John Wiley and Sons, Inc., 1939.) 11*s*. net.

DURING the last ten years there has been a wide expansion in the applications of alternating current power both for domestic use and in industry. The wide use of static condensers for improving the power factor, and the introduction of more efficient rectifying devices, have made a knowledge of the operating principles of these devices essential to the practical electrician, who is keenly alive to keeping abreast of the latest improvements. The second edition has been prepared with this end in view. Many practical men have forgotten much of the mathematics they studied at school, so the authors devote themselves to simplifying the mathematical wording as much as possible and giving graphical methods which, with the help of simple numerical tables, enable them to solve most of the practical problems they come across with the minimum of labour. The chapters on motors, starters and controllers, and on converters and rectifiers will be found useful to many.

Mathematics

A New Geometry for Schools

By Clement V. Durell. Pp. xvi+572+xxii. (London: G. Bell and Sons, Ltd., 1939.) 5*s*. 6*d*.

MR. DURELL'S "Elementary Geometry" appeared fourteen years ago, and the author has now decided to replace it by an entirely new book, recasting his treatment in the light of his own experience, the suggestions sent to him by others, and the recent Second Report of the Mathematical Association on the Teaching of Geometry. He gives a course from the first stage up to the standard of the School Certificate, developing each group of geometrical facts by the following successive stages: examples for oral discussion, numerical examples, formal proofs of theorems, and a carefully graded and classified set of riders.

Computation and Trigonometry

By Harold J. Gay. Pp. vii+143. (New York: The Macmillan Company, 1938.) 10*s*. net.

THE fifteen chapters of this book cover a wide field. The first three are concerned mainly with computation and contain much useful information on arithmetical accuracy, logarithms and the slide rule. Chapters iv–xii deal with plane trigonometry up to the solution of triangles, whilst the remaining three chapters are devoted to the elements of spherical trigonometry with some interesting applications. All the fundamental formulæ are summarized at the end and occupy no less than five pages. Throughout the text, the student is well supplied with exercises, but no answers to these appear to be provided.

In comparison with the course covered the book is somewhat large, but this is due to the fact that bound up with the text is a revised edition, running into over 142 pages, of logarithmic and trigonometric tables, prepared under the editorship of Prof. Hedrick. Most of these tables are given to five places and include compound interest, compound discount, annuity and American Experience Mortality tables.

Some Notes on Least Squares

By Dr. W. Edwards Deming. Pp. iv+181. (Washington, D.C.: Graduate School, Department of Agriculture, 1938.) 1.50 dollars.

THE method of least squares, developed largely by Gauss, and applied widely by astronomers and physicists in the last century, has taken on a new lease of life with its application to statistical problems. Students approaching the method from the statistical point of view are perhaps not as familiar as could be desired with the work of the older writers, and Dr. Deming is to be congratulated on presenting the subject in a way which stresses the continuity of its development. These notes are a mimeographed transcription based on lectures given by Dr. Deming in the Washington School of Agriculture. As the author points out in the preface, they were not assembled with the idea of forming a complete text on the subject, but they do perform a useful function in directing the student who wishes to go into the theory of least squares somewhat closely. Many numerical examples are worked.

Calculus

By Prof. Frederic H. Miller. Pp. xiv+420. (London: Chapman and Hall, Ltd.; New York: John Wiley and Sons, Inc., 1939.) 15*s*. net.

THIS is an account of the differential and integral calculus, with a chapter on infinite series and another chapter on differential equations. It is intended for American students of science or engineering, and also for those interested in mathematics for its own sake. It covers all the usual elements of the subject, going as far as partial differentiation and multiple integrals. There are many geometrical and physical applications, and more than 2,300 examples. The appendixes contain formulæ from other branches of elementary mathematics and useful tables.

Miscellany

A Vicarious Trip to the Barbary Coast

By Mary Berenson. Pp. xii+146+23 plates. (London: Constable and Co., Ltd., 1938.) 7*s*. 6*d*. net.

MRS. BERENSON, owing to ill-health, was unable to accompany her husband on a trip through Italian North Africa to visit the archæological sites and examine the collections of antiquities in the museums. From the detailed descriptions and the accounts of incidents on the journey, which were conveyed to her in letters, and with the aid of guide-books, maps, and authoritative works of reference, she has constructed an account of her "Vicarious Trip" with illustrations. No one, naturally, will go to such a book for original research; but if they wish for a brightly written, informative account of the ground covered, and people encountered, together with a glimpse of what the authorities are doing to explore the archæological sites and preserve the relics of the past in this country, here they will find at least something to satisfy their desire.

Manuel de la conservation et de la restauration des peintures

(Office International des Musées.) Pp. 310. (Paris: Institut Internationale de Coopération Intellectuelle, 1939.) 150 francs.

SOME little time ago, a committee of specialists interested in the conservation and treatment of paintings met in Paris to discuss these activities in detail, and to agree so far as possible upon standard methods of policy and nomenclature. This book is the result of their labours. The separate contributions have been co-ordinated with the view of obtaining constancy of style: this editorial work has been very ably carried out. However, the various sections are by no means equally successful in their subject-matter; for example, the description of methods available in the restorer's studio is admirable, whereas the information relating to radiography and what it can do is extremely sketchy.

So far as the more truly scientific aspects are concerned, the impression is given that the writers sometimes have little personal experience of the processes involved; there is a lack of contact with things as they are in the laboratory.

The bibliography, in spite of an editorial disclaimer, is restricted, and provides a very narrow view of how much has been accomplished in various countries of the world. The volume ends with an excellent glossary (French-English-German-Italian), which curators and others will heartily welcome.

F. I. G. R.

Forty Acres and Steel Mules

By Herman Clarence Nixon. Pp. vii + 98 + 32 plates. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1938.) 2.50 dollars; 11*s*. 6*d*.

THIS very clear and straightforward account of the emergence of the Southern States from plantation slavery and their subsequent submergence under another kind of slavery, in which share croppers and tenants bleed the exhausted soil to pay their feudal dues to absent landlords and small-town traders, illustrates the immense problems of social reconstruction confronting the American cotton belt. The author paints a most depressing picture of the present 'dark age' and does not minimize the difficulties of bringing light into it. He proposes a comprehensive scheme of social, agricultural and industrial readjustment which reads like sound common sense and would have been unnecessary in a world where common sense had prevailed. The book is very graphically illustrated.

An Introduction to Astronomical Navigation

By P. H. Legg. Pp. xiii + 102. (London: Chapman and Hall, Ltd., 1939.) 10*s*. 6*d*. net.

WITH the increase in range and speed of aircraft, the use of astronomical observations to fix the position, independently of observations of ground objects, has become of increasing importance. When flying above continuous cloud or over the ocean, astronomical observations provide the only means of determining the position. In this elementary introduction to astronomical navigation, the means are described by which a position line can be drawn on a map as the result of an observation of altitude of the sun, moon or a star.

The treatment is very detailed and elementary, no previous knowledge of the geometry of the sphere, of the definitions of astronomical quantities or of methods of navigation being assumed. Yet terms such as 'meridional parts' and 'rhumb line' are introduced without explanation. Some familiarity with navigational tables and with the Air Almanac seems to be presupposed. It would have been more in accordance with the scope of the book to assume no such knowledge, to have explained what data are given in the Air Almanac and why the data are given in the form they are, and to have given some description of various tables and other aids to the reduction of the observations.

The dead reckoning position is employed for constructing the position line. The advantage, when using navigation tables, of using an 'assumed position', near to but not necessarily coincident with the dead reckoning position, is not mentioned.

H. S. J.

Philosophy

Medieval Number Symbolism

Its Sources, Meaning and Influence on Thought and Expression. By Prof. Vincent Foster Hopper. Pp. xiii + 241. (New York: Columbia University Press; London: Oxford University Press, 1938.) 15*s*. net.

THE significance of number goes far beyond the pragmatical uses of computation and the abstract necessities of its mathematical treatment. The Pythagorean tradition of linking number with every human interest, which asserted itself in the mystical developments of neo-platonism as well, found a considerable field of application in the religious interests of the Middle Ages. By symbolism, the abstract is brought into the realm of the concrete, where it is immediately recognizable and meaningful. Thus, the abstract beauty and loving-kindness of the Deity were humanly realized in the person of the Virgin, the concept of which was brought ever closer to sense experience through the artistic media of sculpture and painting. The author endeavours, on the basis of the number symbolism of earlier periods which has been studied at length by various experts, to explain the basis, meaning, purpose, extent and use of number symbolism in the Middle Ages; and has chosen the "Divina Commedia" of Dante as a specific example of his interpretation. Prof. Hopper's work, which is more historical and descriptive than philosophical, might have been strengthened by a discussion of the medieval theories about signs and symbols which are expounded by the leading theologians of the period surveyed. As it is, it will serve a useful purpose in enabling one to understand one of the most original aspects of medieval thought. T. G.

The Kantian Philosophy of Space

By Prof. Christopher Browne Garnett, Jr. Pp. xi + 287. (New York: Columbia University Press; London: Oxford University Press, 1939.) 17*s*. 6*d*. net.

THIS is a valuable discussion of the theories of space due to Newton and Leibniz, the development of Kant's views, beginning with his earliest work, and of some modern theories. As against Leibniz, Kant held that space must be in some sense prior to bodies that move, if there are to be universal laws of motion; as against Newton, that empty space, an infinite no-thing, cannot have absolute reality. Modern views tend to be either Leibnizian or Newtonian, or, if the inherent difficulties are realized, Kantian. Kant finally arrived at two inconsistent theories, but between them they seem to exhaust the possibilities.

Essai sur les origines intuitives du positivisme

Par Dr. Pierre Ducassé. (Bibliothèque de philosophie contemporaine.) Pp. x + 272 + 4 plates. (Paris: Félix Alcan, 1939.) 50 francs.

Méthode et intuition chez Auguste Comte

Par Dr. Pierre Ducassé. (Bibliothèque de philosophie contemporaine.) Pp. x + 620. (Paris: Félix Alcan, 1939.) 80 francs.

THESE two books constitute a sympathetic exposition of Auguste Comte's positive philosophy in relation to his life and the development of his thought. Dr. Ducassé is more readable and less dogmatic than Comte himself. His work should do something to revive interest in a thinker once hailed as the founder of a new universal religion and now too much neglected. As the prophet of the application of scientific method to the study of human life and society, if for nothing else, Comte deserves to be studied.

Physics

Angewandte Kristallstrukturlehre

Ein Hilfsbuch zur Bestimmung von Kristallstrukturen. Von Dr. E. Brandenberger. Pp. vii + 208. (Berlin: Gebrüder Borntraeger, 1938.) 12 gold marks.

THIS volume constitutes an excellent work of reference for theoretical studies and computations accompanying crystal analysis. It contains a clear account of structure-topology which is all too rare. For the rest, the discussion follows traditional lines in dealing with the nature of symmetry, translations, point-groups, space-groups, symmetry axes, and the complete formal solution of spatial systems. The numerous figures in the text are clearly drawn, and some of them (so far as the reviewer's experience goes) are original and decidedly revealing. F. I. G. R.

Proceedings of the Sixth Summer Conference on Spectroscopy and its Application

Held at the Massachusetts Institute of Technology, Cambridge, Mass., July 18–20, 1938. Pp. viii + 172. (London: Chapman and Hall, Ltd.; New York: John Wiley and Sons, Ltd., 1939.) 15*s*. net.

IN this volume, spectroscopy is little more than a thread binding together investigations on many diverse problems, physical, chemical, biological, etc. There are thirty-one papers more or less unco-ordinated, covering a wide field of subjects. On one hand, there are purely technical discussions dealing with instruments, wave-length standardization, photometric technique, and the properties of photographic emulsions. On the other hand, there are examples of chemical analyses, ranging to the extreme case of the application of the spectroscope to the detection of crime. The analyses described follow either the well-known method of emission-line spectra or the alternative method of absorption spectra, so useful in the case of complex organic compounds, of proved value, for example, in the standardization of vitamin preparations. One of the most interesting of the papers describes an extension of this type of work in the use of absorption spectra for fixing the structure of vitamin B_1. There is also a note on still a third method of chemical analysis, the use of fluorescence spectra, by which, for example, the presence of bacteriological contamination can be detected in a cigarette. On the whole, such biological applications of spectroscopy seem to stand out in interest, in that they point the way to a large field of future research. H. W. B. S.

The Nature of Crystals

By A. G. Ward. (Blackie's Tracts on Recent Physics.) Pp. ix + 114 + 4 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 3*s*. 6*d*. net.

THIS is a refreshing little book. It is a very good introduction indeed to the new crystallography, but at the same time there is considerably more in it than that. Above all, it is a revolt—and an exceedingly well-planned one—against the excessive professionalism of science with which we seem to be afflicted. Actually, the reader is conducted skilfully through the subjects of formal and chemical crystal structure, and he is asked to delight in knowing the reasons why materials have the properties which in fact they display. Whether, however, the inquirer will leave his easy chair (as the author requests him to do) and "get busy" with a few crystals, test-tubes and dishes is another matter, but he will be the happier—and the wiser—if he can and will.

Some very sound advice is offered for the making of models, and it is clear that these need be neither troublesome to construct nor unduly expensive.

Naturally, these pages will not by themselves produce a crystallographer, while the theorists might almost deny that the contemplation of natural things can give pleasure. Again, it is all rather more difficult. But Mr. Ward—and Prof. Bernal, with his stimulating preface—have produced something at once original and charming. F. I. G. R.

Physics To-day

By John A. Clark, Frederick Russell Gorton and Francis W. Sears. Pp. vi+634+x. (London: Constable and Co., Ltd., 1939.) 8*s.* 6*d.* net.

On account of the differences in the educational systems of the two countries, an American text-book of elementary physics can seldom be used as a text-book in Great Britain. There can be no doubt, however, of the usefulness of the present volume, by three American physicists, to all teachers of elementary physics. The fundamental laws and principles are set out briefly and simply with plenty of illustration. The outstanding feature of the book is the vitality and up-to-dateness of the linking of physical principles with laboratory experiments and with everyday life. With the increasing use of the epidiascope, the book is worth buying for the 750 illustrations alone. They consist of some conventional diagrams to illustrate physical principles together with many diagrams and actual photographs of simple experiments in progress, photographs of practical applications and portraits of all the famous physicists. As a typical example, the subject of levers is illustrated by a photograph of two men using a long pole to raise a car which has sunk up to the axles in mud. The picture is so clear that an estimate can be made of the mechanical advantage. The lever principle in the typewriter and in commercial scales of the newer pattern without springs is the subject of two very clear diagrams amongst a total of fourteen illustrations on levers.

The mixing of philosophy with physics and a loose use of the word 'why' is in striking contrast with the general excellence of the book. The reader is told that "you, like people of all times, want to know the 'why' of things. . . . Physics . . . aims to give you an understanding of both the 'how' and the 'why' of them". Chapter 1 starts with the question: "Is a solid body *really* solid?" However, the mixing of philosophy with physics, like the mixing of theology with ethics, is a matter of taste, and the volume can be very strongly recommended to all teachers of elementary physics in schools and colleges. W. H. G.

Electricity

By Dr. T. F. Wall. (Home University Library of Modern Knowledge, No. 190.) Pp. 256. (London: Thornton Butterworth, Ltd., 1939.) 2*s.* 6*d.* net.

Dr. Wall's interesting survey of the principles and applications of electricity is a valuable addition to the Home University Library of Modern Knowledge. Even the most recent applications are included. In spite of the condensation essential for the treatment of so comprehensive a subject in so small a space, there is no superficiality. The general reader will here find a trustworthy guide to the remarkable penetration of the use of electricity into every sphere of human activity. Food, clothing, housing, hygiene, health, transport and entertainment are all adequately covered. Simple calculations can be made by the aid of the appendix. The volume would also be excellent vacation reading for university students about to study physics in a degree course, or for those specializing in biological subjects, where electrical apparatus is proving increasingly useful. W. H. G.

Psychology

Psychotherapy

By Dr. Paul Schilder. Pp. 344. (London: Kegan Paul and Co., Ltd., 1938.) 15*s.* net.

Dr. Paul Schilder has given us a very good account of his views on psychotherapy. Generally speaking, his views are psychoanalytically determined, although he is by no means an orthodox Freudian according to the purists. At the same time he incorporates just as much of the work of Jung and Adler as he thinks necessary in his psychotherapeutic technique. He dismisses relaxation as scarcely usable in the everyday approach to the patient. We think this is a pity, as this method does play a part in psychotherapy even although it may be largely suggestive in application. We do not agree with the statement that "the hospital situation makes the adaptation too simple for him" when referring to the psychoneurotic.

A Manual of Psychology

By Dr. G. F. Stout. Revised, in collaboration with the author, by C. A. Mace; with an Appendix by Dr. R. H. Thouless. Pp. xix+708. (London: University Tutorial Press, Ltd., 1938.) 12*s.* 6*d.*

To those of us who were brought up on "Stout" it is a great pleasure to see a fifth edition. There is no alteration from the fourth edition except the addition of an appendix on Gestalt by Dr. Thouless and a note giving Prof. Stout's views.

Dr. Thouless gives a very good brief account of *Gestalttheorie*. Prof. Stout accepts Gestalt psychology in general, but is not satisfied with the Gestalt psychology of sense-perception. The Gestalt psychologists seem to deny much importance to past experience in perceptual processes and to neglect the difference between sensation and perception.

Personality in Formation and Action

By Dr. William Healy. (Thomas W. Salmon Memorial Lectures.) Pp. 204. (London: Chapman and Hall, Ltd., 1938.) 8*s.* 6*d.* net.

The Salmon Memorial Lectures for 1937 were delivered by Dr. W. Healy, director of the Judge Baker Guidance Centre in Boston. Personality is defined as "an integrated system of habitual adjustments to the environment, particularly the social environment".

The author gives a very competent account of the development of the personality in childhood, its actions and reactions in adulthood, and the wider implications which are met with in national and international life.

At a meeting early this year of the Royal Society of Arts, Commander Levick gave an account of the 1938 expedition to Newfoundland, and it is clear from his description that the boys enjoyed the experiences and must have gained enormously from them (*J. Roy. Soc. Arts*, 87, 970, Aug. 1939). In recent expeditions a number of boys from secondary schools have been included in the party, and the Astronomer Royal, who was in the chair, pointed out that the public schoolboys and the secondary schoolboys had a great deal to gain from this contact with each other and from collaboration in such an enterprise.

Field Archæology in War Time

ARCHÆOLOGISTS nowadays for the most part, having other preoccupations, have ceased investigations in the field. Nevertheless, experience in the last war showed that military operations may bring to light evidence which, when recorded with such note of the conditions of discovery as circumstances permit, may point the way, as happened in the Macedonian campaign of 1915–18, to further and valuable fields for further research in later days of more assured tranquillity. The valuable collection of prehistoric antiquities at Salonica is not only an enduring monument to the devotion to archæological studies and the *flair* of those archæologists who served in the forces in that theatre of the war, but also, on the cessation of hostilities, it served as the starting-point of a series of investigations in the Macedonian field which have thrown a flood of light on cultural movement in this borderland of prehistoric Greece. Nor should it be allowed to be forgotten that it was directly out of Dr. R. C. Campbell-Thompson's military service in Mesopotamia, which afforded him opportunity for an archæological reconnaissance, that there grew the joint expedition of the British Museum and the University of Pennsylvania to Ur, at first under the direction of the late Dr. H. R. Hall, and later of Sir Leonard Woolley—as a whole, and in its effect on study of the growth of early civilizations, which is still far from being exhausted, one of the most momentous in a long series of discoveries in the history of archæology.

SUCH opportunities in the field overseas are not likely to recur—indeed it is permissible, without risk of misunderstanding, to hope that they will not. But already on the home front a number of finds, recorded in connexion with A.R.P. and other military or defensive activities, bear witness to the vigilance of local archæologists and their solicitude that any evidence of antiquity brought to light shall not escape record. Among the latest finds reported is a discovery at Canterbury (*The Times*, Sept. 25), where in excavating a trench at the Simon Langton schools, on the site of the White, or Austin Friars' former buildings, material of considerable archæological interest has been brought to light. A passage, built of chalk blocks and believed to lead to the Cathedral, is stated to have been found at this point about twenty-five years ago. The site is also known to cover extensive Roman remains; but unfortunately, the need for haste demanded the use of a mechanical excavator and precluded scientific examination of the stratigraphic record. Most of the relics found were of medieval date, and included massive parts of what are believed to be the base of the Friary buildings, a simple medieval copper ring, a sixteenth-century inscribed German jetton, and human bones in no particular order, as well as an undisturbed east-to-west Christian burial. The copper ring was six feet below the surface in an early, probably medieval, cemetery. Of still greater archæological interest was the evidence of a Roman kitchen midden, from which were obtained much broken pottery coated with soot, some fragments of Samian ware, and quantities of burnt wood. These finds were associated with a bed of oyster shells.

Reports of the Australasian Antarctic Expedition

SLOWLY the reports upon the extensive collections made in Antarctic seas by Sir Douglas Mawson's Expedition of 1911–14 are being completed and published (1, part 3 ; 2, part 4 ; 2, part 8. Sydney : Gov. Printer). Among the zoological contributions are Prof. T. Harvey Johnston's "Parasitic Infusoria from Macquarie Island" which include ciliates from a lamellibranch and a suctorian from an Asellid crustacean, both of which appear to be new to science; an account of forty species of Pycnogonida, among which Decolopoda is not represented, by Dr. Isabella Gordon; and a description by Prof. G. E. Nicholls of seven genera and twenty-six species of Gammarid Amphipods new to science, in a collection which includes ninety species representative of sixty genera.

Earthquake near Smyrna

AN earthquake of considerable intensity shook the district around Smyrna on Friday, September 22. In Smyrna itself more than 200 people are reported killed, many more injured and 5,000 are without shelter. In the surrounding district several villages have been almost destroyed. During the remainder of Friday and Saturday, aftershocks have occurred almost continuously, accompanied by underground rumblings. This region of Asia Minor is liable to earthquakes and earth tremors. Smyrna was affected by an earthquake which was destructive also at Aidin and places in the Meander Valley on September 20, 1899, though on that occasion the epicentre was somewhat to the south of the present one, being then near lat. 37·5° N., long. 27·5° E. A destructive earthquake again affected Smyrna on March 31, 1928, the epicentre on that occasion being calculated from the readings of 96 seismograms to have been at lat. 38·5° N., long. 28·0°E., somewhat inland to the east of Smyrna. Further data concerning the present shock will no doubt be somewhat delayed, though it appears to have been sufficiently intense to have affected seismographs throughout the world.

Other Recent Earthquakes

AN earthquake of moderate intensity was recorded at Kew Observatory on September 15. The *P* waves started at 23h. 21m. 42s. G.M.T. on the seismogram and the epicentral distance has been calculated to be provisionally 2,690 km. On September 18 an earthquake was reported as having had its epicentre approximately 50 miles from Vienna. This shock damaged nearly all the buildings in the small village near the epicentre, and two people are reported killed. On September 20 several earth tremors were experienced in Greece. Early in the day severe shocks rocked the town of Patras, and much apprehension was caused, though there appears to have been no resultant damage or loss of life. Shocks were felt also in several parts of the Peloponnesus, including Pyrgos, though here also no damage is reported. Minor tremors are relatively common in Greece, though shocks such as the one of April 22, 1928, which partly destroyed Corinth, are not so frequent. The last severe earthquake in Greece was probably that of July 20, 1938, which did damage at Scala Oropos and adjacent villages.

Protection of Wild Birds

WE understand that the Royal Society for the Protection of Birds has under consideration the drafting of a Bill to amend and consolidate the existing Acts for the protection of wild birds. Such a measure is highly desirable in view of the complexity of the present laws dealing with wild birds. The general lines upon which new legislation should proceed is indicated by certain resolutions drawn up by representatives of the County Councils Association and of municipal corporations, and referred to in the report for 1938 of the Royal Society for the Protection of Birds: (1) that as the complexity of the existing law had led to difficulties in administration, there was, in the opinion of the Conference, a strong case for consolidation and simplification; (2) that protection should be afforded to all wild birds, their nests and eggs, throughout the whole year, with specific exemptions which should be the subject of further discussion; (3) that meantime the Home Office be asked for its views on the matter.

As earlier attempts have shown, it is no easy matter to draft a Bird Protection Bill which is simple, affords all the protection required, and at the same time avoids the danger of opposition from interested persons who may block its passage through Parliament. But with good will and a willingness to compromise on points not vital to the essential interests of wild birds, it should be possible to draft a Bill which would commend itself to reasonable opinion and obtain the assent of Parliament. On the other hand, possible competition between Bills drafted by different bodies, such as for example the Royal Society for the Protection of Birds, the Scottish Society for the Protection of Birds, and perhaps the Home Office, should not be allowed to obscure the need and demand for new and simplified legislation, or, when conditions are more favourable, to delay its speedy passage to the Statute Book.

Value of Fruit Juices

THE possibility of cessation or restriction of supplies of citrus fruits or other fresh fruit juices from abroad makes some recent work carried out at the Long Ashton Research Station, Bristol, of particular value at the present time (Long Ashton, Ann. Rept. 1938). Canned black currant juice would appear to be of special importance. It has a high content of both vitamin C and iron, and has proved extremely useful in cases of ulceration of the stomach and duodenum or hyperacidity. Similarly, apple juice has been successfully used in the treatment of pink disease (erythrocedema). Information obtained from Switzerland and Germany supports the view of the medical significance of fruit juices, claims being made that they are of benefit in other diseases such as diabetes, inflammation of the lungs or kidneys. The writer suggests that closer co-operation with the medical profession in England is desirable, in order that the true facts and significance regarding the use of fruit juices should be discovered and the danger of any false claims be avoided.

Ordnance Survey Plans

IN a paper prepared for the British Association meeting at Dundee, but not delivered, Brigadier A. B. Clough outlined the recommendations of the report of the Committee appointed in May 1935 to consider the revision, scales, styles, etc., of Ordnance Survey maps. The recommendations may be noted even if delay must now ensue in the fulfilment of some. The principal points are these: (1) that no changes be made in the scales of existing maps; (2) that the large-scale maps be rearranged so as to form a single national series instead of thirty-nine separate county series; (3) that the revision of the large-scale plans be a continuous rather than a periodic process; (4) that a new series of maps be introduced on a scale of 1 to 25,000; (5) that a grid be superimposed on all Ordnance maps. Several subsidiary and consequential recommendations follow, namely, that all large-scale plans should be square, that each 1 to 2,500 plan should cover 1 square kilometre of country, and that the metre should be the unit of measurement for the grid. It is also suggested that additional contours should be added to the six-inch map, and that the practice of publishing archæological maps should be continued.

Research in Freshwater Biology

THE seventh annual report for the year ending March 31, 1939, shows that the Freshwater Biological Association of the British Empire is flourishing. The director, Dr. E. B. Worthington, in his review and forecast, states that in last year's report it was forecast that the year now under review would see the launching of new ventures by the Association, building on the foundation laid down during the previous seven years of the Association's history. Of these new developments, three are of primary importance. First, the investigation of the bacteria of fresh water, financed by the Department of Scientific and Industrial Research, has started and the changes in the bacterial flora of Windermere and other waters have now been followed through nearly a whole annual cycle. Secondly, the investigation of coarse fish, financed by the fishery interests themselves, has commenced, and after a preliminary period of exploring possibilities, a sub-station for this special study has been set up in Cambridgeshire. Thirdly, a scheme for close co-operation between Wray Castle and the former Avon Biological Research, situated in the southern chalk stream area, came into effect from April 1, 1939. Under this scheme the Avon Research henceforth becomes a part of the Association as the "University College, Southampton, Branch for Southern Rivers". It will work under the scientific guidance of the Association while retaining its own individuality of control, and the advantage of being still closely associated with the University College. Thus the position of the Association is improved in every way, and, judging from the report on the work done, one may expect much valuable work in the future.

The Warsaw *Akwarium*

The *Akwarium*, a new magazine published for the information of aquarium keepers in Poland, had run only half the course of its first volume when more serious affairs brought it to an end. The last number (6-7) is a well-balanced guide to aquarium interests, dealing with methods of constructing aquaria, circulating and heating the water; with natural aeration by plants and artificial aeration; and with several of the creatures which have become standard inhabitants of the aquarium. Descriptive articles discuss among other things the alligator, some bizarre varieties of gold-fish, and the Egyptian mouthbreeder, *Haplochromis multicolor*, the curious habit of which is to hatch the eggs and protect the young within the cavern of their parent's mouth. We hope that before long the *Akwarium* may resume publication from Warsaw under happier and more settled conditions.

Social Distribution of University Education

In a paper on the social distribution of university education which was given before the Royal Statistical Society on March 21 (*J. Roy. Statist. Soc.*, 102, Part 3), Prof. Major Greenwood discusses the data of whole-time higher education, with particular reference to social class and such foreign experience as is available. Even with a stringent allowance for the difference of mean intellectual levels, it appears that under present conditions a large number of children of ability fit to profit from higher education do not receive it. Prof. Greenwood, however, concludes that the primary importance of university education, so far at least as concerns whole-time university education, is vocational, and as a matter of parental and governmental philosophy this fact is complacently accepted. On this philosophy no large increase of the whole-time university population should be expected. Data, however, about part-time higher education are incomplete, and the matter is of great importance, because increased leisure, which renders higher education possible for numbers greatly exceeding those before, is distributed through life, not concentrated in a few years of complete leisure. In commenting on the paper, Prof. A. M. Carr-Saunders pointed out that the number of those intellectually fit to profit from university education was very much larger than the number required to recruit the professions. He believed it should be the aim of the universities to bring under their care all who could profit fully from university education.

The Lingard Festival

The festival recently held at Stockholm in commemoration of the centenary of the death of Per Henrik Ling, the founder of scientific gymnastics, was attended by nearly eight hundred athletes from thirty-four countries, who took part in the many displays of various methods of training and education for fitness. The general opinion of experts was that the standard of efficiency was remarkably high and proved that the principles on which Ling founded his system still offered a firm basis for popular physical education, though the details had undergone considerable modification in recent years. The British delegates at the Lingard and the subsequent gymnastic congress included Mr. Kenneth Lindsay, Parliamentary Secretary to the Board of Education, Lord Aberdare and Lord Dawson of Penn as representatives of the National Fitness Council of England and Wales, Lord Burghley, president of the Amateur Athletic Association, and others.

A Big Sunspot

For the third time during September, a large naked-eye sunspot group has occurred. The last of these is a giant single spot crossing the disk between September 22 and October 4 with central meridian passage on September 28·0. Near the east limb the spot had an area corrected for foreshortening of more than 1,500 millionths of the sun's visible hemisphere. This spot is the return of an even larger spot (Nature, Sept. 16, p. 508) which crossed the disk between August 26 and September 7.

The Night Sky in October

On October 1 in the latitude of London, night (sunset to sunrise) lasts for 12·3 hours and on October 31 for 14·3 hours; civil twilight (the sun 6° below the horizon) shortens the night by more than one hour. The moon is new on October 12 at 20·5h. and full (the Hunter's Moon) on October 28 at 6·7h. U.T. There is an occultation of the third magnitude star, β Capricorni, on October 20, the disappearance as seen from Greenwich taking place at 17h. 52·0m. at position angle 42° and the reappearance at 19h. 4·7m. at position angle 282°. On October 28 there is a partial eclipse (magnitude 0·992) of the moon that is partly visible from London. The moon enters the earth's umbral shadow at 4h. 54m., reaches mid-eclipse at 6h. 36m. (13 minutes before moonset at London) and leaves the umbral shadow at 8h. 18m. This lunar eclipse is preceded by a total eclipse of the sun on October 12 visible in the Antarctic Ocean south of Australia, the limits of latitude for the central line of totality lying between 60° 0′ and 81° 28′ south. Lunar conjunctions with the planets occur as follows: on October 13 with Mercury; on October 21 with Mars; on October 25 with Jupiter and on October 27 with Saturn. Mars souths at about 19¼h. in mid-October; Jupiter at 22½h., and Saturn at 0¼h. Saturn is in opposition to the sun on October 22 when the planet's distance from the earth is about 772 million miles. Close groupings of Jupiter's four inner satellites can be seen at 22½h. on October 24 and 25; in the 24-hour interval, satellites I, III and IV have swung from west to east of the planet. On October 19–20, Jupiter occults the ninth magnitude star B.D. –1°3. At Greenwich the immersion takes place at 22h. 3m. and the emersion at 0h. 6m. As the motion of Jupiter is retrograde at the time, the immersion takes place at the planet's west limb. The computed times are liable to an error of some minutes owing to the slow motion of the planet. From a radiant in Draco a meteor shower associated with the comet Giacobini-Zinner (1900) may occur between October 8 and 10. The zodiacal light may be observed before dawn in the middle of the month. On moonless nights it is also worth looking for auroras, for the sun is still active and there is a pronounced seasonal peak in the frequency of magnetic storms in October, another peak occurring in March.

Scientific and Technical Institutions

The rooms of the Royal Astronomical Society in Burlington House, London, have been closed until further notice; all communications should be addressed to the Assistant Secretary of the Society at the University Observatory, Oxford.

The offices of the Royal Society of Arts have been removed to Buxted Park, Sussex; correspondence should be addressed to the Secretary of the Society, c/o Basil Ionides, Esq., Buxted Park, Sussex.

The Institution of Mechanical Engineers is carrying on the bulk of its work at The Meadows, Bletchworth, Surrey, but the Institution building in Storey's Gate, London, will remain open for dealing with personal inquiries and for members or others wishing to make use of the library.

The offices of the Iron and Steel Institute at 4 Grosvenor Gardens, London, S.W.1, are remaining open, and the Joint Library and Information Department will be available for consultation by members and the industries. Two volumes of the *Journal* for 1939 are being issued, in September 1939, and January 1940, respectively. The publication of a *Monthly Journal*, the first number of which was to have been issued in January 1940, has been deferred.

The head office of the Institute of Fuel has been removed to 30 Bramham Gardens, London, S.W.5. The ordinary meetings of the Institute are suspended for the time being, but it has been decided to continue publication of the journal. Mr. H. A. Humphrey will deliver the Melchett Lecture, on "The Supply of Explosives during the Last War and the Early History of Billingham", at a luncheon to be held on October 19.

The offices of the Institute of Physics and the *Journal of Scientific Instruments* have been removed to the University of Reading, Berkshire.

The offices of the Institute of Wireless Technology have been transferred to 25 Firs Drive, Palmers Green, London, N.13; for the duration of the war, examinations will be held only once a year.

Announcements

Contrary to what has already been published, the majority of the departments of the Imperial College are remaining at South Kensington; only the Mining Department is going to Camborne and the Metallurgy Department to Swansea. All other departments are preparing to begin normally on October 10, this being possible through the provision of adequate shelters in the basements.

The Royal Botanic Gardens, Kew, are now open every day from 11 a.m. until 4.30 p.m., but should daylight air raids take place, then no doubt the Ministry of Agriculture will close them again. The plant houses are open from 1 p.m. until 4.15 p.m. but the museums will remain closed. Only three of the gates will be open: the Main Gate, Victoria (opposite Kew Gardens Station) and the Lion at Richmond end. Visitors to the Gardens go there at their own risk, as there are no air-raid shelters in the Gardens.

Dr. E. Palmén has been appointed director of the Thalassological Institute, Helsinki.

The University of Toronto has received from the Rockefeller Foundation a gift of 250,000 dollars, a third of which is to be spent on researches on insulin and dementia præcox.

King Gustav of Sweden has devoted the money collected on the occasion of the thirtieth year of his reign, amounting to five million kronen, to the foundation for the study of paralytic diseases, especially poliomyelitis, and to the campaign against tuberculosis.

An honorarium of a thousand dollars to promote research work in ophthalmology is offered through the International Association for the Prevention of Blindness. The subject is simple non-inflammatory glaucoma. Further information may be obtained from the Secretary of the Association, 66 Boulevard Saint-Michel, Paris.

The Fleming Manufacturing Company, Providence, R.I., has constituted a fellowship for the study of the design, construction, and operation of oil filters in the Mellon Institute. Dr. Glenn O. Ebrey, who has been appointed to the incumbency of the fellowship, received his professional education at Illinois College and at the University of Pittsburgh. During 1931–32 he was research chemist with the Sinclair Refining Company, research and development division, East Chicago, Ind. For the past seven years he has been chief chemist of the Pennzoil Company, Oil City, Pa.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 600.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nature of the Nebular Red-Shift

FROM an investigation (to be published in *Physica*) of the proper vibrations of expanding spherical space, it follows that—in extremely good approximation—light is propagated with respect to co-moving co-ordinates irrespective of the expansion, except that (*a*) the time-rate of events is slowed down and (*b*) all energy portions decrease, both inversely proportional to the radius of curvature.

The slowing down secures the constancy of the velocity of light and entails the nebular red-shift, which from this point of view takes place *during the passage*. The attempt[1] to decide by observation, whether it is actually due to expansion, rests on two important formulæ, which follow from the new view with great ease. Let l be the linear diameter of a nebula *at the moment of emission* and χ its angular distance from the observer (linear distance divided by the circumference of space), then the angle $d\theta$ between two geodesics of space, pointing at the moment of emission from the observer to the ends of the diameter, is from pure geometry:

$$d\theta = \frac{l}{R \sin\chi}, \qquad (1)$$

R being the radius of curvature at the moment of emission. By the theorem quoted above, $d\theta$ is also the observed angular diameter of the nebula (Hubble and Tolman, equation 3).

Again, let the energy emitted by the nebula within an appropriately chosen unit of time be E_s. It will soon assume the shape of a spherical shell of thickness c (say). Let $R_{\text{obs.}}$ be the radius of space, when this shell reaches the observer. Its surface at this moment is, by pure geometry, $4\pi R^2_{\text{obs.}} \sin^2\chi$. By the theorem quoted above, its thickness then is $c\,R_{\text{obs.}}/R$ and its energy is $E_s\,R/R_{\text{obs.}}$. Hence its energy density ρ is

$$\rho = \frac{E_s}{4\pi c R^4_{\text{obs.}}} \cdot \frac{R^2}{\sin^2\chi}. \qquad (2)$$

ρ is a measure of the bolometric luminosity, observed outside the earth's atmosphere (Hubble and Tolman, equation 4).

My purpose in re-stating here these two important formulæ due to Tolman is to make the following remarks. Both l and E_s refer to the moment of emission, which is different for two nebulæ observed simultaneously. Should l and E_s exhibit a general dependence on R, then it would no longer be reasonable to regard them as *constants*, when equations (1) and (2) are combined (as they actually are) with the hypothesis of uniform spatial distribution of the nebulæ. For the latter, if admitted at all, has to apply to nebulæ which are intrinsically similar at the *same* moment of time—not at such moments as depend on the accidental position of our galaxy.

As regards l, the question is, whether we are inclined to assume (*a*) that the distances between the stars within a nebula behave, on the average, like the distances between two points of a rigid body—say, the ends of the Paris metre rod; or (*b*) like the distance between two distant nebulæ. Clearly the case of the stars is intermediate. To regard l as a constant means to decide for the first alternative. The second one would make l/R constant, giving formula (1) the same form as in the case of a non-recessional explanation of the red-shift (see Hubble and Tolman, equation 3′).

As regards E_s, the possible general decline of the nebular candle-powers has already been mentioned by Hubble and Tolman (see their concluding remarks). To the assumption that the same amount of energy is emitted during every second, there is a peculiarly simple alternative, namely, that the amounts of energy, which *have* been emitted during a second, *remain* equal. On account of the decay of travelling energy, this assumption would mean $E_s \sim 1/R$, which reduces equation 2 to the same form as in the case of a non-recessional explanation of the red-shift (see Hubble and Tolman, equation 4′). I do not mean to suggest $E \sim 1/R$ particularly. I mention it in the way of an example.

These remarks detract nothing from the importance of deciding by observation how $d\theta$ and ρ actually behave, if the photographs are interpreted as assuming uniform spatial distribution. I understand that present evidence points to observed luminosities (ρ) decreasing with distance *not even quite as rapidly* as we should expect (with E_s = const.) from the non-recessional explanation. If that is so, I should say they rather support the recessional explanation, in spite of its predicting a still more rapid decrease of the ρ's. The discrepancy, though greater, can here be removed by assuming the E_s's to decrease with time; an assumption which is very plausible in an expanding universe, which, on the whole, cools down; but not at all plausible in a static one.

E. SCHRÖDINGER.

7 Sentier des Lapins,
La Panne, Belgium.
July 31.

---

[1] Hubble, E., and Tolman, R. C., *Astrophys. J.*, 82, 302 (1935).

The Forbidden ${}^3P_0-{}^1D_2$ Line of O III in the Nebular Spectrum of Nova Herculis 1934

ALTHOUGH the two well-known lines of [O III] λ = 5007 A. (${}^3P_2-{}^1D_2$) and λ = 4959 A. (${}^3P_1-{}^1D_2$) are the most prominent features in the spectra of planetary nebulæ and novæ at the nebular stage, the third line of the triplet, corresponding to the ${}^3P_0-{}^1D_2$

transition, for which the calculated wave-length is λ = 4931·8 A., has not been generally observed. Recently, however, Bowen and Wyse[1] attributed to the $^3P_0-{}^1D_2$ transition the faint line which they observed in the spectra of the nebulæ *N.G.C.* 7027 and *N.G.C.* 6572.

In the nebular spectrum of Nova Herculis 1934, we have also observed, in 1935 and 1936, a rather faint but well-defined radiation λ = 4932 A.[2], but could not find to what it could be attributed. Measurements of our fourteen best plates give the wave-length

$$\lambda = 4932 \cdot 2 \pm 0 \cdot 6 \text{ A.},$$

which agrees well with the predicted wave-length for the third [O III] line. This line has been observed neither by Beer nor by Adams and Joy; but in McLaughlin's table[3] concerning the nebular spectrum of Nova Herculis we find a faint radiation λ = 4932·5 without identification.

Though the intensity of the two lines λ = 5007 and λ = 4959 A. has much decreased since 1936, the line λ = 4932 A. is found again in some plates taken at the Observatory of Lyons during the year 1938. It is perhaps not impossible that the $^3P_0-{}^1D_2$ line is now blended with the faint line λ = 4933 A. of *N V* (6*D*−7*F*); but this line was certainly not present at the beginning of the nebular stage. Thus the attribution of the line λ = 4932 A. to the forbidden transition of O III seems to be not doubtful.

We shall naturally expect to find the same line in nebular spectra of other novæ. On August 8 and 13, 1918, Wyse[4] observed a faint unidentified radiation at λ = 4933·3 and λ = 4932·4 A., in the nebular spectrum of Nova Aquilæ 1918.

According to Condon[5], the transition probability for the $^3P_0-{}^1D_2$ transition has theoretically a zero value, but in a recent paper Pasternak[6] gives a small but non-zero value. The transition probabilities calculated by Pasternak are indeed:

$$\begin{array}{ll} ^3P_2-{}^1D_2 & 0 \cdot 016 \text{ sec.}^{-1} \\ ^3P_1-{}^1D_2 & 0 \cdot 0055 \\ ^3P_0-{}^1D_2 & 1 \cdot 3 \times 10^{-4}. \end{array}$$

Roughly speaking, the $^3P_0-{}^1D_2$ transition should be four thousand times less probable than the $^3P_1-{}^1D_2$ transition. It is impossible to say, without any photometric measurements, whether the observed intensity ratio is or is not in agreement with the predicted value. It seems, however, difficult to admit that the observed line λ = 4932 A. is four thousand times less intense than the line λ = 4959 A. The $^3P_2-{}^1D_2$ and $^3P_1-{}^1D_2$ transitions are due to magnetic dipole radiation, and, according to Pasternak, the probability transitions should be accurate in absolute value to within 25 per cent; on the contrary, the $^3P_0-{}^1D_2$ transition is due to electric quadripole radiation and the corresponding probability transition should be good only to within a factor of two.

J. DUFAY.
M. BLOCH.

Observatoire de Lyon.
August 8.

[1] *Public. Astro. Soc. Pacific*, 51, 248 (1938).

[2] *Z. Astrophys.*, 12, 36 (1936).

[3] *Public. Obs. Michigan*, 6, 201 (1936).

[4] *Lick Obs. Public.*, 14, Part 3, 207 and 208 (1939).

[5] *Astrophys. J.*, 79, 217 (1934).

[6] *Public. Astro. Soc. Pacific*, 51, 160 (1939).

Influence of Temperature on the Pressure Broadening of Spectral Lines

IN a former note[1] we reported the results of our researches on the influence of temperature on the broadening of the mercury absorption line 2537 A. caused by helium at constant concentration of both gases. No changes of the line width exceeding the limits of experimental errors were observed. Now we have investigated with the same experimental arrangement the broadening of this line caused by admixture of argon. The constant concentration of mercury was about 6 × 10^{14} atoms per c.c. and that of argon 1·4 × 10^{19} atoms per c.c.

Nearly all absorption spectra obtained show a slight increase of the area limited by the line contour, that is, an increase of the width of the broadened line with the temperature. The increase of area due to the temperature change from 420° K. to 1300° K. was found not to exceed 10 per cent (for different plates this effect varies from −2·3 per cent to 10 per cent, the mean value being 3·6 per cent). This experimental increase does not reach the values calculated on the basis of theories of Lorentz[2] (36 per cent) or even of Weisskopf[3] (18 per cent). Also, as is well known[4,5], the asymmetrical intensity distribution within the mercury line 2537 A., broadened by argon, does not agree with the dispersion distribution given by the above-mentioned theories.

We have observed also another temperature effect, namely, the diminution of asymmetry of the line at higher temperature. Although the temperature influence seems really to exist in this case, both these effects are too small for the exact quantitative investigation with our present experimental arrangements.

It should be mentioned that besides the paper of Orthmann (quoted in our first note) whose results agreed with the Lorentz theory, the same problem has been experimentally investigated also by Hull[6]. The temperature effect on the pressure broadening of the potassium resonance line by nitrogen found by the latter amounts to 1630 per cent of that predicted by Lorentz's theory and 2790 per cent of that predicted by the Weisskopf's theory. Thus these results show even more pronounced discrepancy with the collision damping theories than ours, although their deviation is in the opposite direction to that found by us.

H. HORODNICZY.
A. JABŁOŃSKI.

2nd Physical Institute,
Stefan Batory University,
Wilno.
Aug. 18.

[1] Horodniczy, H., and Jabłoński, A., NATURE, 141, 1122 (1938).

[2] Lorentz, H. A., *Proc. Roy. Acad. Amsterdam*, 8, 591 (1906).

[3] Weisskopf, V., *Phys. Z.*, 34, 1 (1933).

[4] Kuhn, H., *Proc. Roy. Soc.*, A, 158, 212 (1937).

[5] Ruhmkorf, H. A., *Ann. Phys.*, 33, 21 (1938).

[6] Hull, jun., G. F., *Phys. Rev.*, 51, 572 (1937).

Effect of an Excitation Energy on the Specific Heat of Liquid Helium II and its Relation to the Exchange Effect in a Non-Ideal Bose-Einstein Gas

IT has been suggested that, for the explanation of the abnormal properties of liquid helium II, a division of the molecules into molecules 'at rest' and 'moving' ones is an essential feature[1,2,3]. The free path for collision between molecules of different systems should be very large.

London[4] has directed attention to the fact that an ideal Bose-Einstein gas shows a transition point, which lies at 3·15° K. for a gas of a density and a molecular weight of liquid helium. Moreover, below this transition point the gas allows also a division of the molecules in those condensed in the lowest energy state, and others having a kinetic energy.

However, it can scarcely be expected that the velocity distribution of the moving particles in liquid helium can be identified with that of an ideal Bose-Einstein gas, so that it is not surprising that the specific heat of such an ideal gas[4] does not agree with that of liquid helium. The specific heat should increase $T^{3/2}$, whereas experiments show an increase with, at least, T^{6}.[5]

This difficulty can be eliminated by the assumption of an 'excitation-energy', which must be added to a condensed particle before it can participate in the velocity distribution of the moving ones. The specific heat increases then exponentially at low temperatures. In this way a better representation of the anomaly in the specific heat is obtained.

The existence of such an 'excitation-energy' can be explained on similar lines as the disorder energy in Fröhlich's theory of liquid helium[6]. On the other hand, it may also be derived from the gas model, as a consequence of the theory of a non-ideal Bose-Einstein gas below its transition temperature.

Here the excitation energy is due to the effect of exchange, which gives rise to a different interaction when molecules are in the same and when they are in different states. This effect leads to important corrections in the specific heat below the transition temperature, as then many particles will occupy the same, namely, the 'condensed' state.

A more detailed discussion will be published in *Physica*.

A. MICHELS.
A. BIJL.
J. DE BOER.

Van der Waals Laboratorium,
Amsterdam.
July 31.

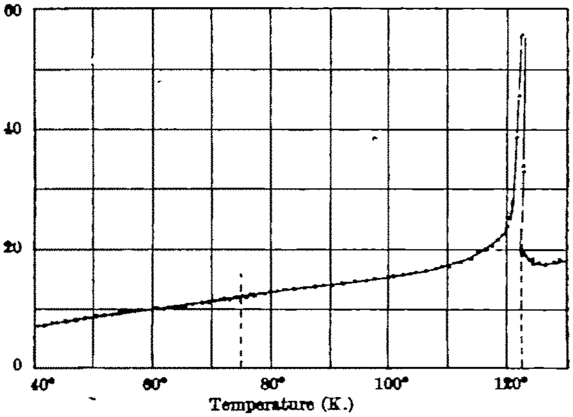
---

[1] Allen, J. F., and Jones, H., NATURE, 141, 243 (1938).
[2] Michels, A., Bijl, A., and de Boer, J., *Physica*, 5, 121 (1938).
[3] Tisza, L., NATURE, 141, 913 (1938).
[4] London, F., NATURE, 141, 643 (1938).
[5] Keesom, W. H., and Keesom, A. P., *Physica*, 2, 557 (1935).
[6] Fröhlich, H., *Physica*, 4, 639 (1937).

Specific Heat of a Substance showing Spontaneous Electric Polarization

VARIOUS authors[1] have investigated the specific heat of Rochelle salt, the best-known example of substances showing spontaneous electric polarization, but the results obtained so far have been somewhat contradictory. In some of the experiments a small anomaly at the Curie point (the upper limit of the Rochelle electric temperature region) was observed. Very little is, however, known about any thermal effects at the lower limit of the Rochelle-electric region. This temperature has sometimes been called the 'lower Curie point', and it has been suggested[2] that it should be marked by an anomaly in the specific heat.

We have now determined the specific heat of potassium dihydrogen phosphate which shows Rochelle electricity in the temperature region between 75° and 122° K[3]. The result of this investigation is given in the accompanying graph. It is evident from our measurements that there is no trace of any anomaly at the 'lower Curie point'. This means probably that the apparent disappearance of spontaneous electric polarization towards lower temperatures is due to a 'freezing-in' of the dipoles; that is, their inability to orientate themselves below a certain temperature owing to lack of thermal motion in the lattice. It seems, therefore, misleading to describe this temperature as a 'lower Curie point'.



A strong anomaly was observed at the Curie point (122° K.). Owing to the very gradual rise of the specific heat at the onset of this anomaly, an accurate evaluation of its energy content seems difficult. While these experiments were in progress, measurements of the specific heat at the Curie point were reported by Bantle and Scherrer[4] and Stephenson and Hooley[5]. Whereas our values in this temperature region agree well with the results of the latter authors, they differ considerably from those of Bantle and Scherrer. These authors observe the anomaly at 114° K. and give much higher values for the specific heat.

A full report of our experiments will be published elsewhere.

J. MENDELSSOHN.
K. MENDELSSOHN.

Clarendon Laboratory,
Oxford.
August 18.

---

[1] Kobeko and Nelidow, *Sowj. Phys.*, 1, 382 (1932). Busterholz, *Helv. phys. Acta*, 8, 39 (1935). Wilson, *Phys. Rev.*, 54, 1103 (1938). Hicks and Hooley, *J. Amer. Chem. Soc.*, 60, 2994 (1938).
[2] Staub, *Naturwiss.*, 23, 728 (1935).
[3] Busch, *Helv. phys. Acta*, 11, 269 (1938).
[4] Bantle and Scherrer, NATURE, 143, 980 (1939).
[5] Stephenson and Hooley, *Phys. Rev.*, 56, 121 (1939).

A Particular Mode of Fission of the Uranium Nucleus

As has been reported by one of us[1], uranium fission products can be collected by the recoil method many hours after the end of the irradiation of uranium by slow neutrons. This phenomenon can be explained in the simplest way by the assumption that one or more of the fission products are radioactive gases, of more or less long life and coming somewhere in the middle of the β-transmutation chain. To test this assumption we have performed the following experiments.

About 20 gm. of sodium pyrouranate placed in a glass tube between two cotton-wool plugs was irradiated by slow neutrons from a radio-thorium plus beryllium source equivalent to about 400 millicuries radon plus beryllium during seventeen days. One hour forty minutes after the irradiation had been interrupted, the glass tube with sodium pyrouranate was connected to a water pump and a stream of pure air (radon-free) was passed through it during 50 minutes to remove any radium emanation and the gaseous products of fission, which might have been accumulated in the uranium. Then a glass tube with pure silica-gel cooled to the temperature − 110°C. was placed between the tube with pyrouranate and the water pump and a stream of pure air was passed through the system for four hours. The silica-gel was then treated by hot dilute (1 : 5) hydrochloric acid to which some barium, strontium and lanthanum salts were added. The solution was filtered under suction and a complete chemical separation of lanthanum, barium and strontium was performed. The lanthanum, barium and strontium precipitates were found to be radioactive and showed the following half-life periods : La + K, $T \sim 30$ m., $T \sim 9$h. 30m., and $T \sim 45$h. ; Sr, $T \sim 20$m., $T \sim 7$h. 30m. and one isotope of much longer period ; and Ba, $T \sim 10$h. and $T \sim 50$h.

To find out whether the gaseous radio-elements are in the middle or at the beginning of the transmutation chain, we have separated the fission products of uranium from uranium oxide irradiated for 36 hours by slow neutrons from a cyclotron. The intensity of the neutron beam was equivalent to about 30 curies of radon plus beryllium. We were able to collect, from the walls of the vessel in which that preparation was contained, the products of transformation of the gaseous radio-elements.

These two experiments show definitely that there exist two new fission processes of uranium under bombardment by slow neutrons, with radioactive isotopes of krypton and xenon as intermediary products of the fission, coming in the middle of the transmutation chain[2].

Further experiments will be made in order to estimate the half-life period of these new radioactive isotopes of krypton and xenon and to search for the beginning of these transmutation chains.

W. G. CHLOPIN.
M. A. PASSWIK-CHLOPIN.
N. F. WOLKOV.

Radium Institute of the
Academy of Science of the U.S.S.R.,
Leningrad.
July 21.

Wolkov, N. F., *C.R. Acad. Sci. URSS.* (in the press).

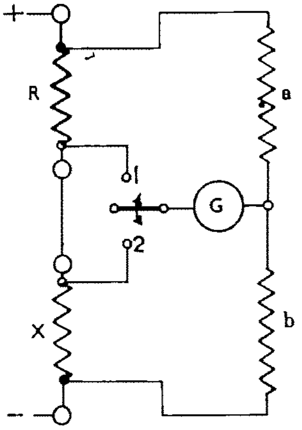
[2] Hahn, O., und Strassmann, F., *Naturwiss.*, 27, 89 (1939) ; Atenjun., A. H., Bakker, O., und Meyn, F. A., NATURE, 143, 516 (1939).

Comparison of Resistances of Four Terminal Resistors

THE only precise method given in the standard text-books for the comparison of the resistances of four terminal resistors is the Kelvin double bridge, and it appears to be the only one used for this purpose. The method described below is at least as precise and should, in my opinion, be as well known.

The circuit is shown in the accompanying figure, in which R and X are the standard and unknown resistances respectively ; a is a fixed resistance, conveniently one of the ratio arms of a standard bridge and b is the variable arm of the bridge.

With the switch on contact 1 a balance is obtained and a second balance with the switch on contact 2. If the values of b for the balances are b and b' respectively and r is the resistance between the inner potential terminals, we may write :



$$R.b = a(X + r) \text{ and } b'(R + r) = X.a.$$

Hence

$$\frac{R}{X} = \frac{a(a + b')}{b'(b + a)}.$$

This method has the following advantages over the double bridge, (1) less apparatus is required, (2) the effective sensitivity of the galvanometer is greater, and (3) no current passes, at balance, through two of the four potential terminals.

ARVON GLYNNE.

College of Technology,
Manchester.
August 4.

Inactivation of Diethylstilbœstrol in the Organism

IN previous reports[1] it has been demonstrated that the sex hormones (œstrone, progesterone) are rapidly rendered inactive in the organism. If a rat is injected with 1,000 I.U. œstrone no more than 1–2 per cent of this substance can be recovered from the organism by organic solvents after a period of forty-eight hours. In contradistinction to this, the hormone esters (œstronebenzoate, œstradiolbenzoate) are very largely recovered. These findings have been corroborated by Laqueur[2], who was able to demonstrate at the same time that the hormone esters remained deposited at the site of injection. They do not undergo slow decomposition in the blood, but are slowly absorbed from the site of injection.

We proceeded to investigate the behaviour of 4 : 4′-dihydroxy α-β-diethylstilbene (diethylstilbœstrol) which was described by Dodds, Golberg, Lawson and Robinson in 1938[3]. The authors, in a most instructive descriptive sketch, demonstrated the resemblance between these œstrogenic substances and œstradiol. Hence we compared the inactivation of stilbœstrol with that of œstradiolbenzoate and some other œstrogens.

Infantile rats were injected with 1,000 I.U. of œstrogenic substance dissolved in 0·1 c.c. of oil. After forty-eight hours the animals were killed and an attempt was made to recover the œstrogenic hormone from the whole body of the animal by my method[1], especially devised for this purpose. The hormone yield is seen in Table 1.

TABLE 1.

Œstrogenic substance	In the body	In the excreta
Œstrone	1–3 per cent	0 per cent
Œstrone benzoate ..	80 " "	Not examined
Œstradiolbenzoate ..	40 " "	1 per cent
Œstrone methyl ether[4]	70 " "	5 " "
Stilbœstrol	25 " "	25 " "

These experiments show that roughly 50 per cent of stilbœstrol can be recovered and that, in this respect, it resembles the hormone esters. It differs from those substances, however, in that half the amount is eliminated in the excreta.

We further investigated the question whether the slow decomposition in the organism is due to storage at the site of injection, or whether the substances are subject to slow decomposition during their circulation in the body. We injected stilbœstrol and other œstrogenic substances (1,000 I.U. in 0·1 c.c. of oil) into the hind-leg of infantile rats, killing the animals after forty-eight hours, and extracted separately the anterior and posterior half (without viscera). The result wás that stilbœstrol was exclusively found in that part which contained the site of injection (Table 2).

TABLE 2.

Œstrogenic substance	Anterior half	Posterior half
Œstradiolbenzoate ..	0	40 per cent
Œstrone methyl ether	0	70 " "
Stilbœstrol	0	25 " "

The experiments lead tothe fo llowing conclusions :

(1) In contrast to œstrone, stilbœstrol is only rendered inactive in the organism to a small extent, resembling, in this respect, the hormone esters.

(2) Similarly to the hormone esters, stilbœstrol remains deposited at the site of injection for a considerable time (depot formation) and from there it is slowly absorbed.

(3) Stilbœstrol is distinguished from the hormone esters by the fact that large amounts are eliminated in the excreta, particularly in the urine.

While after absorption the hormone esters are rapidly rendered inactive in the organism, this is not the case with stilbœstrol. In the excreta large amounts of the active substance are found. The fact that the organism is unable to inactivate considerable amounts of stilbœstrol probably helps to explain its eventual toxic activity (compared with œstrone) particularly if large doses are used.

BERNHARD ZONDEK.
FELIX SULMAN.

Laboratory of the Gynaecological-
Obstetrical Department,
Rothschild-Hadassah University Hospital,
Jerusalem. August 19.

[1] Zondek, B., *Lancet*, 237, 356 (1938); *Scand. Arch. Physiol.*, 79, 133 (1934): NATURE, 143, 282 (1939).

[2] Dingemanse, E., and Laqueur, E., *Amer. J. Obst. and Gyn.*, 33. 1000 (1937): Frank Anniversary Volume.

[3] Dodds, E. C., Golberg, L., Lawson, W., and Robinson, R., NATURE, 141, 247 (1938).

[4] Zondek, B., and Bergmann, E., *Biochem. J.*, 32. 641 (1938).

Estimation and Occurrence of Keto-Acids in Green Plants

ACCORDING to the present conception the keto-acids occupy a central position in the synthesis of amino-acids. Attention has been paid especially to the 'fundamental keto-acids', namely, oxaloacetic acid and keto-glutaric acid, since the amino group of aspartic and glutamic acids formed from them is transferred to other keto acids. In green plants, however, keto-acids other than oxaloacetic acid—the presence of which in the growing legumes has recently been demonstrated in this laboratory[1]—have hitherto not been found, evidently due to the absence of suitable methods.

Lately we have developed the following technique for the determination of keto-acids in plants.

Caustic soda solution and fine quartz sand are added to plant material[1]. The mass is crushed in a mortar and 2-4-dinitrophenylhydrazine solution, strongly acidified with hydrochloric acid, is added to it. The mixture, the pH of which is less than 1, is allowed to stand for one hour at room temperature, whereupon anhydrous sodium sulphate is added until the mass is dry. The mass is extracted with ether in the Soxhlet apparatus. The ether solution, which contains the dinitrophenylhydrazones formed, is shaken with sodium carbonate solution. The solution is then made acid with hydrochloric acid and the hydrazones are again precipitated from it by allowing the solution to stand for three days in the ice-box. The precipitate is separated, dissolved in alcohol and hydrated according to Tafel[2] but at near to 0° C. with sodium amalgam. Amalgam must be added in small quantities to the reaction solution. Thereby the hydrazones are decomposed so that the keto-acids form the corresponding amino-acids as a reduction product. Alcohol is distilled away *in vacuo* and the rest is dissolved in water. The amino-acids formed are determined in the solution. By means of the method in its present form, 80–90 per cent of the keto-acids are found.

In the above manner we have succeeded in finding and determining oxaloacetic acid, keto-glutaric acid and pyruvic acid in growing peas and red clover. For instance, in an experiment with red clover there were found 42 γ keto-glutaric acid, 18 γ oxaloacetic acid and 12 γ pyruvic acid per one gram of fresh material. Investigations are being continued also with non-legumes. The method is applicable also to the determination of keto-acids in animal material and micro-organisms.

A detailed account of the experiments will be given in the *Biochemical Journal*.

ARTTURI I. VIRTANEN.
A. A. ARHIMO.
HEIKKI SUOMALAINEN.

Biochemical Institute,
Helsinki. August 16.

[1] Virtanen and Arhimo, NATURE, 144, 36 (1939).

[2] Tafel, *Ber. deutsch. chem. Ges.*, 19, 1924 (1886).

Effect of Ethylene on *Mangifera indica*

THE variations in the chemical changes of the respirable substrate accompanying the process of fruit development and ripening of the different varieties of the tropical fruit *Mangifera indica* were investigated with the view of finding out the nature and the response of the substrate to the different methods of storage. Such investigations would provide helpful information for devising methods of storage of this delicate and easily perishable fruit. Accordingly, investigations as to the changes in the respirable substrate under the different conditions of storage were planned and carried out, first at a lower temperature of 8–12° C., secondly in ordinary room conditions of 28–32° C., and thirdly the effect was examined of different concentrations of ethylene gas as a means of artificial ripening.

The presence of ethylene gas is detected in developing *Mangifera indica* by stunted growth of pea seedlings in an atmosphere produced by ripening mangoes. The effect of ethylene on pears by Hansen[1,2], on lemons by Denny[3], on bananas by Wolfe[4], and on tomatoes by Work[5] has been studied; but the chemical changes brought about in the metabolites of the fruit have not yet been clearly understood. Hansen and collaborators have found the effect of ethylene on pears to be more marked at a certain period of the maturity of the fruit and found that the rate of respiration, the rate of starch hydrolysis and the concentration of the total and reducing sugars increased.

In *Mangifera indica* we found that the effect of ethylene is more marked in the pre-climacteric phase of the fruit, and in the post-climacteric phase the effect is not pronounced. This effect is marked by a very rapid increase in the respiration rate, by strong hydrolysis of starch and increase in total and reducing sugars and decrease in titratable acidity and alcohol insoluble residue.

Some of the results showing the amount of respirable substrate obtained at the end of a period of nine days experiment from various samples of different treatments (calculated on the basis of original substrate concentration as 100) are given in the accompanying table:

Substrate	Original substrate concentration	At the end of a period of 9 days			
		Un-treated (control)	Ethylene treated		Cold storage
			0 1%	1 0%	
1. Starch ..	100	36 09	10 49	26·29	56 86
2. Total sugar ..	100	443·90	775·70	612 10	302 80
3. Reducing sugar	100	325 00	491·60	416·60	385·83
4 Titratable acidity (expressed as citric acid)	100	55·60	17·60	17 50	94·06
5. Alcohol insoluble residue ..	100	42 17	27·03	37·84	77 80

In cold storage the trend of chemical changes is in the same direction, but the process is appreciably slowed down. The respiration rate increases markedly in ethylene treated fruit. The vitamin C content decreases as the fruit ripens and it decreases also in storage. The effect of ethylene on vitamin content is not yet clear and work on other tropical fruits is in progress. The effect of ethylene seems therefore to be of a respiratory nature. It initiates a chain of chemical reactions in the available substrate of the fruit, and the effect of ethylene reaction is in turn dependent on the nature of the substrate provided according to the stage of the maturity of the fruit.

Detailed results of these investigations are in course of publication in the *Transactions of the Bose Research Institute*.

B. K. KAR.
H. N. BANERJEE.

Bose Research Institute,
Calcutta.
July 13.

---

[1] Hansen, E., *Plant Physiol.*, 14, 145 (1939).

[2] Hansen, E., and Henery, H., *Plant Physiol.*, 12, 441 (1937).

[3] Denny, F. E., *Bot. Gaz.*, 77, 322 (1924).

[4] Wolfe, H., *Bot. Gaz.*, 92, 337 (1931).

[5] Work, P., *Science*, 68, 61 (1928).

Neural Mechanism of Sexual Behaviour in the Female Cat

FEMALE cats in spontaneous or induced œstrus display a characteristic behaviour which may be divided into: (1) courtship activities (playful rolling, rubbing, calling, crouching with pelvis raised, and 'treading'), and (2) the after-reaction (vigorous or frantic rolling, rubbing, squirming, and licking).[1] Bard[1] has shown that extirpation of the neocortex does not change the specific pattern of the sexual response. It was my aim to determine if this peculiar performance of the female cat during 'heat' is conditioned by the activity of an encephalic 'sexual centre' or if some typical components of the complex behaviour could still be elicited from the spinal cord after transection of the brain stem below the medulla.

It is self-evident that, among the reactions mentioned above, only those the accomplishment of which is not dependent on the integrating mechanism of standing and equilibrium are suitable for this kind of experiment. Two reflexes fulfil these conditions: raising of the pelvis, and 'treading'. Treading consists in a rhythmic slow or rapid marching movement of the hind legs with flexion of the thigh and knee and dorsal flexion of the foot, as soldiers mark time. This is obtained by gentle tapping of the perineum. During the course of the investigation another reflex apparently characteristic of 'heat' was observed: when the perineum is tapped on one side the tail is swept towards the other and maintained there until the stimulus ceases, uncovering the whole perineum. This is the natural attitude of the female cat in œstrus when approached by a male. These three reflexes were used as tests for 'heat' in the spinal cats.

The investigation was carried out on thirteen cats, eight of which were normal, in the beginning or towards the middle of their breeding season. Five were ovariectomized during the breeding season and studied towards the end or after the same. In all the spinal cord was transected at the level of the first cervical segment, artificial respiration applied, and the cat kept warm on a heating pad. From three to six hours after the transection, when the spinal shock had subsided, the sexual reflexes were tested on the animal held in crouching position, hindlegs flexed, chest touching the table. Of the eight normal cats, all but one showed a complete positive response to tapping of the perineum. Vaginal smears and the condition of the ovaries indicated œstrus, pro-œstrus or metœstrus. The one negative result was obtained on an old female with anœstrus smear and smooth ovaries. She showed as the only response an elevation of the pelvis. Of the five animals ovariectomized three months previously, three were not injected with œstradiol. Their response was negative as regards treading and tail movements. Two of them showed some raising of the pelvis. When tested before the transection no response whatever could be elicited. The other two ovariectomized animals were injected twice during six days with 1 mgm. œstradiol (Schering Progynon *B* 1939); when they exhibited typical sexual behaviour the transection was made. Reflexes similar to those obtained from the normal cats on heat were obtained from them.

These experiments demonstrate that some components at least of the sexual behaviour are short arc reflexes, comparable to the scratch-reflex, which can be elicited independently of the higher centres, but the occurrence of which depends strictly on hormonal conditions. It seems, therefore, that the existence of a hypothetical 'sexual centre'[1] should be accepted with caution, and then not so much as a pace-maker under the influence of which unspecific activities of the spinal cord are transformed into specific sexual reactions, than as a mechanism co-ordinating certain independent activities pre-existing at different levels of the brain stem. Dempsey and Rioch's[2] failure to obtain sexual reflexes from decerebrate cats may be explained by the extensor rigidity which follows the mesencephalic transection, rhythmic reactions (as treading) and reflex raising of the pelvis requiring for their performance a normal balance of muscle tone.

J. P. Maes.

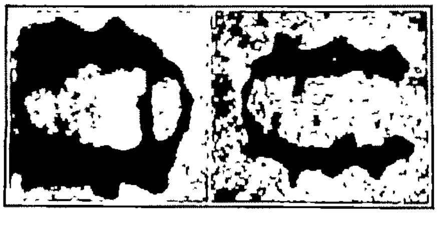
Laboratoire de Pathologie Générale,
Université, Bruxelles.
August 11.

[1] Bard, Ph., *Psych. Rev.*, 41, 424 (1934); *Amer. J. Physiol.*, 116, 4 (1936)

[2] Dempsey, E. W., and Rioch, D. McK., *J. Neurophysiol.*, 2, 9 (1939).

Abnormal Mitosis in Tobacco Plants Forming Hereditary Tumours

Tobacco species hybrids *Nicotiana glauca* ($n = 12$) × *N. Langsdorffii* ($n = 9$), *N. paniculata* ($n = 12$) × *N. Langsdorffii*, *N. suaveolens* ($n = 16$) × *N. Langsdorffii*, etc., formed hereditary tumours[1-4] all over the plants when they were as old as 4–7 months. Each plant of the amphidiploid *N. glauca* × *N. Langsdorffii* (= *N. Vavilovii*; $n = 21$) also formed hereditary tumours at about the same age. In searching for the cause or causes of tumour formation[4-5] I also examined the frequency of the abnormal mitosis in longitudinal sections of root tips of old *N. Vavilovii* plants. I counted normal late anaphases and late anaphases with chromatin bridges and obtained the following figures in studying 752 cells of five different plants which formed hereditary tumours: 21·4, 12·2, 10·7, 8 and 4·2 per cent anaphases with at least one chromatin bridge. 264 anaphases of the maternal plant *N. glauca* and 232 anaphases of the paternal plant *N. Langsdorffii* were also studied. No chromatin bridge was found in these anaphases.



Anaphases with chromatin bridges found in the amphidiploid *N. glauca-Langsdorffii* plants that formed tumours.

Abnormal mitosis, and in particular the formation of chromatin bridges, found in the amphidiploid *N. Vavilovii* does not seem to be due to its polyploid nature, because in studying 72 anaphases of the autotetraploid *N. glauca* no chromatin bridges were found.

The procedure of mitosis in the amphidiploid *N. rustica* ($n = 24$) × *N. glauca* (= *N. rugla*; $n = 36$) was also studied. (This amphidiploid does not form hereditary tumours.) In studying 116 late anaphases of one plant of this amphidiploid I found in four of them chromatin bridges, that is, in 3·4 per cent of the cells. This is a somewhat lower percentage than (though very close to) the smallest one found in the fifth tumour-forming plant; but still high enough when compared with that of the normal species (0 per cent). Tumour-forming plants, however, have on the average a considerably higher percentage of abnormal mitosis. Chromatin bridges represent bicentric chromosomes, resulting, most probably, from exchange of parts between non-homologous chromosomes.

A causal interpretation of tumour formation in the light of these studies can be advanced in the following way. Daughter cells resulting from cells with abnormal mitosis in general and from such with chromatin bridges in particular should have abnormal genetic constitutions. Although such cells may have a lower rate of cell division, their number should be gradually increased, because the process is irreversible, so that the older the plant is the greater percentage of cells with abnormal genetic constitution it should have. When the percentage of the cells with abnormal genetic constitution is considerably increased, determination and differentiation processes become abnormal, so that the plants form tumours (meristematic and parenchymatic tissues) instead of normally differentiated shoots and organs. The formation of abnormal shoots ('bud mutations') in about 12–18 per cent of the plants in some lines of *N. Vavilovii* is also conditioned by abnormal mitosis.

Dontcho Kostoff.

Institute of Genetics,
Academy of Sciences of the U.S.S.R.
Moscow

[1] Kostoff, D., *Zentralbl. Bakter* (II) 81, 244–260 (1930).

[2] Kostoff, D., *Genetics*, 17, 367–376 (1935).

[3] Kostoff, D., *J. Genet.*, 37, 129–209 (1938).

[4] Kostoff, D., *Protoplasma*, 20, 440–456 (1933).

[5] Kostoff, D., *Proc. Indian Acad. Sci.*, 8, 11–44 (1938).

A 'Safe' Fluid for Museum Use

The general practice of using ethyl alcohol as a preservative fluid for museum specimens has several disadvantages. At the present time when we are faced with the possibility of high explosives and incendiary bombs damaging museums, the inflammability of alcohol naturally causes much concern to the staff of such institutions. Ten years ago[1] I directed attention to a preservative fluid, first used by W. Pampel[2], for storing specimens of insects for several years with the tissues soft and in good condition for subsequent dissection. I gave this medium the name of 'Pampel's fluid' and its composition is as follows:

Glacial acetic acid	4 parts
Distilled water	30 parts
Formaldehyde	6 parts
95 per cent alcohol	15 parts

For several years past I have abandoned the use of alcohol for preserving insects and many other arthropods in favour of Pampel's fluid. This fluid is in every way superior to ethyl alcohol, being cheaper, does not need replacement so often and does not cause undue hardening, besides preserving the tissues in a better condition. It is, furthermore, non-inflammable.

I have advocated its use to a number of zoologists and others, and may add that one recent biological expedition preserved almost all its specimens in Pampel's fluid with complete success. It has the drawback that in the case of vertebrates, echinoderms and many of the higher crustaceans, the acetic acid naturally acts upon the calcareous skeleton; but for the vast majority of invertebrate animals this disadvantage does not arise. I recommend that a beginning be made in the use of this fluid with as little delay as possible. Many alcohol-preserved specimens can be transferred into it and it can be adopted for new specimens that it is desired to preserve. It should, at least, be given an adequate trial for a few years.

A. D. IMMS.

Zoological Laboratory,
Cambridge.
Sept. 18.

---

[1] *Bull. Entom. Res.*, 20, 169 (1929).
[2] *Z. wiss. Zool.*, 108, 290 (1914).

The Ancestors of the Eutheria

IN a short article on the ancestors of the Eutheria, published in NATURE of September 16, p. 523, Dr. Abbie lays considerable stress on a novel interpretation of the phylogenetic history of the corpus callosum of the brain. Dismissing the generally accepted interpretation, based on the classical studies of the late Sir Grafton Elliot Smith, he states "it has been shown that in reality the corpus callosum has appeared in quite a different manner". For his evidence Dr. Abbie relies on certain topographical observations which he has published in the *Journal of Comparative Neurology* (70, 9; 1939). Whether Dr. Abbie's interpretation is correct or not, it should be pointed out that his evidence appears inconclusive to several other comparative neurologists. Indeed, in a forthcoming paper by Prof. F. Goldby, to be published in the *Journal of Anatomy*, Dr. Abbie's views on the evolution of the corpus callosum are subjected to serious criticism.

W. E. LE GROS CLARK.

Dept. of Human Anatomy,
University Museum,
Oxford.

Points from Foregoing Letters

E. Schrödinger directs attention to the fact that in an expanding universe (*a*) the diameters of the nebulæ, (*b*) their intrinsic luminosities, may quite reasonably be assumed to depend on the state of expansion. If it is true that their observed luminosities decrease with increasing distance a little too slowly even for the non-recessional explanation of the red-shift, then the recessional one has to be preferred anyhow. For though the discrepancy here becomes greater, a plausible assumption as regards (*b*) will easily remove it.

The forbidden ${}^3P_0 - {}^1D_2$ line of O III, the transition probability of which has a small but non-zero value, has been recently identified in the spectra of two nebulæ. J. Dufay and Miss M. Bloch attribute to this transition the rather faint but well defined radiation $\lambda = 4932 \cdot 2$ A. which they have observed in the nebular spectrum of Nova Herculis.

H. Horodnicзy and A. Jabłoński find that the influence of temperature on the width of the mercury absorption line 2537 A. broadened by argon is smaller than that predicted by the theories of Lorentz and Weisskopf. However, a small temperature effect seems to exist; increase of temperature causes a slight increase of the width and diminution of the asymmetry of the line.

J. and K. Mendelssohn have measured the specific heat of potassium dihydrogen phosphate between 40° and 130° K. No anomaly occurs at the so-called 'lower Curie point', and it is concluded that at this temperature the mobility of the dipoles freezes-in. A strong anomaly occurs at the upper Curie point.

Two sets of experiments on the disintegration of uranium by slow neutrons have been carried out by W. G. Chlopin, M. A. Paswik-Chlopin and N. F. Wolkov. In one set, a uranium salt was exposed to slow neutrons for seventeen days, and the products separated by chemical means; in the other, the exposure was 36 hours and the products of transformation of the gaseous radio-elements were collected from the walls of the reaction vessel. It is claimed that radioactive isotopes of krypton and xenon are formed as intermediate products in the fission of uranium by slow neutrons.

A single bridge method for comparing the resistances of two resistors of low ohmic value is described by A. Glynne. Two balances are effected and the formula for calculating the ratio of the resistances is given.

By experimenting with infantile rats, B. Zondek and F. Sulman have shown that stilbœstrol is only rendered slightly inactive in the organism. Thus it differs from œstrone, but resembles the hormone esters. Also like the latter, stilbœstrol remains at the site of injection for some considerable time and is then slowly absorbed. Unlike hormone esters, stilbœstrol is eliminated in large quantities in the excreta.

A. I. Virtanen, A. A. Arhimo and H. Suomalainen describe a method for determination of keto-acids in plants. The method is based on the formation of 2-4-dinitrophenylhydrazone and its reduction with sodium amalgam in alcohol solution to amino-acids corresponding to the keto-acids. In this way ketoglutaric acid, oxaloacetic acid and pyruvic acid have been determined in plants.

B. K. Kar and H. N. Banerjee have found that the effect of different concentrations of ethylene gas on *Mangifera indica* is more pronounced in the pre-climacteric stage of the developing fruit than in the post-climacteric phase. The effect is seen in the rapid increase of the respiration rate, strong hydrolysis of starch, increased concentration of total and reducing sugars and decrease in titratable acidity and alcohol-insoluble residue. The action of ethylene seems to be of a respiratory nature, and is dependent upon the available substrate, which depends on the stage of the maturity of the fruit.

According to J. P. Maes, sexual behaviour can still be obtained from the spinal cord of female cats in heat when all connexions with encephalic centres have been severed.

RESEARCH ITEMS

Northern Paiute Bands

THE Northern Paiute, once occupying parts of Nevada, Idaho, Oregon and California, belong to the Mono-Paviots dialect of the Plateau Shoshonean language. Although almost everyone writing about these Indians has testified to the existence of bands among them, no one has troubled to ascertain systematically their number, names, or territorial extent. So long ago as 1870, the difficulty of dealing with the Paiutes was recognized by the authorities of the United States as due to the fact that they had no tribal organization, but were divided up into bands of from 50 to 200, each under the nominal leadership of individuals elected by themselves, each band acting independently, although they recognized that they were linguistically and culturally related, and considered themselves as all members of one tribe. The basic unity of the Northern Paiute appears from the fact that they pictured exact boundaries dividing themselves from surrounding tribes, whereas interband divisions were often vague and indefinite. Band territories consisted of a relatively productive area and its environs. In spite of some laxness, the bands had recognized possession of certain tracts, piñon ranges, lakes, streams and hunting grounds. If other Paiutes obtained food there, it was understood that they did so as visitors. Claimed lands seldom overlapped, except where two adjacent bands recognized mutual use of a district. Bands in arid areas travelled more, and spent several months each year as visitors of their friends living in more productive areas. Detailed information concerning each one of the twenty-one bands of the Northern Paiute has been collected in field work and from the literature by Omer C. Stewart (Univ. California: *Anthropological Records*, 2 : 3, 1939) from which has emerged much evidence bearing upon problems of traditional migrations and Paiute affinities.

Protobranchiate Mollusca

THE affinities of the Protobranchiate Mollusca, worked out morphologically by Pelseneer between 1891 and 1911, have now been revised by C. M. Yonge (*Phil. Trans. Roy. Soc.*, B, 230, 79–147; 1939) as the result of a study of living members of the group. Yonge admits three families, the Nuculidæ, Solenomyidæ and Nuculanidæ, the last-named including Thiele's Malletiidæ. In his view "the order Protobranchia established by Pelseneer in 1891 is valid and . . . represents the one unquestionably natural group within the class Lamellibranchia". Yonge studied the mode of life of members of the order at Herdla, Plymouth and Naples, particularly their manner of progression, feeding habits and digestion. The specialization of the foot and its muscles for burrowing into a soft substratum indicates that in this respect they are not primitive, as Pelseneer inferred. The ctenidia are not primarily food collectors and sorters, these functions being undertaken in most by means of a pair of proboscis-like protrusions of the labial palps, which collect organic debris. Typically, the stomach has ciliated sorting and chitinous crushing regions, whence food is passed to the digestive diverticula for intracellular digestion. Yonge asserts that the Protobranchia have been derived from radula-bearing ancestors, but he produces no evidence for this view. The Nuculanidæ differ from the other two families in possessing a *posterior* inhalant current entering through siphons, coupled with a muscular pumping movement of the ctenidia for respiratory purposes. The "Malletiidæ" are Nuculanids which have become modified for life on soft mud in the deep sea. Nuculids are the most primitive Lamellibranchs.

Parasitic Cirripedes of the John Murray Expedition

K. A. Pyefinch has described the Ascothoracica (John Murray Expedition, 1933–34. Scientific Reports, 5, No. 9. British Museum (Natural History); 1939). These parasites have been recorded from a number of hosts, but in this collection they are only in Zoanthids and all belong to the genus Baccalaureus (Broch). Of these, three are new species and one is the *Baccalaureus japonicus* originally described by Broch in 1929. This latter has not previously been recorded from the Indian Ocean. As the author has pointed out previously, the validity of specific distinctions within the genus is a matter of some doubt; since the complete life-history is as yet unknown, what are now regarded as specific differences may merely be due to differences in age of the specimens examined. It is interesting to find that these parasites may themselves harbour parasites. In two cases, once in *B. japonicus* and once in *B. disparcaudatus* from the same station, specimens of a parasitic isopod were found within the cavities of the lateral mantle coils, possibly male and female. A male also occurred attached to the outer surface of the mantle lobes of *B. verrucosus*. These are believed to belong to the family Cryptoniscidæ and are probably a new genus and species, to be described in a later report.

Genetics of the Raspberry

D. LEWIS (*J. Gen.*, 38, 367–379; 1939) describes five new genes in the raspberry. These are *s*, spineless shoots; *b*, shoots without waxy bloom; *x*, red hypocotyl; *g*, pale green leaf; and *d*, sepaloid flowers. The linkage values for genes *T*, *B*, *X* and *G* belonging to one group are *TB* 28·4, *TX* 20·0, *TG* 18·2 and *BX* 36·7. The fact that homozygous hairy plants *HH* are almost completely suppressed suggests that either the constitution *HH* is inviable or that there is a lethal linked to *H*. The occurrence of a large deficiency of recessives in another strain favours the second suggestion. In accordance with Fisher's theory, the only gene (*H*) in the raspberry which is shown to have higher selective value in the heterozygous condition is also the only gene which is polymorphic in the wild.

Triticum sphaerococcum

S. ELLERTON (*J. Gen.*, 38, 307–323; 1939) shows that *Triticum sphaerococcum* differs from *T. vulgare* by one recessive gene *s*. The cytology of the F_1 shows that there is close homology between the chromosomes. The author considers that it is improbable that one recessive mutation should show such diverse and complex effects, and therefore suggests that there is a deletion in *T. sphaerococcum*. The exceptionally high occurrence of speltoid mutants in the F_2 of *T. vulgare* × *T. sphaerococcum* is accounted for by the assumption that the chromosomes which carry the speltoid characters are involved in one of the reciprocal translocations which were observed in the F_1.

Leaf-Spot Disease of Spinach

SPINACH is not subject to many diseases in Great Britain but H. H. Glasscock and W. M. Ware have recorded a leaf-spotting disease caused by the fungus *Heterosporium variabile* (*Gard. Chron.*, August 5). The organism was first described by M. C. Cooke in 1877, from material collected in Welshpool, but it has not appeared again in Great Britain until the present record. Several fungi are, however, mentioned as the cause of leaf-spotting upon spinach in America, and *H. variabile* is among them. The spots are purplish brown, and have conidiophores in the centre portions; they are sufficient in number and extent to cause a serious disease. Cultures have been made of the causal organism, and its characters agree very closely with those of the original description.

A Theory of Mountain-Building

AN important development of the suggestion that convection currents in the earth's substratum may have been responsible for the formation of mountain systems has been made by David Griggs (*Amer. J. Sci.*, Sept. 1939). The theory proposed is synthesized from: (1) the original suggestions of Holmes; (2) the mathematical analyses of Pekeris, Vening Meinesz, and Hales; (3) the author's experiments on solid flow of rocks; (4) thermal experiments and calculations; and (5) a dynamically similar model which demonstrates the action of cyclic convection currents. The structures developed by these currents in the model show striking resemblances to the orogenic structures of the earth. The phases of the convection-current cycle correlate with the three dominant phases of the orogenic cycle: geosynclinal, crustal folding, uplift. The hypothesis is attractive because it seems to satisfy better than any other the three fundamental conditions required of a mountain-building mechanism: (*a*) provision of an adequate compressional force; (*b*) local provision of sufficient contraction for orogenesis; and (*c*) explanation of the intermittent nature of orogenic processes and the threefold character of the mountain-building cycle. In contrast, although thermal contraction may produce sufficient force, it does not seem capable of providing sufficient shortening of the crust to produce the Tertiary mountain systems; moreover, long-distance transmission of compressive stress through the crust to provide localized orogeny is greatly hindered by the viscous drag of the substratum on the over-riding mass. Other forces which have been invoked, such as tidal pull and the *polflucht*, are totally inadequate in magnitude to explain orogenic deformations.

Earthquakes and Crustal Structure near Japan

SEITI YAMAGUTI has recently conducted an investigation (*Bull. Earthq. Res. Inst., Tokyo*, **17**, Pt. 2, 429–442; 1939) to ascertain in which part of the earth's crust near Japan earthquake foci are most frequent. In the neighbourhood of the Japan trench, using the map and bathymetric chart published by the Land Survey Department of the Imperial Japanese Army and the Hydrographic Office of the Imperial Japanese Navy respectively, together with gravity anomalies, the crustal structure was determined and checked by Wadati's seismological results. The thickness of the crust in western Japan appears to be 50 km. and in north-eastern Japan 20 km. The foci of 33 conspicuous earthquakes that occurred in the same Sanriku districts during 1923–38 when the gravity results were being obtained, were as follows: 20 per cent in the subcrustal region just beneath land, 3 per cent in the subcrustal region just beyond the Japan trench and the remainder in the crustal layer or near the boundary of the crustal layer and subcrustal regions on the western side of and about the trench. Near the Inland Sea of Japan, assuming that at a depth of 30 km. isostatic compensation is fulfilled, the configuration of the boundary between the crustal layer and subcrustal region was determined using gravity anomalies. It was then found that 5 out of 7 conspicuous earthquakes between 1923 and 1938 had their foci in the submarine area where isostatic compensation is not fulfilled, and 70 per cent of the 'rather conspicuous' earthquakes, 29 in number, were similarly situated.

Chemistry of the Coloration in Jupiter's Cloud Forms

RUPERT WILDT (*Mon. Not. Roy. Astro. Soc.*, **99**, 8; June, 1939) discusses the action of metallic sodium on both gaseous and condensed ammonia, and suggests this as a possible explanation of the whole range of colours observed on Jupiter. Wildt gives a description of the features of the system sodium-ammonia by the use of the phase diagram taken from a paper by O. Ruff and J. Zedner (*Ber. deutsch. chem. Ges.*, **41**, 1948; 1908) and from the data he draws the tentative conclusion that the coloration of Jupiter's belts may be identified with the brown concentrated solution of sodium formed on the ammonia clouds at temperatures above − 112° C. The absence of conspicuous belts on Saturn is easily understood because this planet has a lower temperature than Jupiter. The hypothesis does not explain the preferentially zonal distribution of the brown shades on Jupiter; specialized assumptions of a meteorological character would be necessary in this case. As the equatorial plane of the planet is in close correspondence with the orbital plane, strong seasonal variations would not exist in the general atmospheric circulation, such as are observed on the earth, and here lies a partial explanation of the distribution of Jupiter's brown shades. A difficulty arises about the small blue areas on the planet because the dilute blue solutions can exist only at temperatures higher than − 78° C., and Jupiter is usually credited with an average surface temperature of only − 140° C. It is supposed that these comparatively rare blue areas are due to the anomalous release of internal energy, a view which receives corroboration from the fact that they appear in nearly all cases during periods of great eruptive activity. A more serious difficulty presents itself when an explanation is sought for the mechanism by which metallic sodium is set free from the sodium compounds that must have been formed during the condensation of Jupiter and are now probably stored in the interior. The author leaves this matter undecided for the present.

TOWN PLANNING AND URBAN CONCENTRATION

THE admirable way in which the evacuation plans have been carried out in the present emergency should not lead us to overlook the importance, when the time comes, for considering the re-planning or further development of our cities on lines designed to minimize such disturbance or upheavals, and the problems which urban concentration presents in civil defence are further reason for attention to this question at the first opportunity. The paper in which Dr. Thomas Adams discussed some economic aspects of urban concentration before Section F (Economics) at the Dundee meeting of the British Association on the very eve of the evacuation could scarcely be surpassed as an analysis of the principles involved.

Dr. Adams pointed out that concentration of industry, economic activities and population in urban centres is essential in order to secure the economic benefits to be derived from scientific progress, and need not militate against social welfare. The advantages of concentration may, however, be impaired by excess or malformation, and in many urban centres such excessive concentration has caused intolerable congestion of traffic, impaired industrial efficiency and overcrowded building development. The most powerful force in causing urban concentration is the existence and potentialities for development of transport facilities, allied with certain favourable qualities in the natural situation, and the planning and control of these facilities are essential to prevent excess.

That New York and London and certain other cities have become too unwieldy to perform their functions efficiently is probably due to their development being artificially promoted, by political agencies and vested interests, beyond that which could occur under the normal play of economic forces. The proper way to eliminate excessive concentration is to promote recentralization on sites with competitive attractions. Even in regard to vulnerability, Dr. Adams does not advocate an excessive attempt to restrict artificially the location and distribution of industry. He argues that if a city, even of the size of London, as a piece of civic machinery, is perfectly designed to perform its functions as an industrial and distribution centre, and if the residue is diffused into compact neighbourhoods and integrated with its industrial areas so as to reduce distances between homes and workplaces, the true solution is to construct adequate defences or even to face evacuation in war time at any cost.

Dr. Adams argues that the steady flow and free movement of street traffic are essential for economic efficiency, and urban areas should be planned or replanned to provide the space required. Further, if the main transport facilities are properly planned and controlled, artificial restriction of the location and distribution of industry should scarcely be required, and provision of ample space for locomotion purposes should simultaneously meet essential requirements of air space and recreation. Economic solutions of these problems largely resolve themselves into questions of transport and land prices. The reduction of costs of transport involves the elimination of unnecessary travel, and the reduction of land prices the elimination of values based on improper or unhealthy uses of land.

The need for scientific investigation of the excess concentration as a first step for a national effort towards its control was stressed by Dr. Adams. Other research is needed to ascertain the best methods of reducing 'friction of space' between producers and consumers of goods and services, and between places of residence and places of work and recreation. Town planning should be based more on the data of the economist and less on the consideration of sentimental values.

Among the major defects in urban growth, Dr. Adams directed attention to the obstruction of the movement of street traffic and the absence of space for standing traffic, as well as to the overcrowding of facilities for passenger traffic and the resultant destruction of nervous energy. He also stressed the overcrowding of population on the land, thus preventing the inhabitants from securing adequate light, air and recreation, and the absence of room for the expansion of industrial plants, markets, etc. Such evils cannot be remedied effectively by the negative process of planning control. Dr. Adams suggested that the ratio of open space in a town for traffic, recreation and space about buildings should not be less than sixty per cent.

CONFERENCE OF LEATHER CHEMISTS

DESPITE the uncertain conditions which prevailed, the Biennial Conference of Leather Trades' Chemists was held in London during August 28–30. The Conference was preceded by a reception of members of the International Society of Leather Trades' Chemists and numerous foreign guests at the May Fair Hotel, London, on Sunday, August 27, when they were received by the president of the British Section, Mr. R. Faraday Innes.

At the opening meeting, the first Procter Memorial Lecture was delivered by Dr. W. T. Astbury, the title being "The Molecular Structure of Fibres of the Collagen Group". The presidential address given by Mr. W. R. Atkin was on the subject of "The Procter Wilson Theory of Protein Swelling in the Light of Modern Ideas of Protein Structure". Prof. P. Chambard of Lyon was elected president of the Society for 1940–41.

During the meeting, it was announced that the Fraser Muir Moffat Medal of the Foundation of Tanners' Research Laboratory of America had been awarded to Dr. Dorothy Jordan Lloyd for her outstanding work in the field of tanning chemistry, and particularly her recent book on "The Chemistry of the Proteins". Among other papers read during the meeting were, "A New Expression for the Buffering Capacity of Solutions" by Dr. V. Kubelka (Brno), "Fatty Spue in Semi-Chrome Leather" by R. Faraday Innes (London), "Studies in Currying" by M. P. Balfe (London), "Precipitation of Natural Tannins with Calcium Hydroxide" by Vl. Němec (Brno), Conductimetric Analysis of Vegetable Tanned Leathers" by S. G. Shuttleworth (South Africa), "Formaldehyde Tannage in Relation to the Constitution of Collagen" by F. O'Flaherty (U.S.A.), "The Chemistry of Formaldehyde Tanning" by Miss W. B. Pleass and Miss J. H. Boews (London), "Reaction between Casein and Formaldehyde" by C. Robinson (London), "A Machine for Measuring the Resistance of Leather to Abrasion" by F. E. Humphreys (London), "Shoe Troubles and Leather Faults" by H. Bradley.

Before the conclusion of the Conference, the following films were shown: "The Inside Story of Lubrication", "Wattle Bark and Extract Manufacture" and "Preparation of Cod Liver Oil".

PROGRESS OF ILLUMINATION

DR. H. W. MELVILLE prepared an evening lecture for the Dundee meeting of the British Association, under the title "New Lamps for Old"

The natural illuminant, the sun, is considered first. We may regard the sun as a 'black body' with a surface temperature of about 6000° C. Being a black body, it emits light of all wave-lengths, but the wave-lengths in which we are particularly interested lie in the visible region from about 4000 A. to 7500 A., for it so happens that evolutionary processes have developed a human optical system which is most sensitive to such a band of wave-lengths.

When we measure the energy emitted by the sun within a small band of wave-lengths, for example, 10 A., and plot the energy as a function of the wave-length of this band of radiation, we obtain a curve with a pronounced maximum at about 5500 A., in the green. Again, the human eye is most sensitive in the region where the sun emits this maximum. Besides radiation in the visible region, there is also radiation at longer wave-lengths in the infra-red and at shorter wave-lengths in the ultra-violet. These radiations cannot be perceived by the human eye, but they can be detected by various physical methods.

It would seem, then, that the production of artificial illumination exactly similar to that of the sun is a simple matter. All we need do is to heat something black to a temperature of 6000° C. But the difficulty is that we cannot devise a means of heating a substance to this temperature, as all known materials either melt or volatilize so quickly that the conditions cannot be realized. Our problem, therefore, is to devise some subterfuge which will get over the difficulty without having to resort to the drastic method of getting radiation similar to that obtained from the sun. As a matter of interest, there is a possibility of doing better than the sun does. So far as illumination is concerned, the infra-red and ultra-violet radiation is wasted. If the energy of these rays could be converted into visible radiation, the efficiency of our source would be appreciably increased.

The goal to be obtained in the search for the ideal source of light is one in which all the energy supplied to the lamp, in whatever form, is wholly converted into visible radiation, with precisely the same intensity and wave-length distribution as that given by the sun. Dr. Melville gives an account of the progress that has been made towards this goal and how far we have still to go.

More than four thousand years ago, it was observed that certain vegetable and perhaps mineral oils, on undergoing combustion, emit visible radiation. Then by using a lamp into which a wick dipped, the burning was easily controlled at the top of the wick. Here then is the first principle of the subject—the conversion of oil into vapour and the subsequent combustion of the vapour. The next development was gas lighting. This phase occurred when it was found that oil could easily be converted into gas, and later when coal was found to undergo a similar reaction.

By allowing a substance to undergo combustion, a sufficiently high temperature is generated to produce visible radiation. If, therefore, we are going to increase the efficiency of our source of light, we must find out what produces the light. An experiment answers this question. The flame of a mixture of hydrogen and carbon monoxide emits only a small amount of radiation in the blue. When the gas is diverted through a bottle containing finely divided carbon, the flame becomes luminous and on close examination the incandescent particles of carbon can be seen describing vortices in the flame itself. The luminosity of the usual gas flame is thus due to carbon. The origin of the carbon in the gas flame is the decomposition of the volatile hydrocarbons present in the coal gas.

The temperature of even finely divided carbon in such a flame is only 1100° C., and therefore its colour does not approach that of the sun. Bunsen improved this by mixing the gas with air and by increasing its pressure. When mantles made of thorium and cerium are used, the light is the brightest. The curves obtained by the so-called Welsbach mixture show that the temperature attained is the highest. The light obtained from an ordinary gas mantle has a distinctly greenish tinge. This proves that it is no longer similar to a black body at the same temperature.

Besides the luminescence emitted by hot interacting gases, there are a number of solid and liquid reactions in chemistry which are accompanied by luminescence at ordinary temperatures. The luminescence of a firefly is a familiar example, but the precise nature of the reaction is not known. Unfortunately, one firefly gives only 1/1600 candle power, mostly in the green and red. For lighting a lecture room of reasonable size, about a million fireflies would be required.

Finally, the electrical methods of producing radiations are considered. The first attempts were made by heating refractory materials by passing an electric current through them. The electric arc between carbon electrodes was one of the first satisfactory sources. Since the temperature of the carbon may reach 5000° C., the light is very similar in quality to that of the sun. But the efficiency is not high and the operation is too complicated for most purposes. The carbon filament incandescent lamp was a poor substitute, as in a high vacuum carbon volatilizes rather easily, with the result that the temperature is only about 1800° C. The tungsten filament was a great improvement, the working temperature of the filament rising to 2400° C. We can in this case use an inert gas like argon or nitrogen, thus making a lamp twice as efficient as the carbon filament lamp. A further improvement can be introduced by coiling the filament on itself.

A still more efficient lamp can be made by introducing a new method, namely, the phenomena accompanying electric discharge in rarefied gases. If a discharge tube be evacuated, it needs a very high potential difference applied across its terminals to produce a flash. By reducing the pressure to about 1/1000 of an atmosphere a much smaller voltage suffices to produce a steady discharge which fills the tube with light. A variety of colours can be obtained by using various gases instead of air. By constructing the interior of the lamp of fused silica and fixing a suitable conducting cathode, the pressure may be increased up to 100 atmospheres with a corresponding increase in luminous output.

The latest type of discharge lamp uses low-pressure discharge, in which the intensity of the ultra-violet radiation is a maximum, and a fluorescent substance which emits visible light under the action of ultraviolet light is put inside the tube. A series of such lamps can be devised with colours which when suitably blended give white light. To obtain white light from a single lamp, a mixture of powders is fused on to the inside of the discharge tube. The new discharge lamps have brought us very close to the perfectly efficient source.

SCIENCE AND THE COMMUNITY

A PUBLIC lecture "Science and the Community" given by Prof. Alex Findlay on September 12, 1938, at the invitation of the Council of the University of Otago, Dunedin, has been published by the New Zealand Council for Educational Research ("Studies in Education", No. 4. London: Oxford University Press). Referring to the achievements of applied science in ministering to the health and material comfort of the people and to industrial efficiency and development, Prof. Findlay points out that science is knowledge and that knowledge can be gained only by persistent inquiry or research, and he urges the importance for the welfare of the country that not merely a few but all the people should become research-minded and recognize with conviction that research is the best insurance of the future. Welcoming the greater attention being paid to the human factor in industry and to the consequences of the impact of science on our social organization, he considers that in proclaiming the great achievements of science we should beware of losing sight of the idealism of science. For the community as a whole, it is not the acquisition of a knowledge of scientific facts that is of chief importance but the inculcation of the spirit of science.

The first great aim of science is the seeking out of truth, and scientific truth is one of the great human values essential for a complete life. Science is, however, not merely an amassing of facts; its spirit is also to be found in the great hypotheses and theories of science, and the cultivation of the spirit of science makes an æsthetic as well as an intellectual appeal, strengthening and perfecting the fulfilment of that other essential factor in a complete human nature, the desire for beauty. Cultivation of the spirit of science is also necessary for the body politic. To cure or ameliorate the evils which flow from the weaknesses to which all democratic government is subject, we must work for a greater knowledge and honesty of purpose, a higher cultural level in the community.

Urging that science is an important factor in the moral and social development of the people, Prof. Findlay stresses the importance of ensuring that the minds of all university students should be opened to scientific truth as revealed in the physical and biological sciences and to recognize the importance of method and facts as well as ideas. For this he does not consider that laboratory work is essential. As regards the place of men of science in the State and in the general life of the community, he suggests that our present dangers are due to neglect of the ethical rather than of the scientific values. While he would not support any plea for a special place for the man of science as such in the councils of government, he urges the duty of men of science to cultivate a rich humanity and to educate their minds to take a wide view and form a balanced judgment, to enable them to take a much fuller share in the common duties of citizenship, placing more unreservedly at the disposal of their fellow citizens that contribution of special knowledge and outlook which their training and studies enable them to make. By cultivating the human values not only of science but also of art and religion, and building into their personalities the qualities of truth, beauty and goodness, scientific men can do much to form a more enlightened public opinion and help in the solution of the educational, social, economic and other problems which face the community. They should strive not merely to bring about a planned order of society with a purely materialistic outlook, but also an order in which individual human nature can find its full expression through the cultivation of truth, beauty and goodness.

UNIVERSITY EVENTS

St. Andrews.—In view of the cancellation, owing to national emergency, of the graduation ceremonial appointed to be held by the University of St. Andrews on the occasion of the visit to Dundee of the British Association, the Senatus Academicus have conferred the honorary degree of LL.D. *in absentia* on the following, who were to be recipients of the degree upon that occasion: Prof. F. T. Brooks, Dr. C. G. Darwin, Sir Albert Seward, Prof. R. V. Southwell, Lord Stamp, Sir Aurel Stein.

Dr. Cyril Dodd, of Durham, has been appointed to the lectureship in natural philosophy in the United College, St. Andrews, which fell vacant on the appointment of Dr. F. L. Arnot to a post in Australia.

SCIENCE NEWS A CENTURY AGO

Travels of Schomburgk and Gould

IN its column of "Weekly Gossip" the *Athenæum* of October 5, 1839, referred to the naturalists Robert Schomburgk and John Gould.

Of the former the journal said: "We have also the pleasure to announce the arrival in London, after an absence of twelve years from Europe, of Mr. Robert Schomburgk, who, during the last four years has been engaged exploring in the colony of British Guiana under the auspices of the Geographical Society, in the course of which time he has twice ascended the Essequibo, and explored that river to its sources, about 40 miles north of the equator; he has also examined the Berbice and Coventyn rivers. . . . During his last journey, on which he was absent about two years in the interior, the traveller crossed the frontier to Fort San Joaquim in the Brazils, and ascended the Caruman mountains; thence returning to Pirára, he journeyed in a north-west direction to Roraima, a remarkable flat-topped sandstone mountain, rising 7,000 feet above the sea; and by a westerly course to Esmeralda, on the Orinoco, thereby connecting his labours with those of Baron Humboldt in the year 1800, and materially changing the position of the sources of that river as laid down in all our maps. Thence descending by the natural canal of the Cassiquiare to San Carlos, he embarked on the Rio Negro and followed its downward course as far as Moura, from which place he ascended the Rio Branco to San Joaquim thus completing a circle of upwards of 2,000 miles, a great part of which was through a country hitherto almost unknown. . . ."

Mr. (afterwards Sir) Robert Hermann Schomburgk was of German birth, being born in Prussia, June 5, 1804. After his explorations in the West Indies and British Guiana, he was appointed Government Commissioner for surveying and making the boundaries of British Guiana establishing the 'Schomburgk line'. Afterwards he was British Consul at San Domingo and at Bangkok. He died at Schöneberg, near Berlin, on March 11, 1865.

Of the naturalist John Gould the *Athenæum* said: "Mr. Gould, another of our enterprising naturalists, gone on a scientific pilgrimage to the very antipodes, and whose proceedings and success we have from time to time been enabled to announce to our readers, has, according to accounts just received, left Van Diemens Land for Southern Australia. He had already collected about 800 specimens of birds, 70 of quadrupeds (several of which are new), more than 100 specimens preserved whole in spirits for dissection, and the nests and eggs of above 70 species of birds, together with skeletons of all the principal forms".

Born at Lyme Regis on September 14, 1804, Gould as a boy lived with his uncle at the royal gardens at Windsor. In 1827 he became taxidermist to the Zoological Society and during the years 1831–37 published works on the birds of the Himalayas and of Europe, the drawings for which were made by his wife, who in 1838 accompanied her husband to Australia, where she died. Gould returned to England in 1840 and afterwards published "The Birds of Australia", "The Mammals of Australia", "A Handbook of Birds of Australia" and "The Birds of Great Britain". He was elected F.R.S. in 1843 and died in London on February 3, 1881.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

The Archaeology of the Channel Islands. Vol. 2: The Bailiwick of Jersey. By Jacquetta Hawkes. Pp. xvii+320+12 plates. (Jersey: Société Jersiaise.) 25s. net. [59

Imperial Bureau of Animal Breeding and Genetics. Bibliography on the Genetics of Drosophila. By H. J. Muller. Pp. 132. (Edinburgh and London: Oliver and Boyd.) 5s. [140

Twentieth Annual Report of the Ministry of Health, 1938–39. (Cmd. 6089.) Pp. xi+312. (London: H.M. Stationery Office.) 5s. net. [159

Other Countries

India Meteorological Department. Scientific Notes, Vol. 7, No. 80: Normal Monthly Percentage Frequencies of Surface and Upper Wind (Afternoon) up to 3 km. in India, Burma and Persian Gulf. Pp. 149-232. (Delhi: Manager of Publications.) 3·6 rupees: 5s. 6d. [19

U.S. Department of the Interior: Office of Education. Vocational Division Leaflet No. 6: Instruction in Poultry in Secondary Schools. Pp. iv+18. (Washington, D.C.: Government Printing Office.) 5 cents. [49

Southern Rhodesia. Report of Commission to enquire into the Preservation, etc., of the Natural Resources of the Colony. Pp. ii+76+8 plates. (Salisbury: Government Stationery Office.) [49

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 193: The Control of Mole-Crickets with Barium Fluosilicate. By A. Kassab. Pp. ii+13+9 plates. P.T. 4. Bulletin No. 217: Nematode Disease of Stone-Fruits. By Dr. Amin Fikry. Pp. ii+9+21 plates. Mills. 35. Bulletin No. 229: Dibble-Sowing of Cotton—Methods, Effects and Profits. By David S. Gracie and Dr. W. Lawrence Balls. Pp. ii+49+16 plates. P.T. 6. (Cairo: Government Press.) [49

Southern Rhodesia. Meteorological Report for the Year ended 30th June 1938. (Salisbury: Government Stationery Office.) [49

Carnegie Institution of Washington. Publication 512: The Volcano-Seismic Crisis at Montserrat 1933–1937. By Frank A. Perret. Pp. xii+76. (Washington, D.C.: Carnegie Institution.) [59

The Bunas of Bengal. By Minendra Nath Basu. (Reprinted from the Journal of the Department of Letters, Vol. 32.) Pp. viii+120+23 plates. (Calcutta: Calcutta University Press.) [59

Indian Forest Records. Silviculture, Vol. 3, No. 7. A Note on the Control and Eradication of New Outbreaks of the Spike Disease of Sandal (*Santalum album*). By Rao Sahib S. Rangaswami and A. L. Griffith. Pp. v+263–290+6 plates. (Delhi: Manager of Publications.) 1·6 rupees; 2s. [59

Rubber Research Institute of Malaya. Planting Manual No. 8: Bud-Grafting; Practical Instructions for Bud-Grafting Rubber Trees. Pp. 61. (Kuala Lumpur: Rubber Research Institute of Malaya.) 50 cents. [59

Government of India Industrial Research Bureau. Report for the Year 1938–39. Pp. v+47. (Delhi: Manager of Publications.) 1.6 rupees; 2s. [59

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 48: Empirical Relationships between Count, Twist and Strength of Cotton Yarns. Part 1: Count—Single Thread Strength; Part 2: Twist—Strength. By Dr. Nazir Ahmad and V. Venkataraman. Pp. ii+29. (Bombay: Indian Central Cotton Committee.) 1 rupee. [59

Smithsonian Miscellaneous Collections. Vol. 98, No. 22: Birds from Clipperton Island collected on the Presidential Cruise of 1938. By Alexander Wetmore. (Publication 3548.) Pp. ii+6. (Washington, D.C.: Smithsonian Institution.) [79

Transactions of the Academy of Science of St. Louis. Vol. 30, No. 1: Springtails (Collembola) of the St. Louis Area. By Elmer D. Bueker. Pp. 32. 35 cents. Vol. 30, No. 2: Analyzing and Mapping Natural Landscape Factors of the Ozark Province. By Arthur B. Cozzens. Pp. 33–64. (St. Louis, Mo.: Academy of Science of St. Louis.) [79

A Report on the Work of the Archeological Survey of India. By Sir Leonard Woolley. Pp. ii+47. (Simla: Department of Education, Health and Lands.) [119

Madras Fisheries Department. Administration Report for the Year 1937–38. By Diwan Bahadur Dr. B. Sundara Raj. Pp. iii+78+3. (Madras: Government Press.) 8 annas. [129

Koninklijk Nederlandsch Meteorologisch Instituut. Mededeelingen en Verhandelingen, 42: Het Klimaat van Nederland (The Climate of the Netherlands). H: Mist (Fog). Door Dr. C. Braak. Pp. 49. ('s-Gravenhage: Rijksuitgeverij.) 0.40 f. [129

Nigeria. Annual Report on the Geological Survey Department for the Year 1938. Pp. 18. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 1s. 6d. [159

Catalogues

Bollettino delle Opere scientifiche. Anno 22, N. 2: Medicina. Pp. 32. (Bologna: L. Cappelli.)

Rotary Pumps for the Production of High Vacua. (Rot. 3.) Pp. 12. (London: W. Edwards and Co.)

A Catalogue of Books selected from the Stock of Bernard Quaritch Ltd. (No. 566.) Pp. 112. (London: Bernard Quaritch, Ltd.)

Editorial & Publishing Offices:
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

Telegraphic Address:
Phusis, Lesquare, London

Telephone Number:
Whitehall 8831

Vol. 144 SATURDAY, OCTOBER 7, 1939 No. 3649

SEEKING AND SECURING THE PEACE

THE fundamental war aims of France and Great Britain have been stated clearly by the Prime Minister as being "to redeem Europe from the perpetual and constantly recurring fear of German aggression, and to enable the people of Europe to preserve their independence and their liberties". Mr. Chamberlain's clear-cut phrasing expresses without ambiguity the spirit of determination with which the peoples of France and Great Britain have entered on the task which lies before them. It reflects with crystal clearness their resolve to restore to Europe conditions in which all its nations, without discrimination, may live side by side in the firm assurance that each will be free to develop to the full and at will in accordance with its traditions and culture under a settled order, of which the sanctity is recognized and respected as inviolable equally by all.

For the man of science and the student of the modes of development of human societies throughout the ages, this resolve of the people and their leaders is pregnant with hope for the future. In its grasp of realities it argues an appreciation of the rights and dignity of the individual, as well as of the integrity of national units, which while observing every consideration for the expression of that individuality, will not hesitate to demand that in its exercise each will contribute its appropriate share to the common stock—a contribution which will not only recognize the rights of other communities, but will also co-operate to relieve their necessities. For we may rest assured from our experience of the last war that, at the close of hostilities, innumerable social and economic problems will arise to demand with insistence the co-operation of each and everyone for their s
tion, under penalty for failure of the coll

civilization. It is not in this war that there lurks the supreme danger for mankind—no war undertaken in the spirit of a crusade can fail to ennoble, though the individual perish—but in the peace which will follow. The elimination of an aggressor will not solve automatically the difficulties which in recent years have troubled the world and left it at odds with itself. The ending of this striving for dominance will do no more than prepare the way to the search for a remedy for these difficulties. It will make possible co-operative study in the light of an objective and scientifically detached view of the facts and the circumstances from which they have arisen.

In this way alone, and only in such conditions in international relations as it is our aim to establish, will it be possible to exercise a scientific control of future social and economic development, instead of the erratic play of economic forces damned by ill-judged and ill-conceived measures to bolster up a false and misguided conception of national prosperity, or even of national security. Though projected to stem the breakdown of the economic system, many such measures have only accentuated its weaknesses by wrecking the system of exchange and hampering distribution, so that valuable products of soil a
have been destroyed as a glut, and whol
tions have been on the verge of starv
the earth brought forth in plenty.
ment of the *United States*, the ri
in the world in gold, the conventi
exchange which it co
of d

a hundredfold, and probably with many more, which will still await solution 'after the war'.

Those of us who are old enough to remember clearly the outbreak of the two major wars in which the British people have been engaged in the present century—the Boer War and the War of 1914–18—will contrast, not without some amazement, the difference in the expression of popular feeling with which we have entered upon this war—a difference far more impressive in its undemonstrative exhibition of a complete unity of direction in purpose than the ebullient enthusiasm of the cheering crowds of the early August of 1914. Nor has there been any attempt to revive such an outbreak of popular feeling through the incitement of a vague and general statement of aims, an ideal for which we are to fight. We are not even assured, as politicians assured us in 1914, that this is "a war to end war". If we are the poorer in slogans, we are the more direct in purpose.

Yet, as the correspondence now appearing in the daily Press can show, there are those who hold that this direction of purpose might gain in strength and intensity if our ultimate aims were clearly defined. Mr. H. G. Wells, for example, in his letter in *The Times* of September 26, while arguing that "more and more of us are beginning to realize that there can be no more peace or safety on earth without a profound reconstruction of the methods of human living", goes on to assume that the Western world is quite inevitably marching towards a world collectivism. He suggests that we should make a genuine attempt to realize "that phase of world-wide plenty and safety" through a federation of mankind by free and unfettered discussion, simple and sincere, of the various means for the attainment of that end.

In Mr. Wells's view, the failure of the League of Nations to become such a federation of mankind as he envisages, was due to the fact that it
"too conservative of existing things, half-
diplomatic". *Is* not the truth exactly
Its most effective work has been in
esearch, the discussion of scientific,
nomic problems, and the application
to practical problems—witness the
rug traffic in some of
up-

affecting literature, art and science, had for long been the order of the day. The League extended the scope of this co-operation, regularized and systematized it, and provided the machinery and organization for its more effective operation. Here it functioned with a most gratifying and surprising success. On the other hand, it was where it was most novel in its methods that it failed. For in a world of unharmonized peoples, many of whom were passing, or had passed recently, through a reconstruction on the principle of national or racial self-determination, it asked in some measure for an abrogation of a sovereignty either lately won or saved from destruction at enormous cost.

While the student of the forms of civilized society may see that the process of growth in the formation of human communities has been one of constant reintegration in larger and larger social unities—from family or kin to tribe, from tribe to people, from people to nation, and from nation to empire—it may well be that, in the long run, the logical goal of this ordered evolutionary process is the largest integration of all, the federation of mankind. But the time for this is not yet. Not merely is too large a proportion of the world's populations still in a state of retarded development—the populations of India and China alone, of whom a preponderating number is an impoverished peasantry, account for between a third and a half of the world's numbers—but the idea of nationality is too deep-seated as an emotional spring of action to be eliminated by the logical completeness of a theory. Though the excessive and frequently pernicious growth of nationalist sentiment in recent years has proved a setback to social and economic development, nevertheless a strong national tradition may be made a great asset to advancement, as the history of the world has shown.

In the discussion of problems of world-wide import—and all problems of a serious character nowadays tend to be world-wide in their application—in this discussion then, which is inevitable, racial and national traditions and cultures will each contribute a different point of view and a different outlook, whereby discussion will be the more capable of producing ultimate harmony, rather than any attempt to form an organization in which that tradition is likely to suffer a sense of frustration all too soon. For whatever may be the form or the machinery, be it league or federa-
n, through which the peoples of the world will
co-operation which is inevitable unless

the order of civilization is to crumble away, it is not discussion of general principles or machinery, in other words of the form of government and the means to secure it, which will save mankind from disaster, but the scientific study on a co-operative basis of the concrete problems which are vital to the well-being and the very existence of the unit from which the social aggregation is built up, whatever its form—the individual man, woman and child.

THE NATIONAL REGISTER

A NATIONAL REGISTER is, in essence, a continuous census. It is best regarded as a means of obtaining and recording that accurate knowledge of its human resources which the advance of science has made necessary to a civilized community. For more than a century past a periodic census has given us a record, at approximately ten-year intervals, of the numbers and distribution of the population in Great Britain, together with varying amounts of information about its composition as to sex, age, occupations, and so on. These records have become fuller during that time; and there has been pressure to make them also more frequent. A quinquennial census has been authorized, though not carried out. Now, under the stress of war, we have begun the transition from a periodic to a continuous record. Of course, it is not possible to publish continuously; but it should be possible to issue quarterly returns, akin to those now submitted by the registrars-general in respect to births, deaths, and marriages.

The information collected for this first edition of a British National Register is similar to, though less extensive than, that for recent censuses. It is limited to the name, sex, age, condition as to marriage, and occupation of every individual, with an additional column for members of the defence services. The plans for it were made during peace but are being carried out in a country at war, which is probably the reason for the extreme reduction of the form to be filled in by each householder. The most striking omissions are the absence of questions as to nationality, birthplace, workplace, or usual residence for those away from home. The first of these may perhaps be adequately replaced by the register of aliens kept by the police; the others are less urgent at present. But all these, and more, will be needed for a permanent national register.

The new feature which distinguishes this registration from all previous censuses is the provision for keeping it up to date. This takes the form of a legal obligation placed on all persons to notify every change of residence to the National Registration Officer of the district into which they move. Soon this must be extended to notification of all changes that affect the Register, and are not otherwise recorded, such as a change of occupation. The records of all these changes will make it possible to obtain information of increase or decrease of population in every local government district at frequent intervals. Everyone concerned with the administration of local government, or of education, has often felt the need for such information, which will now become available in respect of all the people. It has hitherto been available only in respect of certain groups, such as those on the live registers of the employment exchanges. It is urgently needed by all authorities responsible for public health. For all such services, and for local transport and retail distribution, a National Register will make possible greater efficiency, providing that it is well maintained.

The last full census was taken in 1931. It is, therefore, out of date for many purposes. The need for a prompt stocktaking of all our manpower is now urgent; and the experience of the War of 1914–18 shows that some such register can be invaluable in respect to both military and industrial organization for war and to the maintenance of the national life. By its regimentation and conscription of men and women, the German Reich has already got some corresponding record of its human resources. Not enough is known here about the system used to allow useful comparisons with this British register.

It is unfortunate that the Register was not compiled months ago, before the outbreak of war made the task at once more urgent and more difficult. The evacuation of children and women from large towns, and the parallel removal of many other people will make the early months of the war a time of special difficulty in keeping in touch with the abnormal number of changes of residence. On the other hand, the fact that the Register is to form the basis for the lists of those entitled to food ration cards provides a strong incentive to prompt notification. Even so, the organization for the maintenance of the Register will be very severely tested in the next few months.

This registration is accompanied by the introduction of the personal identity card, which has long been a familiar thing in many European countries, where its value has been well proved. Like the Register, this first identity card is extremely simplified: in fact it is scarcely more than a reference to the register by name and number. But both should become permanent features of our national life; and both will inevitably become more comprehensive. The value of the card is obvious. In normal times, cases of difficulty in the identification of persons suffering from loss of memory, or victims of street accidents, are sufficiently frequent to stress the need for such a document. Only the law-breaker has a real, if not a socially valid, reason for objecting to it. It is interesting to note that it does not bear the name of the country, thus following the tradition of British postage stamps.

The National Register and the identity card are essential to the scientific organization of a civilized community, and should have been introduced years ago. The State which does not know its human resources accurately cannot organize them well; nor can it measure with sufficient accuracy its liabilities to its dependent members and its children. The rapidly increasing complexity of modern life, and the resultant increase in the number, the importance, and the intricacy of the functions of government, national and local, and of other social organizations, make it more and more necessary that their working shall be based on a full and accurate knowledge of our human resources and liabilities. For defence against external enemies, against disease, and against internal disorder, for the supply of satisfactory nutrition to all the population, in fact for all the many needs of social life for which we, as social beings, are dependent on the society of which we are units; it is necessary to have such knowledge as a national register can best provide. Each one of us is, willy-nilly, in some degree his brother's keeper and is affected by that brother's well-being or misfortune, and for the fulfilment of the social duties implied in this relation we need this knowledge.

Of course this does not mean that the mere existence of a national register, however complete and well kept it may be, will ensure social efficiency. Nor can it determine any policy. It may be a basis for the development and application of policies of very different types and aims. It is only a tool, a very valuable tool, for the organization of life in a civilized country. How, and for what purposes, such a tool may or will be used is a matter of national policy that will be determined in the same way as other such policies are decided in Great Britain.

As an example of the matters on which precise information can be obtained from the Register as it is now, we may note the composition of the population, nationally and locally, by age and sex groups. It will be possible to know promptly if, and how far, internal movements such as the so-called 'drift to the south' have left some areas with an unduly low proportion of adolescents and young adults, and a correspondingly high proportion of either or both children and old people, and given to the areas of immigration a badly balanced population of reverse type. Many other examples of such possibilities could be given; but this one is enough to emphasize the value of the Register in enabling us to have accurate information of such social facts in place of uncertain estimates, which have hitherto been checked only by the periodic census.

This is the first attempt at compiling a national register in Great Britain; and, although it has been carefully planned, it is experimental. There can be no doubt that experience of its working will give rise to many suggestions for improvements and extensions intended to make it more useful. After the war, at least one census will be needed as a check on its accuracy, and to strengthen the continuity of our national records by an overlap between the periodic censuses and the continuous register. There will also be changes in the identity card and the record on it. Some day the official mind may grasp the fact that it would be a convenience to the public if such things as this card, driving licences, bank notes, postage stamp books, and other articles to be carried in a man's pocket or a lady's handbag, were made of standard uniform sizes.

The most valuable of all our national resources is the human material. The National Register can help to provide a more scientific basis for attempts to improve its quality, by nutrition and training, to control its numbers, and to make better use of it in the development of the good life for all members of our society.

THE MARIHUANA PROBLEM

Marihuana, America's New Drug Problem
A Sociologic Question with its Basic Explanation dependent on Biologic and Medical Principles. By Prof. Robert P. Walton. Pp. ix+223+12 plates. (Philadelphia and London: J. B. Lippincott Co., 1938.) 12*s.* 6*d.* net.

THE hop plant (*Humulus lupulus*) and hemp (*Cannabis sativa*) are close botanical relatives and each secretes a physiologically active resin. The hop resin is, of course, important in Europe in the manufacture of beer, but hemp resin has found little application, the plant being normally grown only for fibre production. A different state of affairs exists in Africa, the Near East and India, where the resinous exudate of the hemp plant has been widely used (or abused) from remote times for its narcotic properties, under a variety of names according to mode of preparation, the best known of which is perhaps hashish. The virtual absence of hashish addiction in Europe can scarcely be attributed to difficulty of access, since hemp is readily cultivated, particularly in the Mediterranean area, and it has been frequently assumed that temperamental differences between Europeans and Orientals make the euphoric action of hashish less attractive to the former. A similar explanation has been advanced to explain the preference of the Chinese for the languorous dreams of opium rather than the wild ecstasy of hashish.

Viewed in this light, the establishment of the hashish habit in Central America, where hemp, under the name of marihuana, is smoked usually in the form of cigarettes, is perhaps not surprising, nor is the fact that marihuana smoking penetrated to some extent from Mexico into the extreme south of the United States. Astonishing, however, is the enormous increase in the vice which has taken place throughout the United States during the last ten years. There it has assumed almost epidemic proportions and has become a national problem. A particularly dangerous feature of the American situation to-day is the spread of the habit among school children and adolescents, and it is this feature which has made marihuana a subject of moment not only to the Bureau of Narcotics but also to every class of social worker. The increasing attention given to this problem has, of course, stimulated the interest of medical and scientific investigators, since it is clear that a thorough knowledge of the drug in all its aspects is of primary importance in combating the menace of its use.

The literature on the subject of hashish is vast and so heterogeneous in character that it is no simple matter to obtain from it a clear picture of any feature of the subject. Medical and scientific workers will therefore welcome this admirable monograph by Prof. Walton, which provides a survey of our present knowledge of hashish. The lay reader will doubtless find much of interest and value in the chapters dealing with the history and distribution of the vice and its present status in America. As this section, however, comprises but 39 pages of reading matter out of a total of 195, it does not, in the reviewer's opinion, justify the advertising matter on the dust cover of the volume; this at first sight suggests a popular treatment of the marihuana habit rather than a monograph dealing with hemp drugs from a scientific point of view. The section of the book dealing with descriptions of the hashish experience is fairly extensive, but while it is true that the layman might be interested in at least the more colourful literary descriptions of Ludlow and Gautier, it is difficult to see how he would benefit in any way from them.

Of particular value to the professional reader are the chapters devoted to acute and chronic effects of hashish, in which the author has analysed the recorded descriptions of its effect and has carefully classified them; his findings should remove many common misconceptions. Save in extreme cases, deprivation of the drug appears to cause no serious physical symptoms in marihuana addicts, and the tendency to chronic addiction is much less than that observed with the so-called 'white' drugs (cocaine, etc.). These facts, together with the relatively low degree of physical deterioration associated with the use of hemp drugs have, of course, been known for a considerable time, and the Indian Hemp Drug Commission reported that the hemp drugs were considered by many in India to be less harmful than alcohol. Prof. Walton, however, rightly stresses that the most serious aspect of the problem in America is the extent to which the vice promotes juvenile delinquency, serves as an introduction to more dangerous drugs, and increases the use of extreme violence by criminals.

The two chapters dealing with the pharmacology and chemistry of hashish cover practically all the published work on the subject, and there are many references to the original literature. The bibliography is good and the appendix on the nomenclature of the various hemp preparations used throughout the world is most valuable. One feels with the author that although therapeutic applications of Cannabis are at present negligible, the drug is well worth further consideration, since its extraordinary physiological action suggests that a marked increase in therapeutic use may follow the isolation and identification of the active principles.

A. R. Todd.

METALS AND THEIR ALLOYS

Metals and Their Alloys
By Sir Harold Carpenter and Dr. J. M. Robertson. Vol. 1. Pp. xxii + 824. Vol. 2. Pp. xii + 825–1486. (London, New York and Toronto: Oxford University Press, 1939.) 105*s*. net.

THE publication of the present work in two volumes by Sir Harold Carpenter and Dr. J. M. Robertson is an event which merits not only especial mention but also especial consideration. For, as a result of the actual development of our knowledge, works of this kind, if not exceptional or unique, are becoming increasingly rare.

The wide range of subjects under consideration in this work—which is concerned with metals and their alloys, with their constitution, their structure, their treatment from both the thermal and mechanical aspects, and with their properties and uses—together with the monumental qualities of the book, which contains 1,472 pages and the spirit, both theoretical and practical, in which it is conceived, might tempt one to regard it as a treatise. But in actual fact it is no treatise, neither in conception, inspiration, execution or purpose.

A treatise proper may be defined as an exposition, as complete as possible, of the sum total of knowledge and experience concerning the subject under consideration—in this case, the science of metals and their alloys together with practical applications. Such a work is designed to include within its scope every publication on the subject, regardless of relative value; and to present them all as being on the same level. But although the number of publications mentioned in the present work is very large (more than six hundred) the authors have made their selection; for, as Sir Harold Carpenter says in his preface, if the development of present ideas and theories were to be traced and all opinions and criticisms represented, this number would have to be doubled. Thus it is the personal opinion of the authors which is expounded in these two volumes rather than the sum total of published opinion.

In the same way, a critical selection of published works which the authors consider to be the most useful for the purpose in view, has been included.

Furthermore, in view of the accelerated pace of research and the consequent mass of published work, the material labour involved in the publication of a treatise proper would involve the collaboration of a large number of different authors who would divide among themselves the labour of analysis and exposition of the published material. In this way, a treatise proper loses in unity of thought and conception what it gains in the extent and quantity of accumulated documentary material. A treatise is intended to be included in a reference library; but not to be read and meditated over as a whole. It is a tool or instrument, rather than a work of instruction; and seldom possesses either educational or critical value.

On the other hand, the work under review, which has been completed in its entirety by two authors in close collaboration, manages to preserve a remarkable unity of thought and opinion. To me it appears as an achievement of unique educational value, whether to a student in the completion of his studies, to an engineer desiring to keep in touch with the latest advances in metallurgical science, or to a specialist anxious to compare and debate his opinions with those of a master of the subject.

This book might well be included in an academic course; and, as a matter of actual fact, one of the authors, Sir Harold Carpenter himself, occupies the principal chair in metallurgy in England, apart from which he has presided over and directed the investigations of three great technical institutions concerned with metals; namely, the Iron and Steel Institute, the Institute of Metals and the Institution of Mining and Metallurgy. All this is a proof of his exceptional authority and is also largely responsible for the perfection of this book as a whole and for the admirable sequence and co-ordination of the material contained in it. Actually, at the present time, the structure of metals considered from every aspect constitutes the essential foundations of our knowledge when it is combined, on one hand with the chemical composition of the product furnished by the metallurgist and, on the other, with the mechanical and heat treatment effected by the transformer; and finally, with those properties which constitute the very basis of practical usage and application.

At the same time, the work—very justifiably—includes in the preliminary chapters a thorough and careful study of the constitution of metals and their alloys, together with their relations to deformations. This is followed by an examination of properties and treatments. These comprehensive chapters concerned with instruction in general metallography constitute the first volume of the work (Chapters i to x)—a volume which thus expresses its individuality and unity.

Incidentally, the remarkable order in the arrangement of the book as a whole is equally carried out in the detailed presentation of the various chapters; and particularly in those dealing with the deformation of metals, which show clearly, on one hand, the interdependence of the three variables—time, temperature and deformation—and, on the other, the triple aspect of the mechanical problem which they condition: namely, a deformation which is very limited in practice, an important deformation without rupture in cases of mechanical transformation, and a deformation forced to the point of rupture in mechanical experiment.

The principles enunciated in the first volume find their application in the second, which is concerned with those metals and alloys, both ferrous and non-ferrous, which are of the greatest importance to industry. These chapters also are very well balanced.

From the point of view of the instructive value of the work, it is perhaps a pity that the authors found it necessary, in order not to be involved in a long chain of developments, to suppress the historical section dealing with the laborious acquisition of our knowledge of metals and their alloys. An exposition of the kind has a distinct educative value inasmuch as it helps the student and others to realize that this knowledge is not the product of to-day, but has been slowly and painfully amassed over a long period of time. Furthermore, it helps to show him that many of the most modern ideas on the subject were divined or predicted by men of exceptional perspicacity and foresight—men such as Sorby, Tschernoff and Osmond, whose names should live for ever in the minds of successive generations of metallurgists. It is for this reason that the present authors, in their just appreciation and recognition of all those who have in any way contributed to the building of this scientific edifice, have dedicated their book to them.

In the planning and development of the various chapters of the book the pedagogic qualities of the authors have been fully demonstrated. But they appear also in another capacity, as experimenters who have themselves made contributions of the first importance to the subject. Neither the compilers of treatises nor those who devote themselves to the task of imparting knowledge are necessarily at the same time research workers or experimenters. Indeed, the combination is a very rare one. For the builder and architect can quite well work with materials furnished and delivered by others. But Sir Harold Carpenter and Dr. Robertson are both world-famous for their work on metals, and this fact lends an especial interest to the chapters of the book in which they record the development of their own experimental work.

To give one example only. In Chapter xi, where the transformation of the iron-carbon alloys is described, the account is based, for the most part, on three papers of fundamental importance, by Sir Harold Carpenter and Dr. Robertson, which were read at the Iron and Steel Institute between 1931 and 1933 (The Formation of Pearlite from Austenite; The Austenite - Pearlite Inversion; Structural Changes in Hypo-eutectoid Steel on Heating). These papers had been preceded in 1931 by a work of Dr. Robertson's on "The Effect of the Rate of Cooling on the Structure and Constitution of Steel" published by the Mines Department (Publication No. 59 of the Safety in Mines Research Board). For this reason, unfortunately, the work is relatively little known, especially to French readers; and this is all the more regrettable in view of the fact that the work of the French school is both emphasized and appreciated in the paper. It is thus very welcome to find in one of these chapters a description of the whole of the original work done by the authors themselves, illustrated by their exceedingly remarkable photomicrographs.

Thus, two characteristic aspects of the authors' activities—instruction and scientific research—are combined harmoniously to lend a particularly individual quality to this work, namely, the quality of a didactical exposition of the whole of our metallographical knowledge as conceived by them as a result of their own researches and of the study of other published investigations.

The work as a whole constitutes a most valuable synthesis to which, in this branch of science, it would be difficult to find a parallel. A work such as the present one represents an expenditure of effort undertaken in a spirit of enthusiasm. It is a task accomplished as a result of years spent in the calm of scientific meditation and reflection. All this confers upon it an individual and lasting value; and the appearance of the two volumes, the illustrations, etc, are excellent and worthy of the contents.

This is not a book to be relegated to library shelves, but should have its place on the desk or work-table. It is not a mere distributor of information, but a source of creative ideas and researches and therefore rich in consequences.

Albert M. Portevin.

INTRODUCTORY FORESTRY

(1) An Introduction to American Forestry

By Prof. Shirley Walter Allen. (American Forestry Series.) Pp. viii + 402. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 21*s*.

(2) The Nation's Forests

By William Atherton Du Puy. Pp. ix + 264. (New York: The Macmillan Company, 1938.) 13*s*. net.

(3) An Outline of Forestry

By Thomas Thomson and M. R. K. Jerram. Pp. viii + 208. (London: Thomas Murby and Co., 1938.) 7*s*. 6*d*. net.

(1) THIS is the first volume of an "American Forestry Series" which will include other volumes on "The Theory and Practice of Silviculture", "Forest Pathology", "Identification of the Timbers of the United States", "Forest Mensuration", "Forest Insects", "Textbook of Dendrology and Management of American Forests".

The present volume by Shirley Walter Allen, professor of forestry, University of Michigan, expresses its object in the words in the preface, "Forestry is in need of a wider circle of acquaintances". Since there has been a Forest Service in the United States of America for several decades, this displays the difficulties of implanting in the public, as we know in Great Britain, a knowledge and sound appreciation of the value of forests to a country. The author has accordingly aimed, not so much at the instruction of forestry students who intend taking up forestry as their professional work (though as an introduction it serves that purpose) but rather at instructing a reading public.

It may be admitted that Prof. Allen's aim is admirably fulfilled, if we omit the factor of its length. For example, since the "Series" is to include volumes on protection, the sixty-five pages devoted to the subject might have been curtailed.

The plan of the book is indicated by the chapters, as follows: man and the forest, building the country with forests, where our forests are and what they produce, what a forest is, forestry that starts with a forest (a chapter which may well be commended to those responsible for the great existing forest capital in the Colonies under British administration), forestry that starts with bare ground, defending the forests from (1) fire, (2) insects, etc., (3) fungus, pests and the elements, measuring and harvesting, and finally, several chapters on forest policy generally. An appendix is devoted to general statistics.

(2) An even more popularly written book than Allen's "Introduction" is Mr. W. A. Du Puy's "The Nation's Forests", which has an introduction by that eminent forester, F. A. Silcox, chief of the United States Forest Service.

In the introduction, Mr. Silcox writes: "For the most part, those of us who handle forest problems are technical men. We are very close to our tasks. It seems difficult for us to tell, simply but graphically, about the vast public properties entrusted to our care; about what those properties are, how they are used, how—directly and indirectly—they affect the average citizen; how they make more jobs; how they add to the security and stability of families and communities, and increase the permanent wealth of a nation". To some extent Mr. Silcox is correct in his complaint that the forest officer is curiously pen-tied when he wishes to transmit his thoughts on his work and on Nature as he sees it to the public; and commonly the layman does not possess sufficient technical knowledge to paint a correct picture. In the book in question, written for America and Americans, Mr. Du Puy shows that he possesses both knowledge and facility to translate forestry problems into easy, even fascinating, language based on personal investigations.

The author commences by pointing out that each American citizen possesses an 'estate' of one and a third acres—his share of the national forests—and this is supported by the striking photograph of a forest fire, facing p. 124. The photographs form an educative feature of the book. This latter is divided into fourteen chapters, entitled: everyman's forest, when the lumberman came, Nature heals her wounds, which trees to cut, planting forests and sustained yield, erosion control, fire protection and recreation, wild animals, range management and wilderness areas, of which all are well written. Finally, the author deals with products of wood, and State and private forestry.

(3) This text-book is written by two members of the staff of the Bangor Forestry School at the

University College of North Wales—Messrs. T. Thomson and M. R. K. Jerram. The aims of the book are not so clear cut as those of the two American books already discussed. The authors suffer from having attempted too much. They state that their "main object is to provide for students on their initial approach to the subject an explanatory outline of the kind of knowledge they will have to acquire; it is hoped that it may prove useful to others who are interested in the subject". If we consider Chapter iii, on the practice of sylviculture, which forms one fourth of the book, the material dealt with is far beyond the ordinary reader and comes under the definition 'technical'.

In two hundred pages the authors have attempted in reality to cover the whole subject of forestry, as shown by their own table on p. 6, which exhibits their four main divisions: forest policy; forest bionomics, subdivided into the foundations of sylviculture, the practice of sylviculture, and forest protection; forest economics, subdivided into forest valuation and finance, and forest utilization; forest management, subdivided into general considerations, the regulation of the yield and the preparation of a forest working plan.

It is somewhat difficult to say to whom the book will appeal. Most trained foresters nowadays hold the opinion that the above branches of forestry require to be kept apart and considered separately in text-books to be used by the student training for the forestry profession—as in fact is shown in "American Forestry Series" alluded to above. For example, Chapter x is entitled "The Preparation of a Forest Working Plan". This important subject is discussed in some three and a half pages. For the ordinary reader possessing some knowledge of forestry, the book may be commended, as it contains much useful material.

SOME EARLY GANOID FISHES

The Triassic Fishes of Besano, Lombardy

By James Brough. Pp. ix+117+7 plates. (London: British Museum (Natural History), 1939). 20s.

During the Triassic period the ganoid fishes with a gristly skeleton, belonging to the same grade as the existing sturgeons, were gradually replaced by ganoid fishes with a bony skeleton like the surviving Amia and Lepidosteus of North American fresh waters. Links between the two grades have already been recognized among Triassic fishes, and there can be no doubt that the one evolved from the other. The transition, however, evidently took place in the sea, and it has hitherto been studied chiefly when it was beginning (as in the Lower Trias of Spitsbergen, East Greenland, and Madagascar) and when it was almost completed (as in the Upper Trias and Rhætic of Italy and Austria). The ganoids of the Middle Trias—those of the critical period—are still well known only by freshwater forms from Australia and South Africa; and it must be noted that from early geological times onwards fresh waters have always been retreats for life which is no longer in the forefront of progress.

A large collection of marine fishes from the Middle Trias of Besano, Lombardy, recently obtained by the British Museum, is therefore of great interest, and it is now made available for science by a descriptive catalogue which has been prepared by Mr. James Brough. There is a varied series of new forms intermediate between the older and the later ganoid grades, and they are well illustrated by numerous outline sketches, restorations, and beautifully clear untouched photographs.

The essential changes in the bones of the cheek and in the median fins are especially traceable, and there seem to be all possible gradations. In fact, as Mr. Brough remarks, the ganoids of the later or 'Holostean' grade appear to have originated in several parallel lineages from the earlier or 'Chondrostean' grade. At first the preoperculum is a broad plate extending over the cheek above the long maxilla; it then gradually shrinks backwards until it forms merely the front rim of the gill cover, while the maxilla is reduced behind and is left comparatively free. At first the tail is completely heterocercal, but the upper lobe soon becomes extremely reduced or even disappears; and the dorsal and anal fins are made more efficient by the exact correlation of the dermal rays with their endoskeletal supports.

There are so many variants in this evolution that Mr. Brough classifies the new Middle Triassic fishes in seven families, and he suggests that they should be separated both from the Chondrostei and from the Holostei in an order Sub-Holostei. He also describes in detail two of the earliest holosteans of the family Eugnathidæ, and discusses the relationship of the Triassic bony fishes to those of later date. Mr. Brough's volume is much more than a museum catalogue, and he is to be congratulated on having formulated problems of wide biological and geological interest.

A. Smith Woodward.

SCIENTIFIC RESEARCH AND AGRICULTURE*

By Sir Thomas Middleton, K.C.I.E., K.B.E., C.B., F.R.S.

When, in 1912, Section M held its first meeting, my presidential address was upon the early improvers of husbandry, and I referred especially to the assistance given to agriculture through the societies and associations formed by them for promoting experiments and discussion. Section M was the latest addition to associations of the kind, and we who were then present looked forward with expectation to the benefit agricultural science would get from the formation of the new section. In spite of the calamity of the War of 1914–18 and the unrest in the world which has since developed, I feel sure that, in returning to Dundee where that first meeting was held twenty-seven years ago, all will agree that the hopes then formed have been more than fulfilled by the progress of Section M.

My purpose in selecting the motto "Practice with Science" is not to use it as an occasion for a review, but so that I may refer to matters affecting the present circumstances of both partners in the motto. The existence of Section M is in itself a proof of the large amount of scientific work now being carried out on behalf of agriculture, and also of the interest which the scientific public take in the subject. Although it has many shortcomings, as the workers concerned will be the first to admit, it may be claimed for agricultural science that it has prospered and is prospering; in contrast, everywhere there is evidence of the difficulties of agricultural practice.

With subsidies, price-insurance and other measures of the kind for assisting agriculture which at present occupy so much of the farmer's thoughts, the majority of scientific workers have no direct concern. The remedies for agriculture's handicaps which they have to offer depend on research, and fortunately research is a remedy so widely approved that, when it does arouse criticism, the complaint usually is that too little use is made of it and that the financial resources provided are too meagre.

For criticism of the kind there is, no doubt, justification; but in the past thirty years, scientific research in agriculture has made great progress in Great Britain, and the prospects for further progress are now better than they ever have been. The subjects under investigation at our research institutes and university departments of agriculture are so numerous that the time at my disposal would not permit me to comment on them in any adequate way. My remarks on the scientific workers' programmes must necessarily be of a very restricted kind.

As for meagre financial resources, no one can be more conscious of the needs and demands of the scientific worker than I am. During long years in Whitehall, I have many times reflected that the doctrines of Malthus, confounded though they may be by twentieth-century birth statistics, are peculiarly applicable to agricultural science; the pressure of its annual recruits on the means of subsistence has given me many an anxious hour. Yet when I look back to the first years of the century, when Hall, Russell, Percival and Theobald were breaking new ground at Wye, when Wood and Biffen were making the reputation of the Cambridge School of Agriculture, when Somerville had already shown how pasture improvement may be effected and measured, it is not the meagreness, but the growth of the resources now available to the agricultural worker that impress me. For I recall that, in the first report to be written by me in Whitehall Place, I had to point out that for the purpose of experimental work and research the State had granted no more than £380, whereas in the present year the Development Fund, which Mr. Lloyd George provided for us in 1909, is assisting the scientific worker in agriculture, and through him the British public, to the extent of some £500,000; and the Development Fund, although much the most important, is not the only source of funds available.

It is questionable if the general public realizes how largely the programmes of the agricultural investigator are framed in the interests of the nation as a whole. Indeed, if these programmes were framed solely for the farmer's benefit, some who have read my doleful account of the difficulties caused to the unhappy farmer by surfeited markets, may suppose that my remedy would be transference of the millstone of surplus from the shoulders of the producer to the neck of the scientific worker! But although fully conscious of the large increase in world production recently brought about as a result of the activities of plant breeders, chemists, pathologists and others, I trust you will not think my logic faulty if I disclaim any such idea.

---

* From Part II of the presidential address entitled "Practice with Science", Section M (Agriculture) of the British Association, delivered at Dundee on August 31.

Take, for example, the benefits that both agriculture and nutrition would derive from discoveries that would improve the health of farm livestock. By raising the standard of health in domestic animals we would meet some of the most insistent demands of nutrition experts. It is generally agreed that nothing would do more to reduce the number of C3's among us than an increase in the consumption of milk and eggs; it is generally claimed, too, that to secure increased consumption, prices must be less than they now are, and I believe it will be held by those who have studied costs of production that the possibility of lowering prices depends first and foremost on improving the health of the cow and the hen. So long as the wastage in dairy herds and poultry flocks remains at the present level, it is difficult to see how the cost of milk and eggs could be much reduced. To a less extent, perhaps, but still to a substantial degree, the cost of other animal products is increased by the ravages of disease on our flocks and herds.

It was the extent of these losses to the stock owner, and their effect on the food supply of the public, that led the Agricultural Research Council, soon after it was established in 1931 and had surveyed the tasks confronting it, to decide that its main effort in the immediate future should aim at effecting an improvement in the health of farm animals.

With this object in view the Council formed technical committees which brought together for joint study those already engaged in the investigation of a number of diseases of special importance. It made grants for assisting research in numerous cases where additional funds were necessary. It employed trained surveyors to visit stock-raising districts in which diseases, especially those of an obscure kind, were prevalent, and in this way collected much fresh information on the incidence of disease. Experience gained in work of the kind pointed to the need for a central field station at which it would be possible to carry out investigations on selected diseases on a large scale and under farm conditions. For this purpose the Council has acquired an estate of about 1,500 acres, and this is being provided with laboratories, houses for the breeding of laboratory animals and isolated cattle sheds for accommodating animals under investigation.

The work of the Council on animals is paralleled by the assistance it provides for investigational work on farm crops. Committees of specialist workers have been set up, for example, on virus diseases, on plant diseases due to helminth attack and on insecticides and fungicides. One very active committee has been that on the Preservation of Grass and other Fodder Crops. Most of the special grants made by the Council for work on crops are in aid of pathological investigations. Until 1911 very little attention was given to crop diseases in Great Britain, but when the Development Act provided funds, entomologists and mycologists were added to the staffs of most agricultural institutions and, as research workers or advisory officers, they have since given much-needed help to agriculture and horticulture; thus the increase in fruit growing and other forms of horticulture that has taken place in recent years has been stimulated by the researches of plant pathologists and, as in the case of animal products, the nutritional demands of the public are being successfully met because of the invaluable aid which the scientific worker is able to give to the producer. Some of the best examples of "Practice with Science" that the country can show to-day may be found in the orchards of Kent and other apple-growing counties.

So far I have referred to matters that engage the attention of the scientific worker, while agriculture follows what has been called 'its natural lines'; but unhappily for us, our peaceful art must face the problems raised by war, and although opinions have been expressed, and expressed freely on the subject in recent months, it cannot be said that there is any agreement on the role that agriculture either should, or could, be expected to fill in the event of war. Recent discussions, and my own experience in attempting to increase home produce during the War of 1914–18, lead me, therefore, now to refer to the scientific workers' programme in connexion with home food production.

In recent discussions on this subject, advocates of storage, of increased shipping for transport and of increased tillage for home production have all been heard, but too frequently as advocates of rival methods of providing supplies in war. It cannot be stated too strongly that these methods are in no sense rivals. All the aid that each can give would be wanted in a war of long duration. In the early stages of a war, stores would be of especial value, throughout the period of hostilities all the tonnage which could be made available for the carriage of human and animal foodstuffs would certainly be wanted, and in the later stages of a long war reliance might have to be placed largely on home supplies.

It may be accepted, I think, that in any emergency, while every effort would be made to maintain our normal diet, chief anxiety would be caused by the position of energy-supplying foods, in practice our breadstuffs. It was generally recognized during 1914–18 that the comparative absence of food difficulties then experienced was due to the circumstance that breadstuffs were not rationed.

In the pre-war years 1909–13 Great Britain was producing about 35 per cent of its energy requirements; in 1918 the food production campaign succeeded in raising the home supply to about 42 per cent. Entering the war with home supplies that would have maintained us for 125 days, we produced in 1918 the equivalent of 155 days' normal needs. Because of lack of labour, machinery and implements the difficulties we faced were extreme. With the number of tractors now available, grassland could be broken up rapidly; but it is one thing to break up grassland and quite another thing to farm it properly, and it is the farming, rather than the breaking up, that calls for careful preparatory work.

But why break up grassland? That was the question asked in 1915 and 1916; it caused much controversy and will do so again.

The answer is that, of human food of the kind which we should chiefly want in war, other crops produce much more than grass. In "Food Production in War" I have given many figures in support of this opinion which I need not cite here: one general statement will suffice. In the years 1909–13 the soils of the United Kingdom maintained a population of about 15½ millions. I estimated that less than one-third of this total had been maintained by our 34 million acres of cultivated grassland (that is, had been provided with the million Calories per person per annum necessary), and that more than two-thirds had been maintained by our 13 million acres under crops other than grass. Per 100 acres of land, 12 and 80 persons respectively had been provided for. These figures, though they relate to the energy value of foods only and not to other things which are essential in our diet, give a fairly correct idea of the relative importance of grass and other crops in providing war rations. The chief reason for the very low production shown by grass is that a large percentage of our grassland is of poor quality and is grazed by store cattle and sheep. For the average pasture grazed by dairy cows my figure was 41 persons maintained per 100 acres; well-managed grass carrying good cows might indeed provide the energy needs of 75–80 persons per 100 acres.

Our present systems of husbandry took form long before the aeroplane had to be reckoned with and they may be regarded as suitable for conditions that until recently existed, but I cannot agree that, as Europe now is, we should remain satisfied with methods of farming that, in war, would leave us dependent for some 65 per cent of our food supply on imports. My personal view is that, for defence reasons, we must change to a more flexible method of farming than that which is now commonly followed, that we should adopt a system which under peace conditions would provide from 35 to 40 per cent of our requirements and in an emergency would enable us rapidly to increase food production to a figure providing about half our annual needs. The change which, for defence reasons, I now advocate is that for which my predecessor argued at Cambridge on grounds of good farming, namely, a change over from permanent to temporary grass.

Sir George Stapledon advocated ley farming on an extensive scale. The adoption of this system would in his view improve the output of nearly all English cultivated grassland. For the purpose I suggest above, it would not be necessary to replace more than from four to five million acres of permanent grass by temporary leys. If, say, 4½ million acres were thus converted, Great Britain would then have 16½ million acres under arable cultivation as it had fifty years ago. About 40 per cent of the cultivated area would still remain under permanent grass, so that, in selecting the area for conversion into temporary leys, a wide choice would be available.

The substitution of temporary for permanent grass need not, in itself, call for substantial changes in the character of the land's output. The grassland would, as Sir George Stapledon stated, carry more stock, and if stock were paying better than crops the main change in output under peace conditions would be an increase in livestock products. From the point of view of war farming the advantages of temporary leys are obvious. The use of the plough and of other implements would be familiar to farmers cultivating temporary leys, but in many cases would be quite unfamiliar to those occupying only permanent grass. Tillage implements would be available on the farms on which they would be required in an emergency and the quality of the land itself for tillage purposes would be well known; thus, in an emergency, arrangements for corn growing could quickly and easily be made.

In spite of the advantages to both the country and the farmer which can be claimed for ley farming, it must be recognized that in England there are circumstances which strongly tend to check the spread of the system. Permanent grass growing is the well-established custom of the country; the change over from tillage to grass farming saved many from bankruptcy at the end of the nineteenth century, and since that time grazing has, on the whole, been a safer business than agriculture. Again, short of capital as farmers are, it would take a good deal of courage to expend £3 to £7 per acre in forming a temporary ley, even if arithmetic proved that a return of 10 to 20 per cent on the outlay may be expected over a period of years. The confidence of farmers in the future has been undermined as a result of their experiences since the War of 1914–18, and much will depend on the extent to which confidence can be restored as a result of the Government's recent policy.

What is now called for is intensive research at a central station on the many questions that would arise in connexion with the conversion of permanent into temporary grassland, together with a close study of local conditions, favourable and unfavourable, for the extension of ley farming, by economists and other scientific workers in different parts of the country. Sir George Stapledon himself is at some pains to explain that he is not an economist; all the more need that we should put the economist on his tracks! He has already persuaded a number of farmers to adopt his advice, and the results secured by men who have successfully turned from permanent to temporary grass farming would be of much value. Relatively the number of men concerned may be small, but I believe that they are sufficiently numerous to provide us with guidance of a kind that we cannot afford to neglect.

There are, indeed, features in the present situation which suggest that there is much scope for the economist, and not only in connexion with the interpretation of the experiences of grass growers. All readers of agricultural journals know that, in spite of agriculture's depressed state, there are within the industry many enterprising men who are doing well both for themselves and for their land. Their methods are certainly worth study and exposition, and the audience waits. Thanks to such movements as the Young Farmers' Clubs and to the facilities for training provided by Farm Institutes, there are now in Great Britain a large number of lads and young men keenly interested in agricultural progress and anxious to learn. Economic studies of the methods of successful men would be welcomed by these learners and by them would be translated into practice later on. The young farmers of my generation learned chiefly by example, and no doubt the young farmers of to-day continue to do so; but to-day, much more than formerly, they are so trained as to welcome precept, if precept is based on economic studies of the kind I have in view. Thus in the process of converting some four or five million acres now in permanent grass into temporary pastures, which would be necessary to fit England to respond rapidly, as Scotland already can, to the call for increased food supplies, I lay much stress on the assistance which the economist can give.

The awakening of the soil, which would follow the breaking up of permanent grassland, would intensify the programmes of most other scientific workers and in some cases would call for substantially increased activity. This would be the case especially in agricultural engineering. Whether in tilling a larger area in normal times, or in rapidly extending the tillage area in war, no form of aid would be more welcome to the farmer than aid in selecting and employing machines and implements that would enable him to use manual labour to advantage.

Many other matters would call for the attention of the scientific worker in war; some of them could be predicted because of 1914–18 experience, others could not, for one thing learned in 1914–18 was that war throws up new and unexpected problems. On the precise nature of these problems we need not now speculate; rather let us note that the scientific worker is confronted with one very definite objective. This objective, which must be approached from different angles, may, in a sentence, be stated to be the preparation of British agriculture to expand its normal output of food rapidly if called upon to do so. The immediate aim should be the provision of a six months' supply of food for the nation in an emergency.

Many of those who have considered the subject of food supply in war would not agree with the views I express; they would point to agricultural experience in recent years and argue that the production of half the nation's food from the soils of Great Britain would be impossible. But while I admit that experience since 1919 has not been encouraging, my view is that our present tendency is to underestimate the capacity of our agriculture, and I claim that our outlook should not be restricted by the experience of the past twenty years.

There is little amiss with the soils, or the climate, of Britain; our tillage land responded well to the calls made on it a century ago and would respond again. Our farmers taught those of most other countries, and if their pupils are now, in some cases, ahead of them, there is no lack of farming talent. Research and education in agriculture have been with us for a generation; growth may have been slow at first, but advances are now being made at a rate that is encouraging, and we may confidently expect much more aid from science in future than it has given us since 1919. Thus, from the technical point of view, I see no insuperable difficulties in the programme I have outlined.

From the point of view of farmers themselves, however, the case is otherwise. If they and their employees are to earn as meagre a share of the national income in future as they have done in the past twenty years, a further decline in the arable area is only too likely, for the reason that, under recent conditions, masters and men have lost confidence in their future prospects.

There is an atmosphere of 'defeatism' about, and not only among agriculturists themselves. There is too ready an acceptance of the doctrine that economic changes have condemned the land of England to slumber under grass, and that economic reasons forbid its awakening by the plough. As matters are, it would certainly cost the nation money to bring several millions of acres back into arable cultivation and to substitute temporary for permanent pastures; but if the change were made, not only would we add largely to the agricultural output, but also there is at least a prospect that farmers would find themselves better off than they now are. In my judgment the ease with which tolerably good grass can be grown in many parts of England has led far too many farmers to bury their talents under the green sod, and too many farmers, as well as their counsellors, believe that it is prudent to leave these talents buried; but looking to the future I am satisfied that good and faithful service to the country calls for a change, and, I hope, for a change that would be rewarded. To science I look for assistance in bringing this change about and, for the farmer's reward, to the belief that the world's non-agricultural inhabitants cannot expect a continuation of the conditions which, during the past century, have enabled them to buy their food at less than cost price. But these conditions may not quickly alter, while changes in farming are needed now, and as I have admitted that the nation must pay before large changes in our methods of cultivation can be expected, I will be asked: Why should the nation pay?

Whatever the next year or two may hold in store, Britain, hateful as the prospect may be, cannot afford to neglect preparations for defence. In these preparations agriculture must have a place. How large this place should be is a matter of opinion. My personal view, based on experience gained during 1914–18, is that it should have a large place; but be its place large or small, it is for services rendered in connexion with defence that farmers can legitimately ask the nation to pay, as it is paying, and paying heavily, for the services of others similarly engaged.

Thus looking to the future I conclude that the century-old motto which heads my paper is still applicable; the nation which relied on the British farmer for its food supply in 1839 cannot do without his aid in 1939; while he himself, if he is to do his part as his forefathers did, must take as his watchword "Practice with Science".

NUCLEAR REACTIONS IN STELLAR EVOLUTION*

By Prof. G. Gamow,

George Washington University, Washington, D.C.

(3). Apart from the stars of the main sequence, there is known a large class of stars having very high luminosities but possessing much lower effective temperatures (that is, much greater radii) than the stars of the main sequence of the same luminosities. In the Hertzsprung–Russell diagram these so-called *red giants* form a rather irregularly distributed group on the upper right side of the main sequence. Because of anomalously large radii these red giants possess very low densities, and the estimated central temperatures are considerably lower than those for the stars of the main sequence (for typical red giants the central densities can be as low as 5×10^{-7} gm./cm.^{3}, and central temperatures less than 1×10^6°C.). Thus it is clear at once that the energy production in these stars cannot be due to the same nuclear reaction as in the stars of the main sequence, and we have to look for reactions taking place at an appreciable rate at much lower temperatures than the carbon-nitrogen cycle. From Table I [p. 575] we see that the nuclei which can be responsible for the energy production at lower temperatures are the isotopes of heavy hydrogen, lithium, beryllium and boron, and, using the data of this table together with formula (1), it is easy to estimate at which temperatures these different processes will be of importance. Then, using the homology transformations, we can calculate the location of stars with different energy-producing reactions in the Hertzsprung–Russell diagram[8].

The result of such calculations shows that stars with different energy-producing reactions should be located within different rather broad bands running parallel to the main sequence. The central lines of these various bands are shown in Fig. 2 together with the central line of the main sequence. It is interesting to notice that, whereas the bands corresponding to the reactions of the isotopes of hydrogen and lithium are very close together, the bands of ^{10}B and ^{11}B are widely separated. This comes from the fact that the two isotopes of boron lead to quite different nuclear reactions, one being

* Continued from page 577.

the radiative capture and the other the much more probable splitting into three particles.

In order to notice this 'lateral structure' of the red-giant region, it is most convenient to use the observational material on the ***pulsating stars*** which, as well known, form a one-dimensional sequence, all their properties being the functions of their (directly observable) pulsation period. In Fig. 2 the region of pulsating stars is shown by a shaded area, its width at each point being proportional to the number of stars observed. We see that there are definite concentrations of stars near the places where the different thermo-nuclear reactions of light elements, calculated as indicated above, become of importance. The short-period group of cluster-variables contains the stars in which the transformations of ^{10}B probably take the main role. The second group includes the *Cepheid variables*, the number of which shows a broad and irregular distribution as a function of the period; this is probably due to overlapping of three separate groups corresponding to the reactions of $^{6;7}$Li, ^{9}Be and ^{11}B. Finally, the group of the ***long-period Mira-type variables*** should be interpreted as due to deuterium (and possibly ^{3}H). It can be seen that the calculated effective temperatures for the stars of this group are considerably higher than the values actually observed. It must be due, however, to the fact that these stars show abnormally high central condensations[9] and the observed effective temperature actually corresponds to the extremely rarified outer atmospheres surrounding the main body of the star.

The same kind of 'lateral structure' would be also expected for the non-pulsating red giants, and, as a matter of fact, something of this kind can be seen in the diagram, where all stars with known characteristics are plotted; however, due to large errors of the parallax measurements of these stars, the structure is not so definite as for the pulsating variables.

Inasmuch as the light elements responsible for the life of red giants do not possess regenerative properties like carbon and nitrogen, and are permanently destroyed in the process of energy production, the life-periods of a star during which the different reactions mentioned above are of importance are very short as compared with the time a star spends on the main sequence. As soon as one of the light elements is consumed, the star undergoes a comparatively much faster, gravitational contraction until the central temperature reaches the value suitable for the beginning of the reaction of the next element. The evolutionary track of such a star is shown by a heavy line in Fig. 2.

Now we come to the discussion of a very peculiar feature of the Hertzsprung–Russell diagram. It has already been pointed out that the pulsating variables are distributed along a definite line crossing various bands of the red-giant region. It is also known that this line represents ***an upper limit*** for the distribution of red giants, and that almost no stars are known between this line and the upper part of the main sequence. What is the physical meaning of this limiting line, and why do the stars begin to pulsate when they approach this line in the process of their evolution? The answer to this question can probably be found[10] by considering the relative importance of the production of thermo-nuclear and of gravitational energy in a red giant. If $-dX_1$ represent the decrease of the content of the light element responsible for the reaction, the total amount of the liberated energy will be evidently given by $Q.dX_1.M/m$, where M and m are the masses of the star and of the atom of the element in question and Q the energy liberation per nucleus. According to the homology transformations, the decrease of X_1 will cause a corresponding decrease of the radius of the star which, in its turn, will lead to the liberation of a certain amount of gravitational energy. The condition that this additional liberation of energy can be neglected as compared with the nuclear energy is evidently

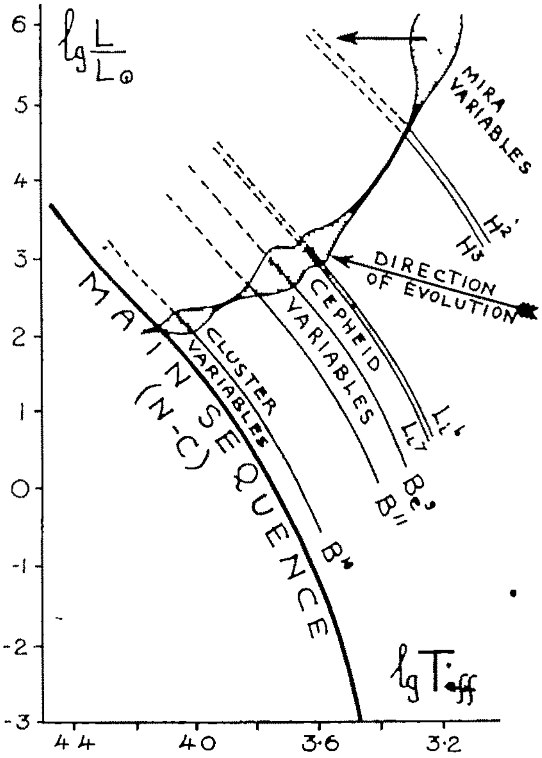


Fig. 2.

$$d\left(\frac{GM^2}{R}\right) < QdX_1\,\frac{M}{m_1}, \qquad (5)$$

which can also be written, using the homology relation between R and X, in the form:

$$\frac{R}{M} > \frac{1}{n + 1{\cdot}75}\,\frac{Gm_*}{QX_1}. \qquad (5^1)$$

Remembering that $M \sim L^{1/3}$ and $R \sim L^{1/2}\,T_{\text{eff.}}^{-2}$, we can write our condition for the critical line in the form: $L \sim T_{\text{eff.}}^{12}$, which roughly coincides with the equation of the line of pulsating variables. Moreover, substituting the numerical values, we find that the line given by this condition really passes through the location of these stars in the diagram. *Thus the line of the pulsating stars represents the geometrical locus of points where the gravitational contraction begins to play a more important part than the nuclear energy production.* Above this line no 'lateral' structure can be expected, and any star goes through this region rapidly contracting and radiating the gravitational energy liberated in such contraction. This process stops, however, as soon as the star reaches the main sequence where, due to a very high abundance of hydrogen, the energy liberation through the catalysing action of carbon and nitrogen becomes again the predominant process.

Let us now imagine a star which has just passed this limiting line and the source of energy of which is therefore mostly gravitational. If, for some reason, the radius of the star decreases slightly, the central temperature will increase correspondingly and the nuclear energy production will become of importance, giving to the star an impulse to expand. But as soon as the expansion starts and the central temperature again drops, the nuclear energy production becomes again negligible as compared with gravitation. It is easy to see that *this effect will cause an undamped pulsation*—in which the star will be, so to speak, 'bouncing on the critical line'. The pulsation will last as long as there is still sufficient amount of the reacting element, and there is every reason to believe that *the observed pulsations of stars near the limiting line are due to such a process.* After the amount of the element responsible for the pulsation becomes quite negligible, the star will rapidly pass the region of gravitational contraction and will become a star of the upper part of the main sequence.

(4). It remains now only to consider the later stages of stellar evolution, when the star, after staying sufficiently long in the main sequence, has consumed all its original content of hydrogen and enters into the stage of the final gravitational contraction. It is known[11] that the final stage of such contraction depends essentially on the mass of the star.

If the mass of the star is smaller than *the limiting value* 1·4 $M_\odot$ (for stars completely deprived of hydrogen), a degenerated electron gas will begin to be formed at a certain stage of contraction, and the star will tend to the state of very high density and low luminosity characteristic of the stars known at present as *white dwarfs.*

For stars of larger mass, no lower limit of contraction exists, because the gravitational pressure of the outer layers cannot be balanced at all by the pressure of the degenerated electron gas. At a certain stage of the contraction one may expect that *in the interior of the star a large amount of free neutrons will begin to be formed*, leading to a rapid collapse of the whole star and to the liberation of tremendous amounts of gravitational energy[12].

The question as to how such explosions can be connected with the observed phenomena of *novæ* and *supernovæ* is not yet quite clear, and we will not enter here into its discussion.

Summing up, we can say that, due to the application of our present knowledge of nuclear physics, the problem of stellar energy sources and the main features of stellar evolution can be considered at present as practically solved.

---

[8] Gamow, G., and Teller, E., *Phys. Rev.*, 55, 791 (1939).

[9] Chandrasekhar, S., "Stellar Structure" (Chicago Univ. Press, 1939).

[10] Gamow, G., *Phys. Rev.*, 55, 796 (1939).

[11] Chandrasekhar, S., *Mon. Not. Roy. Ast. Soc.*, 91, 456 (1931) and following publications.

[12] Baade, W., and Zwicky, F., *Proc. Nat. Acad. Sci.*, 20, 259 (1934).

SUBSTITUTES FOR PETROL

THE need to conserve available supplies of petrol and the consequent severe restriction of the amount allotted under the rationing scheme in Great Britain, raises a question as to the applicability of other fuels to the ordinary motor-car or trade vehicle. It has to be borne in mind, however, that at the present time no fuels should be used except for good and sufficient reason, as fuel is a vital supply in the conduct of modern war.

The fact that town's gas was quite largely used in the years 1915–17 as a motor-car fuel suggests that it might once more be brought into service. It will be recalled that the cycle of operations in the petrol engine is essentially the same as that employed in the gas engine. In the former, the liquid fuel is atomized, metered and mixed with air by means of the carburetter, which also provides the means of controlling its flow. When gas is to be used, a diffuser of much simpler construction than the modern petrol carburetter can be employed, the mixture of fuel and air being effected by a gas supply pipe of about three eighths the diameter of the inlet pipe. On the gas supply pipe a regulating valve is necessary; this might be of the needle type and it might be arranged to operate in conjunction with the accelerator pedal. A main gas tap is obviously needed, because when the engine is shut down the gas must be turned off. For perfect combustion about 6 volumes of air must be supplied; but for economical results 8–10 volumes are better. The power obtainable will be somewhat less than from petrol, but there should be some saving in cost per mile.

For the storage of gas, large and cumbersome gas-bags were used, the obvious place for which is on the roof. As an alternative, steel cylinders containing high-pressure gas can be carried, but as these would generally have to be given some of the interior space of the car, their presence would doubtless be found less acceptable than the swaying bulk of the gas-bag overhead.

The use of gas is in the nature of a reversion to an older system; but it cannot be said that the newer systems offer any possibility of ready adaptation to existing cars. The heavy oils used in Diesel or semi-Diesel engines require a quite different cycle of operations and therefore an essentially different engine. The direct use of powdered fuel is making headway; but it would necessitate an engine approximating to the heavy-oil type. A further possibility is that of generating coal gas for the use of the engine; but this would involve the provision of extra plant as well as the adoption of a new technique by the driver.

The most immediately hopeful change-over will, therefore, be to the gas-bag, out of place as it may appear on a smart car. Some gas companies are understood to be planning the supply of gas in bags both at their works and through the garages and service stations, and it may be anticipated that they will arrange also for the provision of gas-carburetters or diffusers so that an easy change-over may be effected. The subject has received little attention in the text-books and reliable data are difficult to obtain. In "Carburetters and Fuel Systems" by A. W. Judge (third edition), illustrations of several carburetters will be found and quite a lot of practical information that would be most useful to anyone considering making this change.

OBITUARY

Mr. Sydney Evershed

MR. SYDNEY EVERSHED died on September 18, at the age of eighty-two years, at his home in Ealing. He had been associated with the manufacture of electrical testing instruments for fifty-three years. As an inventor his influence can be traced in the development of many electrical instruments in many countries in the world. He was the son of John Evershed of Gomshall, Surrey, and his younger brother John, the well-known astronomer, a fellow of the Royal Society, now resides at Ewhurst, Surrey.

At a meeting of the Institution of Electrical Engineers held in 1922 to commemorate the first ordinary meeting of the Society which was held fifty years previously, Mr. Evershed gave some interesting reminiscences of his own early life. In 1876, the year of the Centennial Exhibition in Philadelphia, he read in the newspaper of someone having listened to Hamlet's soliloquy being spoken by Dr. Graham Bell's telephone, and was lost in amazement, as at that time it was commonly believed that this would have required thousands of musical reeds. A year later he saw a drawing of a telephone and was surprised to find how simple its mechanism was. With the help of two baking-powder boxes in which he cut holes in the lids with his knife, a small bar magnet and some silk-covered wire wound round one pole, and a disk of thin sheet iron, which he cut with scissors, near the other, and using a long piece of telegraph wire to form the connecting line between the two crude telephones, he found to his amazement that they worked admirably, the speech transmitted being practically perfect.

He remembered in his own early life in Surrey the days when you saw only one arc lamp at a time, and what a great blaze of light it made to people accustomed to the dingy gas lights in the streets! In these days a strenuous research was being made 'to subdivide the electric light'. There was great excitement amongst the physicists when a cablegram came from America saying that Edison had succeeded in dividing it by means of a platinum incandescent lamp. Contemporaneously with this feverish research, Joseph Swan was working in England on his carbon vacuum lamp.

Evershed was then living a few miles from the town of Godalming in Surrey. Strange to say, this quiet Surrey village was the first town in England to light its streets by electricity. A dynamo was installed in Pullman's leather mills, not far from the town, on the river Wey, where water-power was available. The electric lighting of Godalming began on December 15, 1881. He remembered, on a later date, seeing the leather mills lit up with what he was told were Swan lamps. A leather worker with whom he spoke had a Swan lamp all to himself, but he admitted that he preferred a tallow candle. The main street of the town was illuminated by three arc lamps and the smaller streets by Swan lamps. The electric cables were simply laid in the gutter. He remembered kneeling on the pavement and putting a charm compass close to the cable and being very puzzled because he got no deflection. It was his first experiment with alternating current. In about a year afterwards Joseph Chamberlain's Electric Lighting Act was passed, and the newly born industry of electric supply was practically snuffed out for six years.

In 1886, taking with him samples of measuring instruments of a moving iron type which he had made with his own hands, Evershed applied for and obtained the position of manager of a little factory established by the firm of Goolden and Trotter in Westminster for the manufacture of Cardew hot-wire voltmeters, for which there was then a considerable demand in the Navy. Captain Philip Cardew had invented this instrument two years previously. It was the first of its kind and in many ways was most suitable for its purpose.

After several changes of name the firm became Evershed and Vignoles, Ltd., with Mr. Evershed and Mr. Vignoles as managing directors. In 1889 Mr. Evershed introduced his portable ohmmeter and hand generator. From this date the measurement of the insulation of house wiring ceased to be a laboratory operation. In 1903 he completed his invention of the moving-coil ohmmeter. He combined the high-voltage generator and ohmmeter in one box in such a way that there was no magnetic interference and the instrument called the 'megger' was in demand in practically every country in the world.

The firm built a large factory called 'Evershed and Vignoles' near Chiswick Park Station. In 1924 Evershed gave up his position as managing director but remained as chairman until he retired in 1938.

In 1931 Evershed was asked by the Council of the Institution of Electrical Engineers on the anniversary of the birthday of David Hughes to give a discourse on his life and work. He gave a most enlightening discourse, dwelling mainly on the two outstanding achievements of his life, namely, (1) the invention in his early years of the synchromonotype-printing telegraph and (2) in later life the discovery of the microphone. In reading this discourse you get a deep insight into the life and work of this great inventor. At the receiving end the message was printed on a paper ribbon by the action of an electromagnet in the circuit. Each time the contact arm at the sending end passed over a live stud, a current traversed the line and the electromagnet. The armature of the magnet forces the paper ribbon into momentary contact with the type-wheel and a letter is printed. Only one impulse was required for each letter.

Mr. Evershed's special knowledge of the magnetic properties of alloys of iron and of their use in instrument making greatly impressed scientific visitors when they came to meetings of the Institution and at Council dinners. He often spoke in discussions at the Institution of Electrical Engineers, where his humorous touches always pleased his audiences. The first time the writer heard him speak was in 1891 when J. Swinburne (now Sir James) read a paper on transformer distribution and W. Crookes was in the chair.

In 1899, G. Marconi read his classical paper on wireless telegraphy to the Institution of Electrical Engineers, Prof. Perry being in the chair. In this paper he mentions how he demonstrated the feasibility of signalling between Ballycastle and Rathlin Island in northern Ireland, the distance between the two positions being 7½ miles. Mr. Evershed, who spoke in the discussion, said that he had been working on telegraphy to lightships for many years. One of his suggestions which was submitted to a Royal Commission was tried and found to be a total failure. He therefore desired to be the first to congratulate Mr. Marconi very heartily on having succeeded. Evershed was always delighted and pleased with other people's discoveries.

In 1900 the writer remembers him reading a paper on a 'frictionless motor meter'. He forestalled criticism by pointing out that the adjective 'frictionless' was used in the comparative sense, just as we say 'smokeless' powder or a 'water-tight' compartment. The floating armature was magnetically suspended when working and its vertical axis was pivoted at the lower end.

In his early years Evershed investigated the phenomena exhibited by insulating materials when under electrical stress. His results are given in a paper read before the Institution of Electrical Engineers in 1913, and papers presented to the same Institution in 1930 and 1935 gave the results of his work on permanent magnets which yielded data that enabled scientific design to be substituted for rule-of-thumb methods.

Evershed was for several years a member of the Council and a vice-president of the Institution of Electrical Engineers. The writer knows also that he was invited on more than one occasion to be president. His portrait, painted by Mr. George Harcourt, R.A., was presented to him by his firm to commemorate his fifty years connexion with it. It is now in the keeping of the Institution of Electrical Engineers.

A. R.

We regret to announce the following deaths:

Prof. G. F. Arps, professor of psychology in the Ohio State University, on September 16, aged sixty-five years.

Prof. Henry C. Cowles, emeritus professor of botany in the University of Chicago, on September 12, aged seventy years.

Sir Spencer Lister, director of the South African Institute for Medical Research, known for his pioneer work on pneumococcal vaccines, on September 6, aged sixty-three years.

Prof. R. S. Troup, C.M.G., C.I.E., F.R.S., professor of forestry in the University of Oxford, director of the Imperial Forestry Institute during 1924–35, on October 1, aged sixty-four years.

NEWS AND VIEWS

Prof. M. von Laue

On October 9, Dr. Max von Laue, professor of theoretical physics in the University of Berlin, will be sixty years old, and we take the opportunity to congratulate him on his brilliant scientific work, and especially on his conception of the diffraction of X-rays by crystals, which has led to the development of more than one new and important branch of science. In 1912, Dr. von Laue made the fundamental suggestion that crystals, which had long been believed to contain a lattice structure regularly repeated in space, might behave towards X-rays as a diffraction grating behaves towards light. He worked out in some detail the diffraction effects to be expected from such a three-dimensional grating, and his suggestion led directly to the experimental discovery of the diffraction by his collaborators Friedrich and Knipping. The diffraction pattern obtained when a beam of X-rays of mixed wave-length falls on a crystal is now universally known by his name. The immediate effect of the discovery was to settle the contemporary discussion about the nature of X-rays. The work was immediately taken up by scientific men in all countries, including, of course, the Braggs in England, and, in the years that followed, the diffraction of X-rays has developed into our most powerful method for studying the structure of aggregated matter. Its significance for the biologist is, perhaps, only beginning now. In these days of international antagonism, it is well to note that the branch of science initiated by von Laue has developed by the co-operative effort of men of all nations. Dr. von Laue has numerous friends in Great Britain; all of them hope that he has yet many years of fruitful work before him.

The Central Register: Section for Scientific Research

The Royal Society, at Trinity College, Cambridge, has sent a communication in connexion with the Central Register to the heads of scientific departments in universities, firms, etc., who supplied the Royal Society with lists of persons recommended for the Register. It is pointed out that the Central Register is now being used by the Ministry of Labour for filling vacancies. Some classes are being absorbed rapidly, others only slowly. To obviate hardship, particularly in the latter, it is proposed, in the Scientific Research Section, to make an urgency list of persons who are now unemployed, or whose present jobs are coming or likely to come to an end. This list will be given to the Ministry and, where possible, vacancies will be filled from it. The original lists of recommendations for inclusion on the Register are being returned with the request that names of those who should be placed on such an urgency list should be specially marked. The Royal Society is aware that many scientific people anxiously await information as to whether and when use will be made of the offer of service implied in their registration. No general answer can be given. The absorption of scientific personnel is proceeding, but this is bound to take time, and there is no certainty that every volunteer can be used in his professional capacity. In view of future needs, many will be best advised to remain in their normal occupations for the present. It is permissible, however, to seek employment, with the defence services or otherwise, which is not inconsistent with the Schedule of Reserved Occupations. If doubt exists, the Ministry of Labour can consult the appropriate panel. If employment in national service is obtained otherwise than through the Central Register, the Ministry of Labour should be informed.

Scientific and Industrial Research in India

The report of the Industrial Research Bureau, Government of India, for the year 1938–39, covers work carried out on the development of Indian industrial research and industry by the Bureau, including that of the Industrial Research Council and of the Research Branch of the Government Test House, Calcutta. The Bureau itself has been responsible for work on casein plastics and has shown that high-grade rennet casein is required, while the resin at present produced in India is of the lactic acid type, which is inferior for this purpose. A modified technique for the preparation of rennet casein suitable for operation under Indian climatic conditions requires development by laboratory investigations. The Bureau has also examined the economic and technical possibilities of manufacturing both rayon and staple fibre in India by the viscose, as well as by the acetate, process. It has continued its co-operation with the Central Standards Office Railway Board in matters concerning the lubrication and painting of railway rolling stock. With the view of developing the manufacture in India of phenol and formaldehyde for use in synthetic resins for moulding powders, disinfectants, etc., arrangements have been made for investigations of crude tar acid and phenol-cresol products from the cold distillation plant in Bihar. The Indian Lac Research Institute at Ranchi has obtained promising results in developing a shellac-urea-formaldehyde moulding powder.

The Research Branch of the Government Test House, Calcutta, has continued its paint investigations, covering revised technique for the assessment of natural weathering of paint as well as accelerated weathering, and the investigation of paint formulæ. The setting of pigments and the dispersion and suspension of red lead pigments have also been investigated, including weathering tests with dispersing and suspending agents, which indicate that the use of aluminium stearate is in no way harmful. Studies of particle size have indicated that aluminium stearate reduces the particle size of the red lead pigment to a remarkable degree. Investigations of the growth of fungus on paint films on exposure to weather indicate that substances such as sodium silicofluoride, magnesium borate and tribromophenol, which have proved effective in Western countries for preventing fungus growth, are of very little value in Bengal, but mercuric oxide and mercuric phthalate appear to retard the growth of fungus perceptibly. Work on vegetable oils and lubricants included a search for more effective antioxidants for castor oil in presence of iron, as well as for ground nut oil and for cottonseed oil. The most effective antioxidants found so far for cottonseed oil are not quite effective enough, and the best antioxidants for ground nut oil are less effective than those found for castor oil. Attention is now being confined to castor oil and ground nut oil brands, for which purpose α-naphthol, α-naphthylamine and β-naphthylamine appear to be the most effective antioxidants. Other studies have covered the use of vegetable oils as diesel oils. Work carried on in connexion with the glass industry has covered the improvement of glass furnaces and accessories.

Delinquency and Psychology

IN the July issue of the *Quarterly Review*, Mr. Claud Mullins, the well-known Metropolitan Police Court magistrate, remarks that some believe that the discoveries of modern psychology completely rob our present methods of trial and punishment of all justification, and that nearly all who have committed any serious breach of the criminal law should pass into the hands of psychotherapists and thus be cured, while others deny that our present legal and penal methods are in any way affected by psychology. Both extreme opinions, however, are gradually diminishing. Psychotherapists, by closer contact with delinquents, have become more modest in their practical attitude, while magistrates and lawyers are beginning to realize that psychologists can be of assistance. Mr. Mullins himself has sent innumerable delinquents to psychotherapists, and in many cases has found the results satisfactory. It must, however, be borne in mind that psychologists are concerned mainly with an individual while the Bench is concerned also and mainly with society. Certain criminals, such as fraudulent financiers, fire-raisers, stealing postmen or railway servants, policemen who accept bribes and alcoholic motorists who kill or maim, cannot be dealt with solely or even mainly from the point of view of what is best for the delinquent, and in such cases severe punishment is required to discourage others. While regarding it as highly dangerous for the Bench to assume the functions of the psychotherapist, Mr. Mullins maintains that some knowledge of psychology and psychotherapy is desirable alike in the judge, recorder, stipendiary magistrate and lay justices.

Museums and Education

SIGNIFICANT of the new stress being laid upon the educational possibilities of museums was the presence of the President of the Board of Education, the Right Hon. Earl De La Warr, at the Jubilee Conference of the Museums Association, held at Cheltenham in July. In an address to the members the President of the Board gave clear evidence of his own interest in museums and indicated that, but for the special financial condition of Great Britain, he would have announced the setting up of an inquiry into the relationships of museums to education and to the State. On the whole, he seemed to be doubtful about the expediency of bringing the museums of the country under the control of the Board of Education, believing that freedom of initiative was greater under the present system, and that a happy combination of official help and collaboration with local or voluntary effort was a source of strength in many spheres of work in Great Britain.

THE same point from another angle was referred to in a subsequent discussion at the Conference by Mr. J. Wilkie, secretary to the Carnegie United Kingdom Trust. He pointed out that at present, so far as legislation goes, museums (other than national museums) are almost all linked with libraries and library authorities under the Public Libraries Acts of 1892 to 1919. But these Acts are adoptive, and there is no Government grant in aid of any service which is carried out under an adoptive Act. So that the Markham Report, in suggesting Government grants with some measure of control, is suggesting something quite revolutionary in library and museum policy—the substitution of a compulsory for a voluntary system. That was the problem which faced educational reformers in 1870, and it raises the question whether public opinion, as represented by the man in the street and the public authority, has reached that point of belief in the necessity of museums as educational institutions which would compel the museum service to be made comprehensive, universal and compulsory. Are compulsory museums to follow compulsory education ? An account of these discussions appears in the *Museums Journal* of September.

Anthropological Expedition to Brazil

A PRELIMINARY report, the first to appear, on the movements and work of the expedition to Matto Grosso, Brazil, of Dr. Levi-Strauss and Dr. J. A. Vellard, based on the infrequent telegraphic dispatches which had been received to the time of writing, has been published in the *J. de la Société des Américanistes*, N.S., 30, 1939. The expedition started from São Paulo in May 1938, and, proceeding along the line of the Rondon telegraphic system, made telegraph stations its bases for contacts with the Indians. At Utiarity, Juruena, Nhambiquaras, and Vilhena relations were established with various groups of the Nambikwara, of whom there are approximately 2,000 individuals in a territory extending 400 kilometres north of Utiarity. Three linguistic divisions were differentiated. The material culture was poor; but evidence was obtained of their social organization, system of relationships, family life, and of certain aspects of their technology and art. By October the expedition had arrived at Pimento Bueno, which was selected as a base for further research. Here visits were paid to groups belonging to Guaporé culture, but not classified linguistically. A prolonged stay in a village halfway between Presidente Hermes and Presidente Penna, of which the inhabitants were numerically poor and culturally degenerate, nevertheless proved fruitful in sociological material. Towards the end of the year, on reaching Presidente Penna, the return of the expedition by the normal route towards the south was barred by torrential rains and the ill-health of the members of the expedition. It was, therefore, decided to leave the country by the north in the direction of the Rio Madeira and then west to Bolivia.

Research on Lawns

INVESTIGATION of the particular ecological problems which relate to lawns began in America towards the end of last century. It was not until 1920, however, that such research was prosecuted on a national scale in that country, and not until 1925 that any adequate provision was made in Great Britain. The report for 1938 of the Board of Greenkeeping Research, St. Ives Research Station, Bingley, Yorks. (pp. 1–77, price 2*s*., July 1939) shows to what adequate development the investigation of greenkeeping matters has now attained. There are approximately 1,600 experimental plots at the Station, to inquire into the response of grass varieties to manurial and mechanical treatments, to control pests and diseases, and to select the most suitable varieties of grass for various purposes. Seed of the new strain of St. Ives Creeping Red Fescue is grown and distributed, whilst an improved strain of *Agrostis tenuis* should yield upon a small commercial scale in 1939. Experiments on the control of pearlwort and other weeds are in progress, the effects of sulphur as a dressing for heavy ground are being investigated, treatment of the soil with potassium permanganate for the control of earthworms has proved satisfactory, and various diseases of turf have also been studied. The Station now maintains an extensive permanent collection of greenkeeping implements, and has 'museum' plots of grass and weed species—features which are of great value to students who attend the two courses of instruction which are held during the year. Letters and advisory visits have reached higher maxima than in any previous year, and the results of the Station's researches are published in its *Journal* and in various reprint publications.

The Electric Battery Vehicle

ACCORDING to the *Electrical Times* of September 28, one result of the outbreak of war is a considerable increase in the number of inquiries received by manufacturers of electric accumulators and vehicles as to the price of their wares, the charges of electricity required by the vehicles and the distance traversed for a given charge on a smooth road. Petrol rationing has compelled owners of motor-vehicles to curtail seriously their usual transport facilities, and they are considering the relative advantages of petrol and electricity for transport. Since electric vehicles take their power from storage batteries they are designed as a rule to have only a moderate range of action, varying from about 25 to 45 miles per charge of the batteries. The distance depends on the number of stops that have to be made. If the number of stops are numerous and the average time of a stop long, the advantage lies greatly on the side of the electric vehicle, since it only takes power when it is running. Most retail deliveries are carried out on a 'customer convenience' basis and not on 'transport economy basis'. It has been estimated that the petrol ration for C licence holders is only sufficient for their vans and lorries to cover half the normal mileage. If they have been doing about 75 miles per day, then they would be able to substitute an electric vehicle and still be in the same position as at present. For any distance between 35 and 75 miles per day, an electric vehicle would be an excellent substitute for a petrol one. The electric vehicle has other advantages. It has a long life; low maintenance and cheap running costs enable it, for many duties, to prove superior to alternative transport methods. In addition, it has the advantage of being exceptionally clean, free from fumes and simple to operate. A one-ton carrying capacity petrol van running 10,000 miles a year will use about 650 gallons of petrol, whereas the electric will use 4,000 units of electricity, or about 3 tons of coal. Owing to the grid, if at any time difficulties in transport should arise, then those power stations involving the minimum amount of coal transport could take over much of the load.

Properties and Testing of Heat-Insulating Materials

A GENERAL discussion on "The Properties and Testing of Heat-Insulating Materials", organized by the Joint Committee on Materials and their Testing, in conjunction with the Institution of Gas Engineers, will be held in London on November 23. Authorities from Great Britain, the United States, France, and Canada are to take part. Further particulars can be obtained from the Secretary, Joint Committee on Materials and their Testing, Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.

Chemical Society

THE Chemical Society will continue to function at Burlington House, London, unless circumstances render it impracticable to do so. It is the intention of the Council to publish the *Journal of the Chemical Society* each month as heretofore and to issue the "Annual Reports on the Progress of Chemistry, 1939" in the early spring of 1940. *British Chemical and Physiological Abstracts* "A", *Pure Chemistry*, will also continue to be published monthly. The Council has accepted, with great regret as from September 30 the resignation of Prof. J. W. Cook from the office of honorary secretary, on his appointment to the regius chair of chemistry of the University of Glasgow. It has expressed its high appreciation of the eminent services Prof. Cook has rendered to the Society during his term of office. Prof. W. Wardlaw, professor of physical chemistry in Birkbeck College, London, has been appointed by the Council to fill the vacancy until the next annual general meeting. The programme of lectures, discussions and meetings of the Society for the reading of papers, arranged for the session 1939–1940, will inevitably suffer drastic alterations. The Council hopes, however, that modified programmes will be carried out, and particulars of meetings will be announced from time to time. Until further notice the Society's Library will be open each weekday from 10 a.m. to 1 p.m., and from 2 p.m. to 5 p.m. or sunset when earlier, except on Saturdays, when the hours will be from 10 a.m. to 1 p.m. The Research Fund Committee will meet early in November to consider applications for grants for research purposes. These must be received by November 1.

Physical Society

A special meeting of the Council of the Physical Society was held on Friday, September 22, to discuss the Society's activities in the immediate future. It was decided that the science meetings, the annual exhibition of scientific instruments and apparatus and the annual competition in craftsmanship and draughtsmanship should be suspended for the present, but that the publication of the *Proceedings* should be continued as usual. Volume 6 of the Society's annual "Reports on Progress in Physics" is now in the printers' hands, and it is hoped that this volume will be issued at the usual time—the end of the present year. The Council recently had under consideration a project to hold local meetings of the members of the teaching and research staffs of the physics and related departments of a number of the provincial universities and university colleges; normally two such meetings would have been held in each session in the physics departments of two of the universities concerned. The officers and Council hope that, even though this scheme may not be carried out in its entirety, it may still be possible for local groups to hold meetings of an informal type under the auspices of the Society. For the present, the business of the Society will be carried on at its office at 1 Lowther Gardens, Exhibition Road, London, S.W.7 (Telephone: Kensington 0048); all communications and the MSS. of papers submitted for publication by the Society should be sent to the honorary secretaries at that address.

Institution of Civil Engineers

It is announced that the Council of the Institution of Civil Engineers has decided to continue, so far as may be practicable, the work of the Institution from the headquarters building in Great George Street, Westminster, S.W.1. The meetings of the Institution in London will be suspended until further notice, and the Conference on Engineering Education and Training and the Road Engineering Exhibition are postponed indefinitely. The October examinations of the Institution will be held in London, but not in the provinces. The Council will continue to co-operate in the work of the Central Register of the Ministry of Labour and to assist the War Office and other Service Departments in the recruitment of qualified civil engineers for posts in which their professional experience is of value.

Royal Institution

The policy to be followed by the Royal Institution during the War has been under consideration by the managers, who have decided to maintain its normal activities so far as possible. The libraries and reading rooms will be kept open as usual. Although the present 'black-out' restrictions prohibit the holding of the Friday evening meetings, a series of afternoon lectures at an earlier hour is being arranged and will be announced in due course.

Royal Society

The Royal Society will function normally during the war; the administrative office is located in Trinity College, Cambridge, and it is probable that the meetings of the Society will be held in that town.

Institution of Professional Civil Servants

The Institution of Professional Civil Servants has temporary headquarters at 20 Cedar Road, Sutton, Surrey, to which communications should be sent.

Announcements

Mr. W. C. Wilson, director of the unit for Clinical Research in Surgery at Edinburgh Royal Infirmary, has been appointed regius professor of surgery in the University of Edinburgh.

Prof. Kwanichi Terazawa, dean of the Faculty of Science of Tokyo Imperial University, has succeeded Prof. Mishio Ishimoto as director of the Earthquake Research Institute. Prof. Ishimoto will continue his researches as a member of the Institute.

Dr. Gerald B. Webb, research director of the Colorado Foundation for Research in Tuberculosis, has recently been awarded the Trudeau Medal of the National Tuberculosis Association in recognition of his attempts to produce specific immunity against tuberculosis by the inoculation of animals with very minute doses of tubercle bacilli.

Consequent upon the outbreak of war, the celebration of the Royal Microscopical Society's centenary this month is postponed, and a further notification will be issued in due course.

It was announced in Nature of September 30, p. 592, that the Imperial College is preparing to re-open most of its departments at South Kensington on October 10. We are asked to state that the date is not yet fixed and that students will be advised when to return.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 637.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Connexion between the Life-time of the Meson and the Beta-Decay of Light Elements

As is well known, the assumption of the instability of the meson, which is included in the fundamental hypotheses of Yukawa's theory of beta-disintegration, has received a striking qualitative confirmation from investigations of the absorption of the penetrating component of the cosmic radiation[1]. As stressed by Nordheim[2], there is, however, in the forms of the theory successively considered by Yukawa[3] a serious quantitative discrepancy regarding the value of the ratio between the life-times of the free meson and of *light* beta-radioactive elements: the value of this ratio, calculated by using the values of the constants determined from the magnitude of the nuclear forces, turns out to be much smaller than that derived from observation. Since this discrepancy affects equally any other form of the theory involving only one of the four types of meson fields which, according to Kemmer[4], are possible *a priori*, it may be concluded that no such form of the theory will be able to account quantitatively for the connexion between the life-time of the mesons and the beta-decay of light elements.

On the other hand, it is immediately apparent that the discrepancy in question can be removed as soon as a mixture of independent meson fields is introduced. Consider, for example, such a mixture of two fields A and B. The additive contribution of the field B to the beta-decay constant may then for some elements be much larger than that of the field A, while the life-time of the free mesons associated with field B will be so short compared with that of the mesons associated with field A that only the latter would have been observed at present in cosmic radiation.

Now a discussion of the problem of nuclear forces[5] seems to bring out the necessity of introducing just such a mixture of two types of meson fields, namely, a vector meson field and a pseudoscalar meson field. A closer investigation, which is being continued, shows that such meson fields give rise to an interaction between heavy and light particles which, besides a term of the same type as that assumed in the original Fermi theory of beta-decay, may involve several possible combinations of other terms of a more complicated form.

The resulting theory of beta-decay thus contains a certain amount of arbitrariness, which a comparison with the available experiments is not yet able to remove. Anyhow, it may be expected that it will enable us not only to avoid the discrepancy pointed out by Nordheim, but also to account for such considerable variations of the form of the beta-spectrum and the value of the beta-decay constant from element to element, as are already indicated by the present empirical data.

C. Møller.
L. Rosenfeld.
S. Rozental.

Universitetets Institut for
teoretisk Fysik,
København.

August 11.

---

[1] See, for example, Euler, H., and Heisenberg, W., *Ergebn. d. exakten Naturwiss.*, 17, 1 (1938).

[2] Nordheim, L., *Phys. Rev.*, 55, 506 (1939).

[3] Yukawa, H., *Proc. phys.-math. Soc. Japan*, 17, 46 (1935); Bhabha, H., NATURE, 141, 117 (1938); Yukawa, H., Sakata, S., Kobayasi, M., and Taketani, M., *Proc. phys.-math. Soc. Japan*, 20, 720 (1938).

[4] Kemmer, N., *Proc. Roy. Soc.*, A, 166, 127 (1938).

[5] Møller, C., and Rosenfeld, L., NATURE, 143, 241 (1939); 144, 476 (1939).

A New Technique for the Spreading of Proteins and the 'Spreading Number'

The ordinary volatile solvents employed for fatty substances cannot be used for the spreading of protein monolayers on the surface of water, since the majority of proteins are soluble only in water. Hughes and Rideal[1] have spread proteins directly from the dry crystal, the amount spread being determined with a microbalance. Gorter and Grendel[2] deliberately inject an aqueous solution of the protein on the surface without worrying about the possible disappearance of a part of it in the substrate. Fatty substances and the exceptional protein, gliadin, have been successfully spread from alcoholic solution, in spite of the fact that ethyl alcohol is soluble in water. It appears that in this case, owing to its large spreading pressure, the alcohol spreads very rapidly before it has time to diffuse into the substrate.

Starting from these facts, a general method has been evolved for the spreading of proteins from aqueous solutions. The protein is dissolved in water, the surface tension of which is artificially lowered by adding traces of a capillary active substance, so that, when a drop is placed on the surface of the substrate, it quickly spreads. Once scattered, only the protein remains on the surface and the solvent dissolves in the substrate. As capillary active substance, amyl alcohol at a dilution of 1–2 per thousand has given very satisfactory results. The action is simply one of mechanical dispersion, and the same result may be obtained by using esters (for example, butyl acetate or propionate) as capillary active substances.

Various types of proteins have been thus spread on the surface of either distilled water or dilute hydrochloric acid or caustic soda. Particularly some globulins (for example, myosin, amandin, edestin) have been spread which were reputed not to form films, or at least to spread only on very concentrated salt solutions. Below are given the areas in sq.m. per mgm. occupied by these different globulins. These figures are simply intended to show how the surface concentrations are comparable with those found for the ordinary proteins.

Areas in sq. metre per mgm. under 1 dyne/cm.

	Myosin	Amandin	Edestin
Dist. water	0·9	0·9	0 7
HCl *N*/1,000	1·1	1·3	0·9
HCl *N*/100	1·6	1·1	1·3

A substance may have a very low spreading pressure and yet be spread and give a film stable under relatively high pressures. It has to be emphasized that, with substances that do not spread spontaneously, one of the functions of the solvent is to disperse the molecules over the largest possible area. It is found that to obtain complete scattering, it is necessary to ensure that the concentration of the protein in the drop should be below a certain quantity, just as is the case with solutions of stearic acid or tristearin in a volatile solvent and gliadin in alcoholic solution[3].

The 'spreading number'. It has often been noticed that the spreading of a protein from a crystal is more difficult, if not impossible (for example, casein), at the isoelectric point. This is to be expected since at that point the solubility is at the minimum and, therefore, the work of adhesion being also a minimum, the spreading pressure is lower. This variation of the spreading pressure with the *p*H seems to be in contradiction with the results of Gorter and collaborators, who found a maximum of the 'spreading number' at the isoelectric point, when the protein was injected as a solution. The contradiction is only apparent and is due to the bad definition of 'spreading'. The point in question is rather the *spreading efficiency*: Gorter's curves showing the 'spreading number' as a function of the *p*H or the salt concentration are three-dimensional solubility curves and do not represent a surface phenomenon. In reality, if the substrate's *p*H corresponds to the isoelectric point of the protein, this, being at its minimum solubility, will spread before an appreciable quantity has time to dissolve. At other *p*H or salt concentrations, it will be more or less soluble and the surface concentration will correspond only to the part of the protein which is left on the surface.

In order to show that the variation of the 'spreading number' with the *p*H is in any case not a surface phenomenon, experiments have been made in which the *p*H of the substrate was changed under the monolayer, after this had been formed and the state of equilibrium reached[4]. A layer of egg albumin was spread by the Gorter and Grendel technique on *p*H 4·9 (*M*/1,000 acetate buffer). The *p*H of the substrate was afterwards brought successively to *p*H 3·2, 5·1, 2·6, then back to 4·9 and 11. The order of succession is immaterial: in one case, the film was spread on *p*H 7·8 (*M*/1,000 Co_3HNa) with the new technique and the *p*H afterwards brought to 4·9. The observed areas under 1·5 dyne/cm. are given below, the value 100 being arbitrarily attributed to the area at *p*H 4·9.

Egg albumin (relative areas under 1·5 dyne/cm.)

*p*H		*p*H	
4·9	100		
3 2	106		
5·1	100	7 8	97
2·6	108	4 9	100
4 9	100		
11	109		

If Gorter's curve represents the change of area occupied by a given quantity of egg albumin, the passage from *p*H 4·9 to 3·2 would have reduced the area to one eighth. Likewise, the film should extend 20 or 30 times by changing the *p*H from 7·8 to 4·9. Whereas in fact, as can be seen by the numbers above, the maximum variation in the area is at the most 10 per cent and the area is not even at a maximum at the isoelectric point. As noted by Philippi[5], a study of the complete isotherm shows that these relatively small variations in the area are entirely attributable to changes of the compressibility.

A more detailed account will be published elsewhere.

D. DERVICHIAN.

Laboratory of Colloid Science,
Cambridge.
August 16.

---

[1] *Proc. Roy. Soc.*, A, 137, 62 (1932).

[2] *Trans. Farad. Soc.*, 22, 477 (1926).

[3] See Mitchell, *Trans. Farad. Soc.*, 33, 1130 (1937).

[4] There is in fact a 're-extension' surface phenomenon which occurs in certain circumstances: see, Dervichian, D., *C.R.*, 209, 16 (1939).

[5] Philippi, "On the Nature of Proteins". Thesis, p. 71 (Amsterdam. 1936).

Comparison of the Adsorption, Electrolytic, and Interference Methods of Measuring Film Areas

THE Bowden-Rideal[1] electrolytic method of measuring area by the electrodeposition of hydrogen ions on conducting surfaces has been modified so that rapid measurements may be made by using audio-frequency alternating currents superposed on very feeble direct currents, and measuring directly the alternating changes of electrode potential with an amplifier and wave analyser with one megohm input impedance. Comparisons of surface areas were made by measuring the alternating current required to give the same alternating electrode potential as on one square centimetre of a mercury surface.

Measurements of the same surface were also made by the interference method[2].

Finally, the adsorption of palmitic acid was studied on large metallic granules with activated metallic surfaces, and when covered with coloured oxide films. The electrolytic method was also used with these granules. The results of adsorption measurements are near those of the interference method for slightly oxidized surfaces, but approach the order of magnitude of the electrolytic method for metallic surfaces.

A full account of the work will be published later.

RATIO OF PLANE AREA TO MEASURED AREA

Copper		Nickel	
Interference	Electrolytic	Interference	Electrolytic
1·52	10·4	1 33	9·0
2·26	25·3	2 00	18·2
2·40	26·8	2·70	22·4

ABSOLUTE GRANULE AREA 10^4 SQ. CM.

COPPER

Metal

Interference	Electrolytic	Adsorption
4·6	55·2	30 7

Slightly oxidised (film c. 10^{-5} cm.)

Interference	Electrolytic	Adsorption
4·8	—	6 1

F. H. CONSTABLE.

Faculty of Engineering,
Fouad El Awal University,
Giza.

---

[1] *Proc. Roy. Soc.*, A., 120, 89 (1928), *et seq.*

[2] Constable, *Proc. Roy. Soc.*, A., 119, 196 (1928).

Apparent Anomalous Isotopic Effect in Some Bands Associated with the Swan Bands

A NUMBER of weak bands have been noted in sources of carbon molecular spectra by Johnson[1] and by Fox and Herzberg[2]. Because of their association with carbon spectra, these bands were attributed to the carbon molecule, and several of the stronger ones (λλ 4770, 4836, 4911, 4997) tentatively identified as tail-bands of the Swan system. Measurements of the isotopic heads of the first three of these bands obtained from carbon enriched in the heavy isotope give some information concerning their nature and display an anomalously large isotopic shift.

The following positions of the heads of these bands were obtained from spectra of carbon containing 35 per cent ^{13}C, taken on a 21-ft. grating spectrograph in the first order. The source was an end-on quartz capillary discharge in argon containing a trace of methane, activated by a 3 kw. transformer.

^{13}C head	^{12}C head	Isotopic shift
4770·21 A. 20,957·60 cm.$^{-1}$	4764·77 A. 20,981·52 cm.$^{-1}$	23·92 cm.$^{-1}$
4836·16 20,671·80	4827·57 20,708·59	36·79
4910·95 20,356·99	4898·92 20,406·98	49·99

The values 23·92 cm.$^{-1}$ and 36·79 cm.$^{-1}$ are thought to be accurate to less than 0·1 cm.$^{-1}$, while the value 49·99 cm.$^{-1}$ is not so accurate because the band λ 4911 is much weaker than the other two.

The fact that only two heads were present, even in low dispersion spectra of carbon which contained 50 per cent ^{13}C, is clear proof that the emitting molecule is not C–C, but contains only one carbon atom. The isotopic shift is very large, and can be explained only by the unreasonable assumptions of an infinitely heavy emitting molecule, so that the carbon has its maximum effect on the vibrational energy, combined with very large correction terms for the effects of anharmonicity and rotational shifts. The origin of the band system computed from the relative magnitudes of the isotopic shifts is near 21,500 cm.$^{-1}$, so that the 0,0 band is probably covered up by the 1,0 (λ 4737) Swan band.

From the occurrence of these bands in a wide variety of sources of carbon spectra, they must be due to carbon combined with a very persistent impurity; and from their occurrence in sources of high excitation, the emitting molecule should not be very complex.

These bands were noticed incidentally to measurement of the ^{13}C spin, and on account of pressure of other work, no further research on them can be done at this laboratory.

CHAS. H. TOWNES.

California Institute of Technology,
Pasadena.
August 15.

[1] Johnson, R. C., *Phil. Trans. Roy. Soc.*, A, **226**, 157 (1926).

[2] Fox, J. G., and Herzberg, G., *Phys. Rev.*, **52**, 638 (1937).

Diffraction of Ultra-Short Radio Waves

SOMMERFELD[1] has shown that in the study of the diffraction of electromagnetic waves at a sharp edge, account must be taken of the contribution to the diffracted field of the wave which is reflected at the edge. Because of the variation in boundary conditions at the edge for radiation linearly polarized in different planes, Sommerfeld deduced that the shadow cast by a sharp edge should be deepest for radiation polarized with the electric vector parallel to the edge.

Wien[2] and Jentzsch[3], amongst others, have observed this feature for waves in the visible spectrum. We have obtained the same result with ultra-short radio waves in the wave-band 2–3 metres. When such waves are propagated over hills with long ridge formations such as are found among the downs of south England, we have noted that the shadow behind the ridges is always appreciably deeper for horizontally polarized (electric vector horizontal) than for vertically polarized waves. Typical results obtained on a wave-length of 3 metres on Dunstable Downs are given in the accompanying table. For a fixed transmitter position situated on a plateau about 200 yards from the edge of a slope some 400 ft. in overall height, measurements of the vertical and horizontal electric field-strengths were made at a series of positions on the slope, the transmitting aerial being oriented according to the type of polarization under observation at the receiver.

Position	Field-strength in microvolts per metre		Ratio: vertical/horizontal fields	Remarks
	Vertical polarization	Horizontal polarization		
1	4500	4000	1·12	Gradual slope
2	2200	1800	1·22	
3	1000	800	1·25	
4	630	400	1·57	
5	320	180	1·78	
6	125	70	1·79	Steep slope
7	80	28	2·86	
8	36	16	2·25	
9	32	12	2·67	Gradual slope
10	40	14	2·86	
11	40	17	2·35	

It will be noted that near the top of the ridge (position 1) the vertical and horizontal electric field-strengths were approximately equal, but that on moving the receiver down the hill into the shadow, the vertical electric field increased relative to the horizontal electric field, and that finally, as the slope lessened, both fields increased slightly but the vertical electric field remained throughout greater than the horizontal field.

Similar results have been obtained on other hills devoid of trees. The presence of trees complicates the propagation characteristics of ultra-short radio waves, but it has been found that in the wave-band 2–3 metres, vertically polarized radiation appears, in general, to be the most efficient for conditions in which diffraction by hills is predominant.

This work forms part of the programme of the Radio Research Board, and this note is published by permission of the Department of Scientific and Industrial Research.

J. S. McPETRIE.
J. A. SAXTON.

Radio Department,
National Physical Laboratory,
Middlesex.
July 28.

[1] Sommerfeld, A., *Ann. Phys.*, **47**, 317–374 (1896).

[2] Wien, W., *Wied. Ann.*, **28**, 117–130 (1886).

[3] Jentzsch, F., *Ann. Phys.*, **84**, 292–312 (1927).

Isotope Effect in Potassium Dihydrogen Phosphate

When the hydrogen in potassium dihydrogen phosphate (KH_2PO_4) is replaced by deuterium by repeated crystallization from warm 99·6 per cent heavy water (D_2O), the potassium phosphate separates in a different crystal structure. It can with some difficulty also be made to crystallize in the tetragonal form described by West[1], by adding a nucleus of KH_2PO_4 to a supersaturated solution of KD_2PO_4. When the new crystal form is powdered, it slowly reverts to the tetragonal form over a period of days.

As is being described elsewhere, a comparison of the tetragonal forms of KH_2PO_4 and KD_2PO_4 shows that the short hydrogen bonds (2·55 A.) are associated with a very considerable expansion of the lattice on substituting deuterium, thus showing similarity with the short hydrogen bonds in oxalic acid dihydrate and sodium bicarbonate[2].

The separation of acid potassium phosphate in a new crystal structure from heavy water is further evidence of the difference between hydrogen and deuterium bonds in crystals. So far as can be ascertained with the limited amount of material at present available, the new form is chemically identical with tetragonal KD_2PO_4 and has approximately the same density. From the X-ray data the crystals are monoclinic, with 8 molecules per unit cell, the axes being: $a = 7 \cdot 37 \pm 0 \cdot 01$ A.; $b = 14 \cdot 73 \pm 0 \cdot 01$ A.; $c = 7 \cdot 17 \pm 0 \cdot 01$ A.; $\beta = 92 \cdot 0^\circ$.

Random errors are as given. Systematic errors probably do not exceed 1 per cent except for the a axis, for the determination of which only weak reflections were available. The crystals tend to elongate along the c axis, and prominent faces are (100), (010), and (110).

A detailed investigation of the new crystal structure is being attempted, since it promises to throw further light on the role of hydrogen bonds in crystals.

A. R. Ubbelohde.
I. Woodward.

Davy Faraday Laboratory,
Royal Institution,
London, W.1.

---

[1] West, J., *Z. Krist.*, 74, 306 (1930).

[2] Robertson, J. M., and Ubbelohde, A.R., *Proc. Roy. Soc.*, A, 170, 222 (1939).

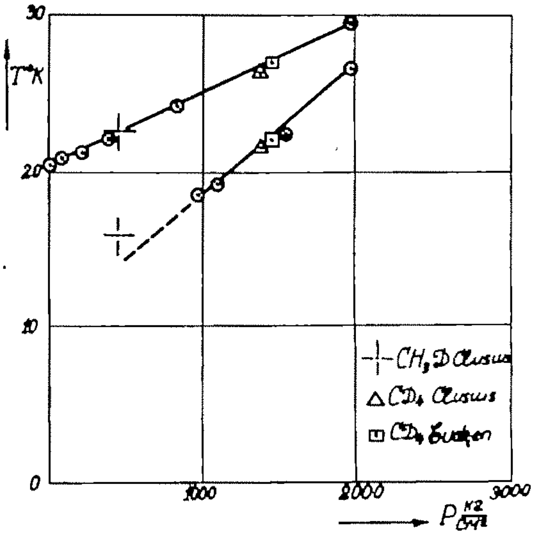
Specific Heat of Methane Under Pressure

Clusius[1] discovered the anomaly of the specific heat of solid methane at 20·4° K.; Eucken, Heuse and others showed further that there was a case of the so-called λ-point. It appeared desirable to study the influence of the pressure of transformation at the λ-point.

Clusius and Perlick investigated the specific heat of solid methane under pressure up to 200 kgm./cm.^{2}. In our laboratory the measurements of the specific heat of methane were carried out from 12° K. to 30° K. at pressures up to 2,000 kgm./cm.^{2}, and the preliminary results are reported below.

The measurements were performed in a steel calorimeter, the specific heat of which was 20 per cent of that of solid methane at 18° K. The pressure was transmitted by helium. At a pressure of 1 kgm./cm.^{2} the anomaly of specific heat occurred at 20·6° K. The maximum value measured was 200 cal./mol. (81 cal./mol. measured by Clusius), the breadth of the maximum at 10 cal./mol. was 0·4° (0·9° measured by Clusius). These data attest the high degree of purity of the methane investigated. The measurements at all pressures were effected with one condensation.

The measurements of methane under pressure revealed the existence of two maxima of specific heat which shift with changing pressure. The accompanying diagram represents the dependence of the temperature T of these maxima on the pressure P. From the curves it follows that the low-temperature maximum which appears under pressure is shifted by the pressure faster than the normal maximum.



To all appearance methane under normal pressure has the second specific heat maximum at the temperature of liquid helium. The pressure shifts this maximum to the region of higher temperatures, where it is observed as the second maximum. The displacement of the maxima appears to depend on the increase of the density of the substance caused by pressure.

Clusius and his co-workers discovered two specific heat maxima: at 15·5° K. and 22·6° K. in CH_3D and 21·4° K. and 26° K. in CD_4. The introduction of one molecule of heavy hydrogen (D) is evidently equivalent to the influence of pressure upon ordinary methane.

The same conclusions were drawn by Eucken and his co-workers from their investigations of mixtures CH_4 and CD_4. Extrapolating, these authors come to the conclusion that CH_4 under a pressure of 1,200 kgm./cm.^{2} must be equivalent to CD_4 at 1 kgm./cm.^{2}. Our measurements (see diagram) show the equivalency of CH_4 at 1,410 kgm./cm.^{2} to the CD_4 of Eucken. The CD_4 of Clusius is equivalent to our CH_4 at 1,350 kgm./cm.^{2}. This slight difference is probably due to the difference in the purity.

An examination of these results confirms the view expressed above as to the analogy of the augmentation of density of CH_4 by pressure and the substitution of D for H in the molecule.

These results have been obtained in a calorimeter in which the helium transmitting the pressure was in direct contact with the methane.

O. N. Trapeznikowa.
G. A. Miljutin.

Kharkov.
June 20.

---

[1] Clusius, *Z. phys. Chem.*, 3, 41 (1929).

[2] Eucken u. Bartholome, *Gott Nachr.*, 2, 61 (1936). Heuse, *Z. phys. Chem.*, *A*, 147, 282 (1930). Clusius u. Perlick, *Z. phys. Chem.*, B, 24, 313 (1934). Clusius, *Physica*, 4, 1105 (1937). Bartholome, Drikos, Eucken, *Z. phys. Chem.*, B, 39, 371 (1938).

Colour of Celestine

Some months ago, through the good offices of Mr. B. Topley, of Messrs. Albright and Wilson, Oldbury, we obtained several specimens of celestine from near Yate, Glos. Some were colourless, others tinged with blue, whilst a few were red. The blue crystals have been observed locally to occur lining channels or 'pipes' where water has bored through the massive mineral; the particular conditions favouring the red crystals are not apparently known.

The blue colour, to which celestine owes its name, is usually attributed to traces of vivianite, which possesses deep pigmentary power[1]. This, however, can scarcely explain the red colour.

Doelter[2] attributed the colours of celestine and numerous other minerals to the presence of colloidal inclusions, the degree of dispersion of which would determine the colour, whilst the concentration would determine the depth of that colour. He suggested, further, that the blue colour of celestine might be caused by colloidal sulphur produced by reduction of some of the sulphate.

Spectrograms of our specimens showed that whilst only minute traces of iron were present, the characteristic lines of gold were well defined in the red and blue specimens, but were scarcely perceptible in the white. The gold was extracted with aqua regia, reduced with phenyl hydrazine[3] and weighed on a sintered glass funnel using a microbalance. The iron was determined colorimetrically.

The results were as follows:

	Gold (p.p.m.)	Iron (p.p m.)
Colourless crystals ..	nil*	19
Pale blue ,, ..	49	4
Deep red ,, ..	85	4

* Too small to extract.

It is noteworthy that the iron content was greatest in the colourless crystals, whilst the gold content rose with the depth of colour. When gently heated, the blue crystals became slightly pink, but the other crystals were unchanged.

We are inclined to the opinion, therefore, that the colours of our specimens are due to colloidal gold. We should like to examine specimens from other localities but are experiencing great difficulty in obtaining them; perhaps some readers of Nature could help to obtain specimens.

J. Newton Friend.
John P. Allchin.

Technical College,
Birmingham.
Sept. 7.

---

[1] Dana, "Descriptive Mineralogy", 906 (1914). Miers, "Mineralogy", 580 (1929).

[2] Doelter, "Die Farben der Mineralien" (1915).

[3] Using Pozzi-Escot's method of reduction (*Ann. Chim. Anal.*, 12, 90 (1907)).

Vitamin B_1 and Acetate Oxidation by Bacteria

It is now known[1] that vitamin B_1 may be a necessary factor for the growth of bacteria. Bacteria can, however, be grown with minimal amounts of vitamin B_1 and such bacteria (for example, *Staphylococcus aureus*) may show enhanced metabolic activities so far as the breakdown of pyruvic acid is concerned, when the vitamin is added to suspensions of the washed cells[2]. If the bacteria are grown on a medium containing adequate quantities of vitamin B_1, the subsequent addition of the vitamin to the washed cells does not affect their metabolic changes. It is evident that a study of the action of vitamin B_1 on the chemical changes brought about by vitamin B_1-deficient bacteria may throw new light on the mechanism of action of this vitamin.

So far, attention has been mainly concerned with the effects of vitamin B_1 on pyruvic acid and lactic acid breakdown, following the work of Peters and his colleagues on the effects of this vitamin on the metabolism of avitaminous pigeon brain.

Werkman and his colleagues[3] have found that the growth and metabolism of propionic acid bacteria are affected by the presence of vitamin B_1.

We have found, using a washed suspension of propionic acid bacteria grown on a vitamin B_1-deficient medium, that the addition of the vitamin very markedly stimulates the oxidation of acetic acid.

Acetic acid is already known from the work of Stone, Wood and Werkman[4] to act as a hydrogen donator in the presence of the resting cells of propionic acid bacteria.

A typical result illustrating the action of vitamin B_1 on acetate oxidation is shown by the following figures, obtained with a suspension of bacteria grown on a vitamin B_1-deficient medium and incubated aerobically in a phosphate medium (in a Barcroft differential respiratory apparatus) at 37° for two hours:

Substance added to bacterial suspension	μl oxygen consumed	μl oxygen consumed, due to the acetate	μl acetate utilized
No addition .. .	197	—	—
0·25 γ vitamin B_1 ..	245	—	—
0 01 M acetate ..	563	366	193
0·25 γ vitamin B_1 + 0·01 M acetate ..	1202	957	486

The following conclusions may be drawn. (1) In the presence of very small quantities of vitamin B_1 (for example, $0{\cdot}08 \times 10^{-6}$ mgm. per ml.) there is a very marked stimulation of the oxygen uptake in the presence of acetate, though not in the absence of the added substrate. This stimulation is not due to an increase in the number of bacteria during the course of the experiment as cell counts have shown. (2) The ratio of oxygen uptake to acetate utilized is approximately 2·0 and this ratio appears to be independent of the addition of vitamin B_1. The ratio of 2·0 would be expected if complete oxidation of acetate occurred according to the following equation

$$CH_3.COOH + 2O_2 = 2CO_2 + 2H_2O,$$

and estimations of carbon dioxide (or bicarbonate) formation have been consistent with this conclusion.

It would be a plausible view that the catalytic action of the vitamin is due to its accelerative effect on the oxidation of pyruvic acid possibly formed as an intermediate during the oxidation of acetic acid. Against this view, however, is the experimental fact that no pyruvic acid appears to accumulate when the acetate is oxidized by the bacteria in the absence of the added vitamin. Moreover, a ratio considerably less than 2·0 would be expected if acetate were oxidized in the absence of vitamin B_1 to an intermediate the further oxidation of which required the presence of the vitamin. Experiment has failed to show that traces of pyruvic acid block the aerobic oxidation of acetic acid. The inference would be that the acetic acid molecule itself, in the case at any rate of propionic acid bacteria, requires the presence of vitamin B_1 to accomplish its aerobic oxidation. Whether this is the case with mammalian tissues is a matter shortly to be investigated.

Our experiments indicate that the catalytic agent is cocarboxylase (vitamin B_1 pyrophosphate) rather than vitamin B_1 itself (*cf.* Lipmann[5]). Silverman and Werkman[6] have recently shown that propionic acid bacteria are capable of synthesizing cocarboxylase from vitamin B_1.

More complete details of these and related experiments will be published in due course.

J. H. Quastel.
D. M. Webley.

Biochemical Laboratory,
Cardiff City Mental Hospital.
Aug. 16.

---

[1] Knight, *Biochem. J.*, 31, 731, 966 (1937)

[2] Hills, *Biochem. J.*, 32, 383 (1938).

[3] Wood, Anderson and Werkman, *J. Bact.*, 36, 201 (1938). Silverman and Werkman, *Proc. Soc. Exp. Biol. Med.*, 38, 823 (1938)

[4] Stone, Wood and Werkman, *Biochem. J*, 30, 624 (1936).

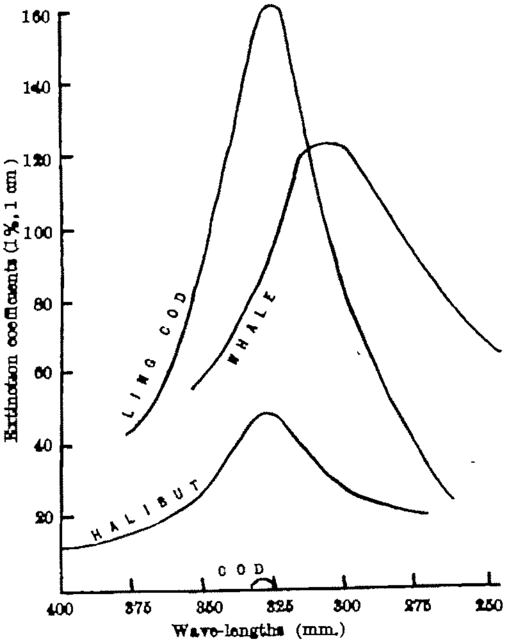
[5] Lipmann, *Enzymologia*, 4, 65 (1937).

[6] Silverman and Werkman, *Enzymologia*, 5, 385 (1939).

Vitamin A in Ling Cod Liver Oil

The ling cod, *Ophiodon elongatus*, is an interesting fish because (1) it is neither a ling nor a cod; (2) it is found only in the north-eastern Pacific Ocean, and is one of the chief fish catches in British Columbia; and (3) it yields a liver oil rich in vitamin A[1].

Recently, in a routine examination of fish oils for whale oil adulteration, no published absorption curves for ling cod liver oil, or for Pacific whale oil, could be found. Such curves, together with average halibut and cod, are therefore presented in this note.



Ling cod liver oil is seen to have a typical absorption around 328 mμ (vitamin A), and in this case, to be much more potent than the sample of halibut liver oil.

Whale oil adulteration can easily be detected by the criteria of Drummond[2], though the curve for whale oil shown here is not quite identical with his curves.

We are very grateful to Dr. H. N. Brocklesby, of Prince Rupert, B.C., who observed the high vitamin A content of ling cod oil, for a sample of liver oil from carefully identified ling cod, and for the whale liver oil.

L. B. Pett.
Marian Lipkind.*
G. A. LePage.*

Department of Biochemistry,
University of Alberta,
Edmonton.
July 26.

---

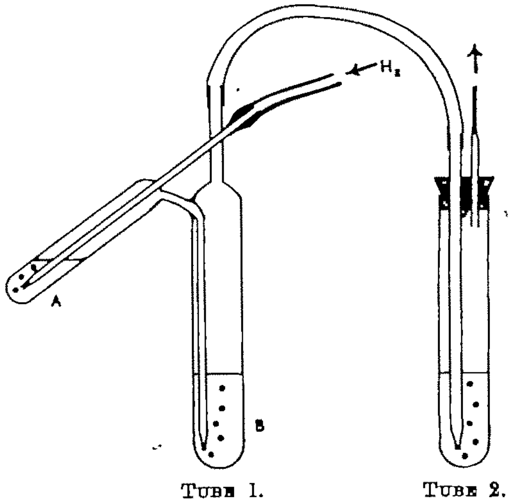
* Assisted from a grant to Prof. G. Hunter from the Associate Committee on Medical Research of the National Research Council, Canada.

[1] Van Wilby, G., "The Ling Cod", Biological Board of Canada, *Bull.* 54.

[2] Haines, R. T. M., and Drummond, J. C., *Analyst*, 63, 335 (1938).

Decomposition of Hydrogen Peroxide by Catalase

It has recently been stated[1], and it appears to be generally accepted, that the decomposition of hydrogen peroxide by catalase can only take place in the presence of molecular oxygen. It has been pointed out, however[2], that this phenomenon is difficult to understand, since it would be expected that such a strong oxidant as hydrogen peroxide would certainly react with the reduced form of the enzyme according to the scheme proposed[1]. As this point is of fundamental importance in relation to the mechanism of cellular oxidations in general, we have carried out some critical experiments to test the validity of the hypothesis. Our results have furnished rather unequivocal evidence that the hypothesis is untenable, and we would, therefore, like to report them here.



The apparatus used is shown in the accompanying diagram. Five c.c. of a 0·1 per cent solution of hydrogen peroxide in 0·125 *M* phosphate buffer, *p*H 7·3, and 0·25 *M* sodium chloride were introduced into the rear arm (*A*) of tube 1, which was then connected by lead tubing to a heavy glass tube containing palladium asbestos. The glass to lead connexions were sealed with de Khotinsky cement.

Into the front arm (*B*) of tube 1, and also into tube 2, were introduced 25 c.c. of a suspension of luminous bacteria (*Ph. Fischeri*) in phosphate buffer sodium chloride solution. The outlet of tube 1 was connected to the inlet of tube 2 by a heavy rubber tube. The outlet of the latter consisted of a capillary tube inserted in the rubber stopper as shown in the diagram. With this arrangement, hydrogen purified over heated palladium asbestos was passed in a continuous stream through the two arms of the first tube, and thence through the second. In less than two minutes after starting the flow of gas, the luminescence in both bacterial suspensions dimmed, which, according to Shapiro[3], would indicate that the oxygen tension was already less than 0·14 per cent. In another five minutes, the luminescence was extinguished, to the completely dark-adapted eye, in tube 1, while remaining faintly visible in tube 2, showing the presence of a minute amount of oxygen that may have been dissolved in, or diffused through, the rubber connexion between the two tubes. The fact that there was no luminescence in tube 1 proves that certainly less than a 10^{-6} atmosphere[4] of molecular oxygen was coming into that suspension from the rear arm containing the hydrogen peroxide solution. After another ten minutes of passing pure hydrogen through the vessels it may be safely assumed that tube 1 was completely free of molecular oxygen.

Tube 1 was then tilted, so that the hydrogen peroxide solution from arm (*A*) was mixed with the bacterial suspension in arm (*B*). There was an immediate and bright flash of luminescence, and a few seconds later the suspension in tube 2 also lighted up. While it may be possible that the luminescence in tube 1 resulted from a direct oxidation by hydrogen peroxide, it is quite certain, from the luminescence appearing in tube 2, that molecular oxygen was liberated when the hydrogen peroxide solution was brought into the suspension of bacteria, and it is equally certain that this reaction began under completely anaerobic conditions.

To make certain that these results were due entirely to enzyme action, a portion of the same suspension was boiled for ten minutes and the experiment was repeated with boiled bacteria in tube 1. In this case tube 2 did not light up after the hydrogen peroxide was mixed with the boiled bacteria.

In connexion with the same experiments, it is interesting to note that the catalase activity of these bacteria, unlike the phenomenon of luminescence, is not dependent on intact, viable cells. Another portion of the same suspension was centrifuged and resuspended in distilled water, which immediately cytolyses the cells and extinguished both luminescence and respiration[5]. A drop of this suspension produced no growth on an agar slant, although the control, inoculated from the uncytolysed cells, produced abundant growth and bright luminescence.

Following the same procedure, hydrogen peroxide was again added in the absence of molecular oxygen. Tube 2 lighted up fully as well as it had when the living cells were employed in tube 1.

In conclusion, we would like to direct attention to the fairly well known, but frequently neglected, usefulness of luminous bacteria as a means of detecting the presence of molecular oxygen. May we suggest, also, that the simple method described in this letter might be profitably employed to investigate the activity of catalase not only in various species of bacteria but in enzyme preparations as well.

Frank H. Johnson.
K. L. van Schouwenburg.

Physisch Laboratorium
Afd. Biophysica,
Utrecht.

---

[1] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, 124, 397 (1938).

[2] Oppenheimer, C., and Stern, K. G., "Biological Oxidation" (The Hague: W. Junk, 1939).

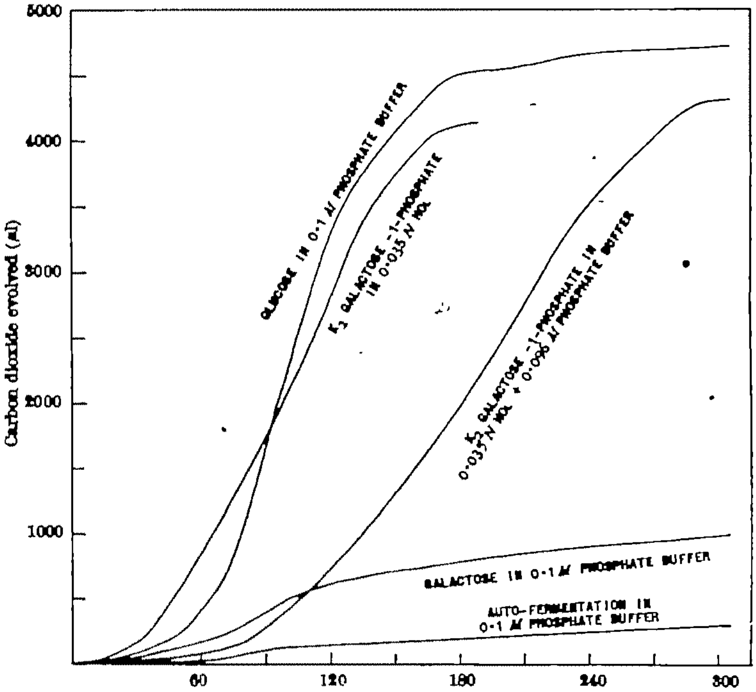
[3] Shapiro, H., *J. Cell. Comp. Physiol.*, 4, 313 (1934)

[4] Harvey, E. N., and Morrison, T. F., *J. Gen. Physiol.*, 6, 13 (1923).

[5] Johnson, F. H., and Harvey, E. N., *J. Cell. Comp. Physiol.*, 11, 213 (1938).

Galactose-1-Phosphoric Acid in Galactose Metabolism

The synthesis of α (?)-galactose-1-phosphoric acid has provided a means of examining the constitution of the galactosephosphate accumulating in the liver during galactose assimilation[1]. Both natural and synthetic esters are non-reducing, very readily hydrolysed by acid, and resistant to alkaline hydrolysis. After removal of the reducing esters by alkaline hydrolysis, the mixture of phosphoric esters



100 mgm. dried galactose-adapted *S. cerevisiae* Frohberg were used to ferment 1 mol of 0·1 *M* sugar or ester solution (*p*H 6·5). Readings were taken at intervals of 5–10 minutes.

isolated from the liver during galactose assimilation contained, apart from water of hydration, 29·6 per cent anhydrous barium galactose-1-phosphate, 3·1 per cent anhydrous glucose-1-phosphate, 2 per cent barium salt of an unidentified acid-labile ester, and 60 per cent barium salt of an acid-resistant ester. This mixture of barium salts had $[\alpha]_{5461}$ + 34·4° and the barium salt of the acid-resistant ester $[\alpha]_{5461}$ − 3·4°. Cori, Colowick and Cori[2] found for anhydrous barium glucose-1-phosphate $[\alpha]_D$ + 75° which corresponds to $[\alpha]_{5461}$ + 89°. By calculation from these values, natural barium galactose-1-phosphate would have $[\alpha]_{5461}$ + 114° while the corresponding value of the synthetic ester is + 110°. Determined in a similar manner, the constant of hydrolysis of the natural ester in 0·25 *N* HCl at 25° would be $0{\cdot}87 \times 10^{-3}$ while that of the synthetic ester is $0{\cdot}89 \times 10^{-3}$. These findings, together with the earlier evidence, make it highly probable that the galactosephosphate present in the liver during galactose assimilation is identical with synthetic α(?)-galactose-1-phosphoric acid. An attempt is being made to crystallize the natural ester as the dipotassium salt.

The biological significance of these results is emphasized by the fact that synthetic galactose-1-phosphoric acid is fermented by dried galactose-adapted *S. cerevisiae* Frohberg at approximately the same rate as is glucose, while galactose itself is fermented only very slowly (see graph). The relative quantities of carbon dioxide evolved during fermentation of glucose, of galactose-1-phosphoric acid, and of galactose, while subject to slight variation with change in concentration of inorganic phosphate, were 100, 94 and 15 respectively. It seems clear that in the fermentation of galactose, at least by the yeast preparation here employed, phosphorylation in position 1 is a necessary initial reaction proceeding at a relatively slow rate, while the phosphorylated product is fermented very rapidly.

The metabolism of galactose in the liver differs from fermentation by dried yeast in that galactose-1-phosphoric acid accumulates in the liver. The magnitude of this accumulation has not as yet been determined. There are obviously large losses in isolating the ester, which so far has been obtained in quantities equivalent to 5–12 mgm. of galactose per 100 gm. of liver.

H. W. KOSTERLITZ*.

Physiology Department,
Marischal College,
Aberdeen.
August 19.

---

*Carnegie Teaching Fellow. A grant from the Medical Research Council is gratefully acknowledged.

[1] Kosterlitz, *Biochem. J.*, 31, 1217 (1937), 33, 1087 (1939). *J. Physiol.*, 93, 34P (1938).

[2] Cori, Colowick and Cori, *J. Biol. Chem.*, 121, 465 (1937).

Blood Clearance of Free Chloral in Normal and Liver-damaged Dogs

FOLLOWING up the investigation on the urinary elimination of administered chloral hydrate in normal and liver-damaged dogs[1], we have made further observations on the blood clearance of free chloral under more or less identical experimental conditions. The data collected are rather interesting and appear to us to be worth recording, in as much as the results not only substantiate our previous conclusions drawn from urinary experiments, but also point the way to the development of a comparatively quicker and possibly more sensitive 'blood test' for gauging the detoxicating efficiency of the liver.

After the oral administration of chloral hydrate to dogs, in doses ranging from 100 mgm.–200 mgm./kgm., 1·0 c.c. samples of blood were taken from the hind limb veins, the first sample being collected when a fair degree of somnolence supervened in the experimental animals (usually between 35 min. and 50 min. after chloral hydrate). Subsequent samples were collected at one-hour intervals for six hours in order to ascertain the time at which the maximum concentration of free chloral was attained in the blood. Free chloral was estimated by the pyridine colour reaction of Friedman and Calderone[2]. Curiously enough, normal blood samples of dogs were found to give a faint pyridine colour reaction. Unless this is taken into account in expressing the final result, a higher figure is likely to be recorded. To eliminate this possible source of error, it was necessary to take an initial reading of the normal blood sample prior to the administration of chloral hydrate. Again, the pyridine colour tends to fade away within a very short time. For accurate readings, it is desirable to finish the colour measurements within a minute after the solution has been finally diluted with water. When these precautions are strictly attended to, fairly reliable results are obtained.

A typical set of experimental results obtained at the height of free chloral concentration in the blood about forty-five minutes after oral administration is presented in the table below.

	Dog No.	Maximum concentration of free chloral in blood (mgm. per cent)		
		Dose of chloral hydrate administered orally :		
		100 mgm./kgm.	150 mgm /kgm.	200 mgm./kgm.
Normal animals	1 (6·3 kgm.)	1·32	2·30	3·50
	4 (6·3 kgm.)	1·54	2·25	3·14
	6 (6·4 kgm.)	1·10	2·00	3·32
* Recent liver damage	1	2·00	3·00	4·56
	4	2·00	3·32	4·00
	6	1·83	3·00	5·00
* Long-standing liver damage	1	3·46	5·00	9·00
	4	3·64	4·85	7·50

* Recent liver damage caused by 4–5 administrations of CCl_4, and long standing liver damage caused by 15–20 administrations of CCl_4; each administration = 2 c.c./kgm.

It will be noticed that there is a significant increase in the blood concentration of free chloral in liver-damaged animals with as low a dose as 100 mgm./kgm. of chloral hydrate. In cases of chronic liver damage, a well-marked change in free chloral concentration is usually observed. In recently induced liver damage, the difference, though not as marked, is sufficiently significant to warrant the conclusion that a differential diagnosis may be possible.

We are indebted to Prof. R. N. Chopra for constant advice and guidance.

B. MUKERJI.
R. GHOSE.

Biochemical Standardisation Laboratory,
Government of India,
All India Institute of Hygiene and
Public Health, Calcutta.

---

[1] Mukerji, B, and Ghose, R., NATURE, 144, 112 (1939).

[2] Friedman, M. N., and Calderone, F. A., *J. Lab. and Clin. Med.*, 19, 1332 (1934).

Order of Magnitude of Morphogenetic Forces

The experimental analysis of embryonic development has been mainly concerned with elucidating the chemical mechanisms which cause different parts of the egg to develop into the organs and tissues of which the adult is composed. Much less is known about the physical forces which cause the changes in relative position which are such an important part of the developmental process. Preliminary measurements were therefore made of some of the physical magnitudes associated with the process of gastrulation in the eggs of the newt *Triton alpestris*.

In the first set of experiments, small steel balls were placed in the blastocoel cavity of young gastrulæ, and subjected to the magnetic field produced by one pole of a long bar magnet. The pole and the egg were gradually brought closer together until the ball was pulled through the blastocoel roof. Two sets of experiments were made: in the first, with a ball 0·216 mm. in diameter, breakage of the roof occurred at distances of 0·83, 2·0, 1·83, 1·0, 1·33, 1·0, 1·0 mm., average 1·36; in the second, with a ball 0·3 mm. in diameter, breakage occurred at 1·5, 1·5, 1·83, 1·5, 1·33, 2·0, 1·83, average 1·66. Converting these measurements into mgm. of pressure per sq. mm. of the hemispherical surface of the ball in contact with the roof, the averages for the two series are 7·02 and 7·29 mgm./mm.^{2}.

In another series of experiments, balls were placed among the gastrulating cells in such a way that the applied magnetic force was opposed to their normal movements; the eggs were placed at various distances from the magnet, and it was noted whether any movement of the balls took place over a period of about eight hours. For balls of diameter about 0·083 mm. placed in the mesoderm, movement occurred at distances of 9·5, 8·0, 6·83 (?), 6·66, 6·33, 6·0, 5·83 mm., no movement at 7·83, 5·5, 5·3, 5·16, 4·66, 4·0. For similar balls in the endoderm, movement occurred at 8·5, 5·83, not at 7·16, 6·0, 5·5, 5·0, 4·66, 3·83, 3·66, 3·33 mm. If we take for both tissues the limit at which movement could occur at about 5·66 mm., the maximum force exerted by the gastrulating tissues is equivalent to 0·34 mgm./mm.^{2} of the hemispherical surface.

These measurements are of a preliminary nature, and no great accuracy is claimed for them. It is interesting to note that the force exerted by the gastrulating cells is much less than the breaking strain of the tissue. Before any attempt can be made to interpret this it will be necessary to know something of the rigidity, and the viscosity at various rates of flow, of the tissues concerned.

C. H. Waddington.

Zoological Laboratory,
Cambridge. August 30.

Points from Foregoing Letters

The quantitative discrepancy between the observed and the theoretical ratio of the life-time of the free meson to that of a light radioactive element can be removed, according to C. Møller, L. Rosenfeld and S. Rozental, by combining a vector and a pseudoscalar field for the meson in the calculations.

D. Dervichian finds that when a protein is dissolved in water to which a trace of a capillary active substance able to lower the surface tension is added, the protein can be spread on the surface of an aqueous solution. He also discusses the meaning of 'spreading number'.

C. H. Townes discusses the presence, in the spectrum of carbon containing ^{13}C, of bands, hitherto ascribed to the carbon molecule, which he believes are due to a persistent impurity of complex molecular structure.

It has been found by J. S. McPetrie and J. A. Saxton that in the ultra-short radio wave-band 2–3 metres the attenuation of received field-strength for positions within the shadow of hills is most pronounced for radiation polarized with the electric vector horizontal.

A. R. Ubbelohde and Miss I. Woodward find that when deuterium replaces hydrogen in potassium dihydrogen phosphate, this substance crystallizes in a new structure, thus giving further evidence of the difference between hydrogen and deuterium bonds in crystals.

O. N. Trapeznikowa and G. A. Miljutin find two maxima, which shift with pressure, in the specific heat of methane between 12° K. and 30° K., at pressures up to 2000 kgm./cm.^{2}. The effect of substituting deuterium for hydrogen in methane has a similar effect to increasing the pressure on ordinary methane.

Specimens of blue and red celestine from Yate, Glos., have been examined by J. N. Friend and J. P. Allchin, who attribute the colour to colloidal gold.

J. H. Quastel and D. M. Webley find that the oxidation of acetic acid by suspensions of propionic acid bacteria grown on a vitamin B_1-deficient medium is greatly accelerated by the addition of small quantities of the vitamin, complete oxidation of the acetic acid taking place.

The statement has recently been made that the decomposition of hydrogen peroxide by catalase can only take place in the presence of molecular oxygen. F. H. Johnson and K. L. van Schouwenburg describe an experiment in which decomposition occurred under completely anærobic conditions.

H. W. Kosterlitz discusses the role of galactose-1-phosphoric acid as an intermediary in the metabolism of galactose in liver and in yeast. This ester is fermented by dried galactose-adapted *S. cerevisiæ* Frohberg about six times as rapidly as is galactose. There is an appreciable accumulation of the ester in the liver during galactose assimilation.

B. Mukerji and R. Ghose report that in recently induced and long-standing liver damage, a significant increase in free chloral concentration of blood occurs within an hour of the oral administration of chloral hydrate to dogs. Blood clearance of free chloral may, therefore, be employed as a test for detoxication function of the liver.

C. H. Waddington describes measurements of morphogenetic forces made by means of steel balls embedded in gastrulæ of *Triton alpestris* and then subjected to magnetic forces. The breaking strain of the blastocoel roof was of the order of 7·15 mgm. per sq. mm. of the hemispherical surface of the ball in contact with the tissues. Gastrulating mesoderm and endoderm could move the balls against a maximum force of 0·34 mgm./sq. mm.

RESEARCH ITEMS

Ethnography of the Washo of Nevada, U.S.A.

Robert H. Lowie, during a stay of several weeks at Minden, Nevada, and at Coleville, California, in 1926, was able to supplement the somewhat exiguous technical information available concerning the Washo. This is an isolated stock or an aberrant Hokan group ranged about Lake Tahoe in westernmost Nevada and easternmost California (*Univ. California Pub. Amer. Ethnol. and Archæol.*, 36, 5; 1939). Kroeber sets their number in 1770 as possibly 1,500, where more recent figures approximate 300. Their settlements were minute, their huts usually being from two to four. The chief had nothing to do with fighting enemies or adjusting quarrels within the tribe. His sole function was to arrange dances and other gatherings, where he would exhort the Washo to be good. Special headmen led in hunting jack rabbits, deer and antelope respectively. The antelope headman dreamed the right to office, the two others were purely secular leaders, the rabbit chief being chosen by the people. Property rights were maintained for clumps of pine nut trees, patches being marked off by lines of rocks. While brothers never quarrelled over pine nut privileges, trespass by a stranger was resented. Acorns were not a staple of diet, though the Washo made a dish of them. The pine nuts were gathered by men and women co-operatively. When dried, the nuts kept for about a year. Along the Walker River, the Washo constructed many 'fish houses'. Trout were speared and fish were also taken in nets or clubbed to death. Antelope, deer and jack rabbits were hunted communally. Other species of animal added to the food supply; porcupine, grasshoppers and locusts were eaten. The shamans became such through dreams, but not every dream was interpreted as a transfer of supernatural power, even though it might be of an uncanny character.

Sacred Twinned Vessels

M. D. W. Jeffreys describes and figures in *Man* of September a collection of sacred twinned vessels, now in the Wellcome Historical Medical Museum, London, which he obtained in 1930 in the markets of the native towns of Akwa and Aguleri, Nigeria—strongholds of the Umundri culture in the Onitsha Province. Design and decoration of one of the vessels suggest that the pottery is based on a wood technique. From the religious use to which they are put the vessels may be regarded as a unit combining the Patten and the Chalice. In them is placed the sacrificial food and oblation of wine when offered to a sky god *Chuku*, to *Alushi*, and to the ancestral spirits *Ndichie*. The vessels are not common, and with the increasing spread of Christianity are now seldom made. Similar twin vessels have been reported from Egypt. It is possible there is a connexion between the use of sacred twin vessels and the derivation of the word *graal* or *grail*. One suggestion is that *graal* is an abbreviation of *gradalis*—*grad*-'step' or 'division', *alis*-'food', that is, a combined or stepped vessel for keeping separate the sacrificial offerings. Bread and wine have been through the ages the offerings to the gods and ancestors and it is reasonable to assume special vessels to prepare and carry them, combining the two into a single unit. The use of vessels having separate compartments for different kinds of offerings appears in the Greek *kernos*, several small cups or jars joined together. It was used in the Eleusinian Mysteries to carry first-fruits, and a similar vessel of metal is in use in the Orthodox Greek Church to-day.

Arthritis in Wild Mammals

Herbert Fox, of Pennsylvania, in the course of examination of 1,700 wild mammals has observed changes in the joints which correspond with chronic arthritis in man (*Trans. Amer. Phil. Soc.*, N.S., 31, 75; 1939). This applies to truly wild animals as well as to menagerie specimens. The cases described seem to indicate that there is no apparent relationship between the incidence of arthritis and the systematic position, geographical distribution, habits or habitat of the mammals involved. On the whole the most conspicuous lesions occur among anthropoid apes, baboons, Felidæ, Hyænidæ, Ursidæ, Cervidæ and a few others; whereas a number of groups, such as Canidæ, Rodentia and Chiroptera, seem to be free from the disease, at any rate so far as shown by the material examined. Prof. Fox makes an interesting suggestion, that the one character which separates arthritic mammals from non-arthritics is body size. This may be compounded of a large body upon slender supports (as in Bovidæ), or stockily built body upon stouter supports (as in Felidæ). Where the greatest stabilization of the spinal column is demanded for the animal's locomotion there the greatest degree of spondylitis arises, and the localization of lesions in the fore-limbs of carnivorous mammals and the hind-limbs of herbivores may be associated with jolt-shock and locomotive power.

Deep-Sea Fishes of Bermuda

The importance of an account of the Bermudan deep-sea fishes of the family Melanostomiatidæ, by Walter Beebe and Jocelyn Crane, can be gauged from the size of the collection described. Intensive collecting in a limited area eight miles in diameter and a mile deep yielded 250 specimens belonging to 10 genera and 32 species, or 62 per cent of all known genera and at least a third of the species taken in all seas (*Zoologia*, 24, 65; 1939). The collecting was noteworthy also because extensive use was made of the bathysphere for recording movements and behaviour, and ten individuals, representing five species, were examined alive and their luminescence and behaviour noted, while more than 100 freshly caught specimens were used for the recording of colour notes and sketches. Hitherto only eight specimens in the entire family had been studied when freshly caught or recently preserved. As with most families of Bermudan deep-sea fish, the depths at which these were taken were greater than the average in other regions, practically none except very young individuals having been taken above 500 fathoms, although they were seen above that level from the bathysphere. The description of the collection runs to 174 pages and contains many striking figures of these deep-sea forms and their remarkable barbels.

Hymenopterous Parasites of Hover Flies

The hover flies or Syrphidæ constitute one of the largest families of the Diptera. In their larval stages many of them are highly beneficial to man since they prey upon aphides and thereby destroy very large numbers of the latter. They are, perhaps, the most important of all the natural enemies of these pests. The usefulness of syrphid larvæ is apparently counteracted to a considerable extent by species of hymenopterous parasites. Our knowledge of the structure and biology of such parasites is extremely meagre and their earlier stages have scarcely been observed at all. An attempt towards filling this hiatus in entomological knowledge is made by M. Kamal who, under the title of "Biological Studies on some Hymenopterous Parasites of Aphidophagous Syrphidæ", contributes an article as Bulletin 207 (Entom. Section) Technical and Scientific Service, Egyptian Ministry of Agriculture. The investigations embodied in this paper were carried out at Riverside (Calif.) under Prof. H. S. Smith, and they serve as a beginning towards a better understanding of the subject. A distinct drawback is the absence of any date indicating when the Bulletin was published.

Pelargoniums

The Pelargonium, which goes too often under the erroneous horticultural pseudonym of Geranium, is a potent and ubiquitous contributor to garden beauty. It is usual to think in terms of one or two species only of this genus, but Sir Arthur W. Hill (*J. Roy. Hort. Soc.*, 64, Pt. 8, August 1939) has recently described a larger number of the 250 species which it actually contains. South Africa is the home of the genus, and more than 200 species grow there. The Dutch were the first to bring over Pelargoniums of horticultural value, and *P. triste* was apparently the first kind to appear in Great Britain, in the year 1632. By 1703, a considerable number of species was in cultivation, and the favourite *P. zonale* was produced by cross-breeding in 1710. Sir Arthur's paper is designed to portray the horticultural possibilities of the genus; he deals with variety in leaf and flower form, outlines the tuberous species, and mentions such kinds as *P. tetragonum* with fleshy stem and cactus-like flower, and *P. crithmifolium* with fleshy leaves.

Crustal Structure of California

Using data obtained by reading seismograms for sixteen near earthquakes and one blast, P. Byerly has determined the structure of the crust of the earth in California and the speeds of the primary and secondary waves in the several layers of the crust (*Bull. Seismol. Soc. Amer.*, 29, No. 3, July 1939, pp. 427–462). The records used were chiefly from Wood-Anderson and Benioff seismographs with a drum-rate of 60 mm. per min. and they were read to the nearest 10^{-1} second of time. The estimate of the dimensions of the crust chiefly rests on the accurate determination of the depth of focus of the Berkeley earthquake of March 8, 1937. These dimensions turn out to be 9 km. of granite overlying a layer 23 km. thick of intermediate material, which itself overlies the mantle. Data obtained for shocks with epicentres to the south of Berkeley were found not to fit this structure, but successfully did so when it was assumed that the granitic layer thickened towards the south. In all the earthquakes considered there was a lag of P_n as it passed under the Sierra Nevada, a fact which had been noticed previously. A reconsideration of the P_n data of the Nevada earthquake of December 20, 1932, together with all the other data, suggests that the root of the mountain mass projects into the mantle beneath the surface layers by an amount between 6 km. and 41 km. The velocities of the P and S waves in the various layers were found to be (*a*) in the surface layer $P = 5\cdot61 \pm 0\cdot05$ km./sec., $S = 3\cdot26 \pm 0\cdot09$ km./sec. and there is a suggestion that these may start from different foci; (*b*) in the intermediate layer $P = 6\cdot72 \pm 0\cdot02$ km./sec. and $S = 7\cdot24 \pm 0\cdot04$ km./sec., though only the former was used for the determination of the structure; (*c*) in the mantle $P_n = 8\cdot02 \pm 0\cdot05$ km./sec.

Age of Meteorites

F. A. Paneth has issued an important paper with this title which describes the methods for determining the age of meteorites and the results obtained (*Occasional Notes Roy. Astro. Soc.*, No. 5; 1939). The most satisfactory formula is derived from the following simple principles: let U and Th be the grams of uranium and thorium present in a sample of a meteorite, and let He be the number of cubic centimetres of helium which have originated from these two radio-elements; then the age in years is

$$\frac{He}{1\cdot14\,U + 0\cdot29\,Th}\,10^7.$$

At one time it was believed that the age-values determined by this method were on the low side, owing to the escape of helium. As Paneth points out, however, temperatures up to 1000° cannot drive out more than about 5 per cent of the helium contained in an iron meteorite, and as only the outermost portion is heated during the flight through the atmosphere, the method is satisfactory for iron meteorites. This remark does not apply to stone meteorites; the stone meteorite Pultusk lost practically all its helium content after 3 hours at a temperature of 800°. Table ii shows the maximum age in millions of years of thirty meteorites. This varies from 2,800 in the cases of Thunda and Mount Ayliff to only 100 with Bethany, Goamus, and Toluca. On the basis of the assumption as to the solubility of thorium in iron, Paneth and his colleagues were of opinion that the real values might be 10–20 per cent lower; but this is an under-estimate. They developed a method for the determination of the thorium content of iron meteorites, preliminary figures for three of which are given, and, though improvements can still be made, they are confident that its quantity in meteoritic iron can be greater than was suspected. The above equation shows that this will diminish the age, and in the case of Bethany, Goamus, the figures are 30 million years instead of 100 million years. The result of the research shows that no meteorites exist with ages greater than that of the earth—a fact which supports the view that the meteorites originated within the solar system. Nevertheless, the low age found seems to give weight to the short time-scale of the universe, that is, that the whole universe is of no greater age than the earth. It seems fairly certain that iron meteorites assumed the solid state at different times, and further research will probably reveal important relations.

THE SIXTH PACIFIC SCIENCE CONGRESS

THE immense area of the Pacific Basin comprises what is perhaps the most fascinating region of the globe. It is bounded on the east, on the north and, as far south as the equator, on the west by volcanic regions indicative of great geological instability. It includes open stretches of sea hundreds of thousands of square miles in extent and contains more than twenty thousand islands, some of them rocky, others volcanic and others again of coral origin. These islands have a distinctive and in many respects a unique fauna and flora. They are populated by most interesting native races, Polynesians, Melanesians and Micronesians, who, coming originally from south-east Asia, settled these widely scattered islands by the most remarkable of all human migrations. There they evolved a civilization which evoked the amazement of those early European navigators who, however unwittingly in many cases, sowed the first seeds of its subsequent rapid decay.

Despite the great pioneer voyages of Spanish, Dutch, British, French and Russian navigators and of New England whalers in the seventeenth and eighteenth centuries and of scientific explorations such as those of the *Challenger* and of the United States exploring expedition under Wilkes in the nineteenth century, the area covered by scientific and commercial surveys up to the beginning of the present century has been aptly described as no more than "a plough furrow in a twenty acre field". To quote from the introductory speech to the Sixth Pacific Congress of Prof. Herbert E. Gregory, former director of the Bernice P. Bishop Museum, Honolulu, and the greatest individual force behind modern scientific study of the Pacific: "The material and records amassed by such long time undertakings as the Wilkes and the *Challenger* expeditions and during the first two decades of the present century by local surveys under the auspices of scientific institutions in England, Scandinavia, Australia, Netherlands Indies, Japan, Canada and the United States is large in bulk and variety. But its study reveals far more questions than answers. It shows that the Pacific is fairly bristling with problems in geography, geology, botany, zoology and anthropology and that the observations recorded here and there in a region that comprises more than a third of the earth's surface are inadequate for comparative studies of the earth's physical features and of the origin, migrations and environment of living forms on the land and in the sea; and that until further knowledge has been gained many of the stories that science has to tell must be incomplete".

Co-ordinated scientific study of the Pacific was discussed at the meeting of the British Association in Australia in 1914 and afterwards in the United States. But it was not until 1920 that, largely owing to the initiative of Prof. Gregory, the first Pacific Science Congress met at Honolulu. This took the form of an informal gathering of some sixty carefully selected delegates from the United States, Canada, Hawaii, the Philippines, the Netherlands Indies, Japan, China, Australia, New Zealand and Samoa. It was realized that a central organization and planned expeditions were impracticable owing to lack of funds, but that a purely volunteer organization could play a great part in the furtherance of research in the Pacific if each unit, while perfecting its own programme, subscribed to a common programme and kept in close touch with associated organizations in other countries bordering the Pacific. While official delegates have been sent by interested Governments to subsequent congresses, these have always consisted essentially of individuals interested in various aspects of research in the Pacific area. This emphasis on the individual rather than on the State and on subjects of general scientific interest, to the exclusion of anything likely to have a political bearing has been the key to the subsequent outstanding success of the Pacific Science Association.

The second Pacific Science Congress was held in Australia in 1923, the third in Japan in 1926, the fourth at Java in 1929 and the fifth in British Columbia in 1933. It was there agreed that the sixth congress should not meet in North America, and the possibility of a congress at Fiji was discussed. This later proved impracticable, while international difficulties steadily increased so that the maximum period of five years between successive congresses was passed without another meeting being arranged. But representations made at Washington to the National Research Council of the United States most fortunately prevented what, as later events have shown, would almost certainly have been a complete break in the continuity of these congresses.

Under the auspices of the National Research Council a sixth Pacific Science Congress was organized and held in and around San Francisco during July 24–August 12, 1939. The meetings were held at Berkeley, Stanford and San Francisco, the University of California and Stanford University acting as joint hosts, and the Golden Gate International Exposition co-operating with them through its Department of the Pacific Area. Prof. Ross G. Harrison was president, and Prof. Roy E. Clausen, secretary-general, of the Congress.

The courageous optimism of those responsible for the organization of the Congress was abundantly justified by the presence of some five hundred delegates, including representatives from Australia, Canada, China, Columbia, France, Great Britain, Hawaii, Hong Kong, Japan, the Netherlands and the Netherlands Indies, New Zealand, the Philippines, Siam, Sweden, the U.S.S.R., and the United States. The discussions covered a wide field, as may be indicated by the nature of the sections and subsections into which the Congress was divided.

Section 1, Geophysics and Geology, dealt with the structure and dynamics of the Pacific basin; section 2, Oceanography and Marine Biology, including Fisheries, with the properties, dynamics and life of the Pacific. Pacific climates formed the subject-matter of section 3, which discussed past climates and also present climates under the two headings of meteorology and climatology. Section 4, Anthropology, dealt with man and culture in the Pacific region and with the objectives and results of the study of these cultures. Section 5 was concerned with the terrestrial faunas of the Pacific islands and bordering countries, and was especially concerned with systematic and economic entomology, including biological control of insect pests, and with medical entomology. General botany and plant diseases of the Pacific region constituted the two subsections of section 6. Section 7 consisted of public health and nutrition, and was divided into subsections dealing with the geography and epidemiology of the communicable diseases of the Pacific region, with health hazards arising from transport, occupation and agricultural practices, with nutritional problems and finally with education in matters of health. Section 8 dealt with the characteristics, utilization and conservation of the soils in the countries of the Pacific.

All who are in any way interested in the manifold scientific problems of the Pacific owe a debt of gratitude to the National Research Council of the United States and to all who pressed, against considerable and not unnatural opposition, for the holding of this Congress. There must be many of the foreign delegates who now feel, with the writer, that this meeting, attended by so many races and nationalities united in the prosecution of disinterested scientific research, will be during the darkness which looms ahead both a memory of a happier past and a foretaste of a more enlightened future. The Congress broke up in the expectation of a seventh Congress to be held in the Philippines in 1943. That the future course of world history makes this possible may well be the wish of every civilized human being.

LOWER PERMIAN INSECTS OF KANSAS

F. M. CARPENTER has recently discussed numerous specimens of fossil insects obtained in 1935 from the Elmo limestone (Kansas), of Lower Permian age (*Proc. Amer. Acad. Arts and Sci.*, 73, 29–70; 1939). More than 8,000 specimens from this formation are now in the collections of the Harvard Museum of Comparative Zoology.

The results of the 1935 collection exceed all others in the number of complete, or nearly complete, specimens that were disclosed. Some of the most interesting fossils obtained are members of the group which Tillyard named the Protohymenoptera, and now regarded as belonging to the Megasecoptera. Thus, in *Permohymen*, the male genitalia are well preserved and are seen to be composed of paired penes with two-segmented claspers which are evidently homologous with the styli of may-flies. Regarding *Asthenohymen dunbari*, 32 specimens were found, and, of these, four present enough of the body structure to allow, for the first time, a complete reconstruction of the insect to be made and the differences between the fore and hind wings to be ascertained. In one example the ovipositor is well preserved.

The Protodonata that were collected on the 1935 expedition proved to be unusually interesting. In the first place the discovery of *Meganeuropsis permiana* gen. et. sp. nov. from the Permian of Elmo constitutes the first example of a Meganeurine occurring in the New World and also in rocks of Permian date. Dr. Carpenter discusses the affinities of the family Meganeuridæ, and does not accept Martynov's contention that they should be placed in the order Odonata as true dragonflies: he concludes that there is no justification for their separation from the Protodonata until it is proved that the Meganeuridæ had a phylogenetic origin different from that of the other families of that order.

The author then passes on to deal with the Homoptera. Altogether twenty-six specimens belonging to this group were collected. While none of the species is new, the material adds to knowledge of the body structure and the hind wings of the Homoptera. In *Permocicytina kansasensis* Till. the single specimen obtained during 1935 shows a long process extending straight back from the end of the abdomen: being 9 mm. long, it exceeds the length of the combined thorax and abdomen. Dr. Carpenter concludes that it is not an ovipositor but rather of the nature of a respiratory tube such as is found in water bugs of the recent family Nepidæ. This contention presupposes that the insect was aquatic, but there appears to be no indication of any modification of the rest of the body from an aquatic environment, a feature shown in the recent family Nepidæ.

The remainder of the paper deals with the Psocoptera, Protelytroptera and Protoperlaria.

A. D. I.

INVENTIONS AND PATENTS IN GREAT BRITAIN*

THE fifty-sixth report of the Comptroller-General of Patents, Designs and Trade Marks for 1938, records a further increase in the number of patents, applications having increased from 36,266 in 1937 to 37,973 in 1938, with increases in the number of provisional and complete specifications from 21,745 and 22,215, respectively, to 26,696 and 23,098. In regard to the trend of inventions, the synthetic production of artificial wool and rubber, the latter by the polymerization of diolefines and halogenated diolefines, continues to be prominent. New developments in the very active field of synthetic resins are the use of polyamide resins for making artificial yarn and the use of resins in water purification by ionic exchange. Antioxidants or stabilizers for rubber, oils, fats, soaps, aldehydes and light-sensitive substances are much in evidence. Applications relating to azo and vat dyes decreased in number, but the development of long-chain polymethine dyes for use as photographic sensitizers is actively sustained.

---

* Patents, Designs and Trade Marks. Fifty-sixth Report of the Comptroller-General of Patents, Designs and Trade Marks, with Appendices, for the Year 1938. Pp. 26. (London: H.M. Stationery Office, 1939.) 6*d*. net.

The manufacture of glass fibres of extreme fineness and the use of short-path high-vacuum distillation for the concentration of vitamins have received attention, as well as directional wireless systems in relation to the navigation and blind landing of aircraft. Notable developments with electron microscopes relates to the magnetic lens systems, the arrangements for inserting the object under examination and the use of a fine scanning beam in place of a fixed electron beam. Methods of giving air-raid signals over electric power networks are being explored, and another interesting development is concerned with the speedy testing of watches, for accurate time-keeping, by electric means. A notable feature has been the production of vehicle bodies and aircraft fuselages and girders from synthetic resins. Mechanical remote-control systems are being devised to free the floors of motor-vehicles from obstruction by control levers, while another field of activity has been in gyroscopic instruments for indicating the course and altitude of flight of aircraft and in the automatic supervision, by means of magnetic compasses, of course-indicating gyroscopes so as to eliminate wandering.

Applications for designs and registered designs both decreased in number compared with 1937, but registered trade marks increased.

GEOGRAPHICAL DISTRIBUTION OF THE COWRIES

In the study of the geographical distribution of the littoral marine fauna, the Mollusca claim special attention, since the activities of collectors have provided far more abundant data regarding them than are available for any other group of marine animals. More especially is this the case with such groups as the large and handsome tropical cowries and cones which have been favourites of the dilettanti for two centuries at least. It is true that a great deal of the older work on them is without any scientific value; endless lists of 'varietal' names have been given to individual abnormalities, environmental modifications, and stages of growth, while localities have been vaguely or incorrectly recorded. Nevertheless, it has long been obvious that a great amount of valuable material was awaiting scrutiny by modern methods.

This has now been done for the cowries by Dr. F. A. Schilder and Dr. M. Schilder in a "Prodrome of a Monograph on living Cypraeidae" (*Proc. Malacol. Soc.*, **23**, Pts. 3 and 4; 1938–39), in which a revision of the whole family is given, together with a detailed analysis of the distribution of the species and subspecies composing it. The material studied by the authors comprised more than 60,000 shells, in some eighty public and private collections in Europe. They recognize 165 species, nearly all of which are further subdivided, each into two or more geographical races or sub-races. The races and sub-races are treated together for nomenclatorial purposes as sub-species, and they "can be recognized at least by the sum of several variable characters of the adult shells and by the fact that each race has usually its own centre of distribution where it is relatively more frequent than at the periphery". The species and races are further grouped into units of higher order designated 'super-species', which are equivalent to the *Rassenkreise* of Rensch, and are defined as "the sum of the allied species and sub-species inhabiting a mostly continuous region and geographically separate from each other".

The authors' conception of a super-species is not very easy to grasp, and it must be said that their exposition is not everywhere a model of clarity. For example, the statement that "in some genera several evidently allied species inhabit the same region; they must each be treated as different superspecies" would seem difficult to reconcile with the definition just quoted. It can be so reconciled, but only to leave one in doubt whether the idea of super-species is worth very much after all.

Nevertheless, the monograph deserves careful study as perhaps the first attempt to apply on a large scale to marine animals those methods of geographical delimitation of races which have hitherto been applied almost exclusively to terrestrial and freshwater organisms.

W. T. C.

THE BREEDING OF OYSTERS*

Experiments on the breeding of oysters in large concrete tanks have been in progress at Conway, North Wales, since 1919. The ultimate aim of the work has been to provide a simple and efficient means of procuring the settlement of large crops of oysters in tanks, in the belief that such a method would prove of value to the oyster growers in replenishing their stocks. Mr. Cole has already explained his methods in two previous papers: 'Experiments in the Breeding of Oysters (*Ostrea edulis*) in Tanks, with Special Reference to the Food of the Larva and the Spat" (Fishery Investigations, Series II, 15, No. 4, 1936) and "A System of Oyster Culture" (*J. du Conseil*, 13, No. 2, 1938). It is now believed that this aim has been realized and that spatfalls of commercial magnitude may be obtained regularly in the Conway tanks.

This work is of great interest and importance and based upon years of labour, early experiments having been made at Conway by Dr. R. W. Dodgson and Mr. H. P. Sherwood.

The main plan is to enrich one large tank gradually by the addition of finely ground crab meat, whilst the other is left untreated. Smaller tanks are also used for breeding. The purpose of the organic enrichment is to bring about the multiplication of minute flagellates which we now know to be the food of the free-swimming larval oyster. Oysters placed in the tanks liberate their shelled larvæ which in both treated and untreated tanks settle as spat, but in the enriched tank the number settling is found to be much greater. Very heavy spatfalls were obtained in the tanks on limed tiles in both 1937 and 1938, and the commercial possibilities of this method of obtaining the settlement are clearly demonstrated. In both these years there was a nannoplankton consisting almost entirely of very small flagellates, and the ability of the oyster larvæ to feed on such flagellates has been confirmed by laboratory feeding experiments, which have also shown that they can not utilize non-motile green and blue-green algæ during the free-swimming period. The higher concentration of flagellates in the treated tanks is favourable to rapid growth and settlement of the larvæ.

---

* Fishery Investigations. Series II, 16, No. 4. 'Further Experiments in the Breeding of Oysters (*Ostrea edulis*) in Tanks", by H. A. Cole, Ministry of Agriculture and Fisheries. (London: H.M. Stationery Office, 1939.)

The length of the larval free-swimming period under tank conditions varies between seven and fourteen days, ten days being the average. Between a temperature of 16° and 22° C. the length of the free-swimming period does not vary more than a day or two and, after liberation, food supply rather than temperature appears to be the critical factor. Temperature, however, affects the spawning, but the relation under tank conditions is complex. Spawning does not usually occur below 17° C. A sudden rise of 2°–3° C. around a temperature of 16°–17° C. is likely to produce spawning among ripe females. Sustained high temperatures (19°–20°) may have the same result.

It is interesting that some of the experimental larvæ reached an enormous size (0·35 mm.) before attachment, the usual size being 0·18–0·20 mm. on liberation and 0·28–0·31 mm. on settling.

The bulk of the limed tiles on which the spat has settled is removed to shallow tanks filled with water from the estuary. In this way they get the much larger amount of food necessary in the fixed stage. Later the tiles are planted out in the Menai Straits, where the oysters grow rapidly. Most of the spat planted in August 1938 was only three weeks old, but it is believed that such early planting does not lead to maximum survival. It seems that it is best to delay the planting out until the individual spat are about 5 mm. across. Unless the settling season is unusually late it is found that spat planted out in the autumn should be large enough to detach from the tiles by the following May or June. A size of 2 cm. should be reached in ten months. After detachment the spat is placed fairly thickly in shallow wire-covered trays, raised on the bottom. Growth is rapid. These oysters should be ready for planting on firm bottom without protection when twenty months old, the average size of a good sample of brood from the Conway tanks at this age being about 5 cm. Samples of such broods have been sold to the oyster growers and have done well after transplanting.

It is encouraging to realize that the tank breeding process may be put forward as a possible means of replenishing the stocks of home-grown oysters on British beds, and that Mr. Cole is justified in his statement that "the results of these three years (1936, 1937 and 1938) taken together, fully warrant the conclusions that a commercial crop of oyster spat can be obtained annually, with reasonable certainty".

SCIENCE NEWS A CENTURY AGO

The Steamship *President*

The *Annual Register* for 1839 records that on October 7, "Several thousand persons went to Limehouse to view the immense steamship the *President*, built by Messrs. Curling and Young for the British and American Steam Navigation Co., and intended to run between New York and London. The *President* is of greater power and tonnage than the *British Queen* (the former being of 600 horse power and 2,336 tons, the latter 500 horse power and 2,016 tons), and was built in the same dock, and not upon a slip; so that she had to be floated out of dock, and not launched. At high tide, however, which happened to be a low tide, there was not enough water to float her, and she remained fast aground aft. Mrs. Laird, wife of the African explorer and projector of Atlantic navigation by great steamships, performed the ceremony of christening, amidst the cheers of the multitudes on the banks and on the river. . . . On Monday the 9th, the water being sufficient, the *President* was floated into the river and towed to Blackwall."

The *President* was the largest of the pioneer Atlantic steamships, but her career was a very short one. She left New York on March 11, 1841, on her third homeward voyage, and foundered next day in a gale, all aboard being lost.

Royal Cornwall Polytechnic Society

The seventh annual meeting of this Society was held on October 8, 1839, in the Polytechnic Hall, Falmouth, Sir C. Lemon, M.P., being in the chair. Several premiums were awarded for mechanical and scientific inventions and improvements. Among the notices in the report was a reference to Prof. Moseley's suggestion for calculating the "Efficiency of Steam Engines", a matter of great interest to all Cornish engineers. His proposal was to use a small cylinder, of about six inches diameter, connected with the large cylinder of the engine, the piston in the small cylinder being acted upon by a spring. Prof. Henry Moseley (1801–72), F.R.S., whose writings on mechanics, etc., were well known, was professor of natural philosophy in King's College, London, and afterwards one of the first of Her Majesty's inspectors of schools, and canon of Bristol. He was the father of H. W. Moseley (1844–91), Linacre professor at Oxford and grandfather of the physicist H. G. J. Moseley (1887–1915), who was killed in Gallipoli during the Great War.

Electro-magnetism as a Motive Power

Dr. Jacobi, said the *Athenæum* of October 12, 1839, in a letter to Faraday thus alludes to this subject:

"In the application of electro-magnetism to the movement of machines, the most important obstacle always has been the embarrassment and difficult manipulation of the battery. This obstacle exists no longer. During the past autumn, and at a season already too advanced, I made, as you may perhaps have learned by the gazetter, the first experiments in navigation on the Neva, with a ten-oared shallop furnished with paddle-wheels, which were put into motion by an electromagnetic machine. Although we journeyed during the entire day, and usually with 10 or 12 persons on board, I was not well satisfied with this first trial, for there were so many faults of construction and want of insulation in the machines and battery, which could not be repaired on the spot, that I was terribly annoyed. All these repairs and important changes being accomplished, the experiments will shortly be commenced. The experience of the past year, combined with the improvements of the battery, give as the result, that to obtain the force of one horse (steam-engine estimation) it will require a battery of 20 square feet of platina distributed in a convenient manner, but *I hope* that from 8 to 10 square feet will produce the effect. If heaven preserves my health, which is a little affected by continual labours, I hope that within a year of this time I shall have equipped an electro-magnetic vessel of from 40 to 50 horse-power."

The author of these experiments, the first made on electric propulsion, was Moritz Herman von Jacobi (1801–1875), who for many years was a professor at St. Petersburg.

Medical School at Athens

The issue of the *London Medical Gazette* of October 12, 1839, contains the following information: "An attempt is making at Athens, the present capital of the modern Greek Empire, to organize a medical school, by several well-educated and respectable Bavarian physicians and surgeons, who are attached to the Court, and whom King Otho has induced to settle in his country.... They had from nine to twelve pupils, natives of the country, who were lectured to by a German in the modern Greek language; the professors, from a residence of several years in the country, being able to impart instruction to their pupils in their native tongue. Although it is the merest beginning of a medical school, it is nevertheless praiseworthy and honourable in its present founders, and may be the germ of an institution which shall move onward hand in hand with the regeneration of poor fallen Greece. . . . Athens possesses at this moment a most excellent military hospital, arranged upon the modern European plan, capable of containing very comfortably several hundred patients. Also a highly respectable and well-arranged cabinet of Natural History."

Subterranean Forest

The *Gentleman's Magazine* for October 1839 contains the following information: "The capacious bonding pond, which is now being excavated at South Stockton, has led to the discovery of an extensive subterranean forest. The timber is chiefly oak. A yew tree, of considerable size, has been found, the wood of which is sound and good and fit for the turner's lathe. Many of the oaks are of large dimensions, and it is expected that some of them will be suitable for the purpose of building. Whilst examining this forest, Dr. Young of Whitby, with some friends discovered one of the oaks to have been cut in two, which had evidently been done previous to its being covered by the earth. He supposes the forest must have been cut down by the Roman soldiers, as they were in the habit of laying timber on the low swampy grounds for the purpose of making roads. Be this as it may, it is certain the hand of man has been exercised on the timber, and it may form a fertile subject for the lover of ancient history and the geologist to speculate on".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned.

Assistant I (reference B.401) and Assistant II (reference B.402) at Air Ministry Headquarters—The Under Secretary of State, Air Ministry, Department ZA (B/127), Harrogate, Yorks (October 13).

Commissioned Ordnance Mechanical Engineers in the Indian Army Ordnance Corps—The Secretary, Military Department, India Office, S.W.1 (quoting O.M.E. Recruitment) (October 17).

Assistant Engineer for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, S.W.1 quoting M/5765).

Meteorological Assistants (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.J., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Report on the Fish and Fisheries of Lake Rukwa in Tanganyika Territory and the Bangweulu Region in Northern Rhodesia. By C. K. Ricardo. (Published on behalf of the Governments of Tanganyika Territory and Northern Rhodesia.) Pp. 78. (London: Crown Agents for the Colonies.) 6s. [159

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1939–40. Pp. 418. (Manchester: Municipal College of Technology.) [189

Proceedings of the Royal Society of Edinburgh, Session 1938–1939. Vol. 59, Part 2, No. 18: Tests of Significance of the Differences between Regression Coefficients derived from Two Sets of Correlated Variates. By Dr. F. Yates. Pp. 184–194. 1s. Vol. 59, Part 2, No. 19: On the Reciprocation of Certain Matrices. By A. R. Collar. Pp. 195–206. 1s. Vol. 59, Part 2, No. 20: Studies on Reproduction in the Albino Mouse. 3: The Duration of Life of Spermatozoa in the Female Reproductive Tract. By Hugo Merton. Pp. 207–218. 1s. Vol. 59, Part 2, No. 21: Reciprocity and the Number 137, Part 1. By Prof. Max Born. Pp. 219–223. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [189

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 3, No. 29: An Early *Dictyoconus*, and the Genus *Orbitolina*: their Contemporaneity, Structural Distinction, and Respective Natural Allies. By Lt.-Col. L. M. Davies. Pp. 773–790+2 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 2s. [189

Other Countries

Proceedings of the United States National Museum. Vol. 86, No. 3065: Neotropical Flies of the Family Stratiomyidae in the United States National Museum. By Maurice T. James. Pp. 595–608. Vol. 87, No. 3066: Ceratopsian Dinosaurs from the Two Medicine Formation, Upper Cretaceous of Montana. By Charles W. Gilmore. Pp. 18. Vol. 87, No. 3067: Two New Parasitic Isopods from the Eastern Coast of North America. By A. S. Pearse and Henry A. Walker. Pp. 19–24. (Washington, D.C.: Government Printing Office.) [189

Smithsonian Miscellaneous Collections. Vol. 98, No. 20: The Holt Township (Indiana) Meteorite. By Stuart H. Perry. (Publication 3546.) Pp. ii+7+9 plates. (Washington, D.C.: Smithsonian Institution.) [189

Advisory Committee on Education. Staff Study No. 10: The Land-Grant Colleges. By George A. Works and Barton Morgan. Pp. ix+141. 25 cents. Staff Study No. 18: Educational Service for Indians. By Lloyd E. Blauch. Pp. xii+137. 25 cents. Staff Study No. 19: Research in the United States Office of Education. By Charles H. Judd. Pp. viii+133. 20 cents. (Washington, D.C.: Government Printing Office.) [189

U.S. Department of the Interior: Office of Education. Vocational Division Bulletin No. 196 (Agricultural Series No. 52): Farm Forestry; Timber Farming including Woods Management and Forest Tree Planting. By W. A. Ross and W. R. Mattoon. Pp. vi+63. (Washington, D.C.: Government Printing Office.) 15 cents. [189

Transactions of the San Diego Society of Natural History. Vol. 9, No. 10: The Holotype of *Barbatia* (*Acar*) *gradata* (Broderip and Sowerby). By Philip W. Reinhart. Pp. 39–46+plate 3. Vol. 9, No. 11: The Silky Pocket Mice of Southern California and Northern Lower California, Mexico, with the Description of a New Race. By Laurence M. Huey. Pp. 47–54. Vol. 9, No. 12: A New Silky Pocket Mouse from Southwestern Utah. By Laurence M. Huey. Pp. 55–56. Vol. 9, No. 13: A New *Perognathus arenarius* from near the U.S.-Mexican Boundary in Lower California. By Laurence M. Huey. Pp. 57–58. Vol. 9, No. 14: Three New Worm Snakes of the Genus *Leptotyphlops*. By Laurence M. Klauber. Pp. 59–66. (San Diego, Calif.: San Diego Society of Natural History.) [189

Bulletin of the American Museum of Natural History. Vol. 76, Art. 4: On the Anatomy and Evolution of the Locomotor Apparatus of the Nipple-tailed Ocean Sunfish (*Masturus lanceolatus*). By Henry C. Raven. Pp. 143–150. (New York: American Museum of Natural History.) [189

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, OCTOBER 14, 1939 No. 3650

A DIRECTORATE OF SCIENTIFIC INFORMATION

THERE are those who affect to believe that scientific people are somehow responsible for the war: whereas, in fact, because of the international character of their interests and friendships, they are singularly innocent. Each generation tends to imagine that its own experience, like its fashions of thought, expression or personal adornment, is unique. This war, therefore, must have some special cause—why not blame it on science? The fact is that history books are already full (too full) of conquerors out for glory and loot, guilty of persecution and treachery, moving masses of ordinary decent men to follow them in hysterias worked up by appealing to fear, hatred and greed.

It is true, nevertheless, that the special character of this war, as to some extent of the last, depends very largely on science: not in its ferocity or its attacks on civilians, as the story of the Thirty Years War—and of many others—will show: but in its speed, its weapons of offence and defence, its transport, its communications. It is a scientific war, and one chief factor in winning it will be to employ the methods of science quickly and to the best advantage; not only in offence and defence, in interception and attack, but also in maintaining the ordered life and well-being of the community on the home front.

In the Service ministries and in civil defence the directors of scientific research have large resources and organizations at their disposal. The Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council advise these and other ministries, and many of the latter have scientific advisers and establishments of their own. The Ministry of Information alone appears to have no special organization from which scientific advice, scientific criticism and scientific fact can be obtained. It is now in course of reconstruction, and we may hope that the omission may be repaired. For the war is a scientific war, and the science of it is not all so secret or so unintelligible that it cannot usefully be made public. If, as Mr. Wilfred Trotter maintained in a striking letter in *The Times* of September 25, our chief advantage over the Nazis lies in the free use of our minds, there should be a special place for science, and its services to the national cause, within the structure of the Ministry of Information.

This view may seem strange, even amusing, to senior administrators of the old type, trained perhaps thirty years ago in a school of ancient philosophy. It will not seem so strange to their younger colleagues, and not at all strange to the large number of skilled working people who are perhaps the most important class in our community. To many of the latter, science is a thing of high repute, and information and advice given in technical and scientific form (provided that is not too dull) carries special conviction. The nation has particular need of their help, their technical skill and resource: it will receive them the more freely if, within the limits of necessary secrecy, they can be told how and why.

During the war, the lives of many of us will be greatly, if temporarily, changed. Scientific knowledge will be needed to ensure that home supplies of food are increased in the right and most economical way; that the food is efficiently used and a high standard of nutrition maintained; that major epidemics are avoided; that medical treatment is forestalled, or economized, by preventive measures and an insistence on public health. In all such matters great improvement is possible: we lag, for example, far behind Holland, Norway, Australia and New Zealand in avoiding infantile mortality. Persistent education, therefore, is required giving scientific reasons in popular form, if standards of life are to be maintained, or —as they ought to be—improved. We say improved. To reduce, for example, the infantile mortality (under one year) to that of Holland would, in a three years war, save more than fifty thousand children whom we shall badly need in the future; apart from the saving of health and lives in the later years of the rest. Persistent propaganda by the Ministry of Information could help to move public authorities, and the people themselves, to take what steps are possible in all such respects: and that propaganda, to be convincing in quality and effective in results, should be based on scientific knowledge.

In other material respects the life of the community must be altered. 'Black-outs' and air-raid precautions, fuel rationing, limitation of transport and communications, the transfer of manufacturing capacity to munitions, the necessity of using home supplies, where possible, of raw materials; all these, and many others, involve scientific knowledge, investigation and adjustment. Often it will be useful and encouraging to our own people, valuable to our prestige abroad, and no help to the enemy, and will assist in removing misunderstanding and lack of confidence, if scientific reasons can be given frankly (when they exist) for action which the Government has to take. In a community of free people, good will and understanding are incalculable assets, and can be obtained by confident, frank and accurate statement of the facts; which can often be expressed in scientific or statistical terms. A Director of Scientific Information, with a small scientific staff, some of whom should be experienced in journalism, having good outside contacts among scientific people, would serve a similar purpose in this respect to the directors of scientific research in the Service ministries.

In the fighting services themselves the methods of defence and offence are largely scientific. Some of these methods are highly secret: others are well known to the enemy. There could be no conceivable harm, and there might be great good, in informing the public freely of the latter. To take a trivial example, ingenious persons could be saved the trouble of working out devices which are either known already or impracticable, and inventions committees could be saved the trouble of examining and replying to them. Moreover, and this is not trivial, information not obviously secret which could be used by an intelligent scientific enemy, might be saved from publication by the scrutiny of an alert scientific censorship. In the absence of such scrutiny, the present danger is that everything scientific may be censored, even laws of Nature.

There is intense anxiety on the part of the scientific community to be of service, and progress may seem slow in utilizing some of the best brains available. This anxiety leads to recurring suggestions that a Ministry of Science should be set up, or that research should be 'co-ordinated' on a grand scale by a National Research Council of some kind. It is really better to work by and through existing agencies, with additions where necessary, and long experience in the last war and since has shown that bright ideas advanced by ingenious minds not in touch with actual needs are of little value compared with direct attack, by orthodox scientific methods, by those who are in touch.

The important thing is to provide facilities for able young scientific men (the older ones are largely in touch already) to make contact with various practical problems of national importance. The problems cannot all be predicted beforehand; some will arise as the war goes on. Nor, for reasons of necessary secrecy, can they always be publicly announced. Within such limits, however, as are necessary, the more clearly the scientific aspects of practical problems can be stated, the more chance is there of the right scientific people emerging to attack them. These problems are not only those of the fighting services; they are also connected with the whole life and activity of the nation. From the wide contacts it will have, the Ministry of Information, through its scientific staff, could act to a significant extent as a clearing-house of scientific ideas, problems and persons.

We do not wish to exaggerate the part which science has to play in the task which lies before us; and we are well aware how much already is being done in the use of scientific methods and research for national defence. Measured in terms of its necessary establishment, a Directorate of Scientific Information would be an insignificant addition to the Ministry; its usefulness, however, under wise guidance, might be great beyond comparison.

THE SOIL AS THE BASIS OF PROSPERITY

(1) The Rape of the Earth
A World Survey of Soil Erosion. By G. V. Jacks and R. O. Whyte. Pp. 314+47 plates. (London: Faber and Faber, Ltd., 1939.) 21*s.* net.

(2) Land Utilization in Australia
Issued by the Australian Institute of International Affairs under the auspices of the Institute of Pacific Relations. By Prof. S. M. Wadham and Prof. G. L. Wood. Pp. xix+360. (Melbourne: Melbourne University Press; London: Oxford University Press, 1939.) 21*s.* net.

(1) MESSRS. Jacks and Whyte have followed up the important bulletin on soil erosion which they prepared for the Imperial Bureaux of Agriculture at Rothamsted and Aberystwyth, by a more general survey of the subject in which they proceed from a description of erosion the world over to a discussion of its consequences—economic, social and political. In the earlier chapters they explain that erosion has been of long standing in the Eastern Mediterranean countries, in India and China, but has come into prominence of recent years since the spectacular destruction in North America, which directed attention to similar processes at work in Africa and Australia, even in New Zealand. Everywhere man has been the cause; reckless deforestation, which bared the hill slopes, turned the river valleys into swamps and choked the harbours; over-hasty agriculture, which left the soil without any binding power; over-grazing, which destroyed the natural protective cover. Yet neither forest exploitation nor agriculture need be destructive; the Old World offers many examples of how production may be maintained indefinitely without loss of fertility. But these lessons have been ignored wherever men have been allowed 'to do what they like with their own'—their own in this case being the land; so that the vast expansion of population in the nineteenth century induced such a hurried exploitation of the land that the world's productive capacity has been permanently impaired.

So far as Great Britain is concerned, erosion is not a problem; with our evenly distributed rainfall and humid atmosphere we can grow grass, and on the basis of an alternation of grass and arable crops we can both protect the soil and maintain fertility. Indeed, even where the conditions are less favourable to grass, as on the great plains of Russia or North America, the evolution of a conservative system of farming will depend upon the introduction of longer or shorter periods of grass to enable the soil to regain its texture with the accumulation of humus and nitrogen. It is in Africa that the problem of erosion presses most upon us, for in the East African Colonies, in particular, the waste of the soil and the growth of the desert has already progressed so far that the land is unable to carry the native population, still less to give them that surplus production which is required for their physical and cultural improvement. In Africa more land for the natives and land for the absorption of surplus population of European origin is almost out of the question; the continuance of the native population is threatened and we are trustees for their well-being. Such questions are discussed by Mr. Jacks in the closing chapters of the book; they are questions that no statesman can ignore.

The book is excellently produced; the illustrations alone are capable of telling most of the story.

(2) "Land Utilization in Australia" is a book commissioned by the Australian Institute of International Affairs, as the national group of the Institute of Pacific Relations. Though it touches on soil erosion, it is mainly a thoroughly documented account of the development of agriculture in Australia and of the possibilities of expansion and closer settlement. Profs. Wadham and Wood are insistent upon the small proportion the cultivable land bears to the superficial area of that continent; even the tropical regions of Queensland and the Northern Territories offer little promise of economic utilization.

The summary of land use shows 40 per cent of 'waste', that is, desert and semi-desert, 3 per cent of crops and orchard land, and 2 per cent of forest, 55 per cent being classed as pasture and rough grazing. But the greater part of this latter area would better be described as ranching land with a low stock-carrying capacity, and dangerous to bring under cultivation. It is interesting to note that the population employed in agriculture has actually declined since 1914, though the gross production has increased. This represents technical improvement and the greater use of labour-saving machinery (probably in no country is the output per man equal to that in Australia), but the shrinkage in the agricultural population is a token of how little is the marginal land available for higher production. Since the War of 1914–18, there has been no lack of schemes for closer settlement and assisted emigration, but progress has been halting and the cost great.

So far as the descriptive part of the book goes, a discussion at this distance would be irrelevant; Profs. Wadham and Wood have done their work well and have produced an indispensable work of reference. But in their later chapters they enter on more general ground by a consideration of how the future agricultural development of Australia is likely to be influenced by changes in the world's markets.

The growth of Australia in the nineteenth century was the outcome of the great increases of population in Western Europe; economically, it was based upon international trade, upon the exchange of food and other primary products for capital and manufactured goods. But the equilibrium has only been temporary; we have now a stationary population in the Old World, accompanied by a marked increase in the power of industrial production. That ought to have led to a freer exchange of commodities and a rising standard of living all round; but country after country has intervened to protect its politically dominant agriculture against the rising tide of cheap food from the new countries The years 1914–18 brought their own dislocations of the mechanism and particularly generated an excessive nationalism which led every country to aim at being self-sufficient.

In this way we have arrived at a world economy based upon scarcity and high internal prices just when the powers of production, industrial and agricultural, are rapidly expanding. Australia stands to be hard hit; so far as manufactured goods go she has joined the ring and maintains high internal prices. At the same time, her cheap agricultural production is rendered futile by the diminished purchasing power of her customers in markets like our own, where prices have been raised for the benefit of the home producer but in which artificial enhancement the Australian is not allowed to share.

It is a bad look-out for agricultural progress, not only in Australia but also everywhere else, until the world begins to act on the fact that plenty is at our disposal whenever we are so minded.

A. D. H.

HOW GENETIC SYSTEMS COME ABOUT

The Evolution of Genetic Systems
By C. D. Darlington. Pp. xi+149. (Cambridge: At the University Press, 1939.) 10s. 6d. net.

A MORE comprehensive and intricate mass of material has been successfully analysed and integrated in this masterly exposition of Darlington's than in any other biological treatise of such small size known to the reviewer. The book is not to be recommended to those who are reluctant to read closely and to do a good deal of hard thinking; and it will displease both those who abhor a contemplation of the forest because of its trees, and those who find it too irksome to study the trees because of the forest. But for those willing to make the effort to understand both in their relations to one another it will prove brilliant, illuminating and highly stimulating, no matter whether or not they agree with all the details in Darlington's remarkably coherent and unifying system of interpretations.

As the account develops, one is made increasingly aware of the fundamental importance not merely of the specific attraction between like genes (and gene parts ?) but also of that peculiarity in this attractive force which causes it to be largely satisfied by a two-by-two association, that is, pairing. In the first place, this allows the autosynthetic doubling or 'division' of chromosomes into sister chromatids, and the holding together of these chromatids in mitosis until anaphase; and in meiosis the cause of pairing of the homologues is traced to their entering the prophase with their attractions unsatisfied because of their delayed doubling; this is in fact the crucial point in Darlington's 'precocity' theory. In conjunction with this, a theory is developed which explains crossing-over as a result of the strain arising in the entwined partners when, each having finally doubled, the attractions between the sister chromatids interfere with the conformation that expressed the attraction between the homologues. It may, by the way, be noted that if this were not the actual mechanism, we might have expected to find some organisms in which crossing-over occurred without doubling and in which, accordingly, there was but one meiotic division. Then, crossing-over having occurred, it is shown how this is necessary for holding the group of four chromatids together, and hence for all orderly segregation, despite the fact that the attractions are primarily in twos. These two-by-two attractions, applied to the four chromatids, cross-over and non-cross-over, and taken in conjunction with the non-specific repulsions existing between all chromosome parts, are shown to explain the various peculiar arrangements seen in meiosis in normal individuals of different kinds, and in all sorts of species hybrids, structural hybrids, haploids, aneuploids, and auto- and allopolyploids.

This analysis of the mechanistic interrelations is, however, but a part of the story. The steps are also explained whereby the wide differences in chromosome structure and behaviour, and in the consequent visible results of breeding, between present-day species—in a word, the differences between *genetic systems*—had their origin in gene mutations, breakage and union of broken ends of chromosomes, and chromosome number changes, and it is shown how these steps happened to persist and become accumulated in given sequences, under the guidance of natural selection. The natural selection may be longer or shorter sighted, according to whether the predominant factor in it is the ultimate advancement of the group, which demands the advantages given by a wide (but not too indiscriminate) opportunity for recombination, or the immediate vigour and rapid reproduction of the individuals, which gains by fixed hybridity, polyploidy and asexual reproduction; usually some compromise, more or less vacillating, between the two is reached. The resultant evolution is traced from the stage of the naked gene, through the formation of chromosomes, then sexual reproduction, sex differentiation, and finally through various elaborations, such as polyploidy, permanent structural hybridity, or apogamy, that often represent a form of degeneration of sexuality. In the light of these considerations, various observed details of the cytology and genetics of reproduction, such as the average chromosome length and number in a species, the frequency and the degree of localization of chiasmata, the degree of terminalization, etc., become much more understandable.

Thus all the tangled skein of phenomena which it has been the painstaking task of the past two generations of descriptive cytologists and geneticists to disclose are protrayed as natural developments of a few fundamental principles. These are: the existence of mutable, self-reproducing genes, arranged in the form of chromonemata, the properties of spiralization, of breakage and reunion, and of non-specific repulsion, of these threads, the specific attraction between like genes and gene parts, and the peculiarity that this attraction is largely satisfied by their paired (two-by-two) association. Good evidence for nearly all of these principles (for all except the fusion of broken ends) has, to be sure, been known for more than a quarter of a century—just as evidence on which Darwin's theory of evolution by natural selection might legitimately have been founded had been known for hundreds or even thousands of years before his time—but the great majority of observers failed to recognize these principles, and failed still more to realize their manifold and far-reaching significance when considered in connexion with one another, and in the variations of their expression that would necessarily have developed in the course of evolution, under the guidance of natural selection.

In so comprehensive and condensed a work it is to be expected that there will be not a few passages the clarity of which would benefit greatly by expansion and by more detailed figures, a number of steps of deduction which at first sight at least appear questionable, and some relatively unimportant inaccuracies. Moreover, many of the arguments would probably have gained quicker acceptance if more tentatively presented to a scientific public working in a field in which sound inference has been, comparatively speaking, so rare. Yet the intrinsic importance of the conclusions is so great, and the case made out for them so strong, that it will be impossible not to take them very seriously. The provocative form of expression used, the terseness, elegance and verve of style, the penetrating flashes of imagery and the succession of scientific *bons mots*, may have a salutary effect in shaking what has at times seemed a torpid subject out of its complacency and into a more vigorous life.

The newer life of cytogenetics must consist not merely of a struggle to confirm or refute the above system of concepts. While this work will now continue more vigorously than before, it is really in an advanced stage already—thanks largely to the wealth of Darlington's own observations and analyses and those of his collaborators. But, standing on the basis of these principles, or of any further modifications and clarifications of them, the subject is by no means closed; as readers of the book will feel, it is moved to a higher plane, in which a set of newer problems now emerges for study. An example of these is the question: If the same specific attracting force leads to gene doubling (by attraction of like gene parts from the medium) and to pairing of sister or homologous chromatids, what decides that the result shall at one time be the former, at another the latter? Again, what factors condition variations in the strength of this force, and in the amount of residual attraction after it is partly satisfied by pairing? Why are there not some organisms that, lapsing from the full advantages of sexuality, forego crossing-over and the second meiotic division, while retaining segregation? How is it that the old chromonema coils progressively loosen while at the same time a new, tighter coiling develops, wave on wave? What are the mechanics of a 'twisting' strain that is entirely compatible with fixity of the ends of the threads concerned (as shown in ring chromosomes and those in inversion loops)? What are the interrelations of the forces between the centromeres and those on the mitotic spindle, leading to the co-orientation of paired centromeres?

The day cannot long be postponed when the help of the physicist and chemist will be required in such problems, but without the prior work of the analytical biologist in laying the problems bare, the former would be operating in a fog which they by their own unaided efforts would never have been able to penetrate; and whatever their answers may be, the biological factors themselves, in their interactions in the course of evolution, furnish the keys for the understanding of the complications of the genetic systems existing at the present day, and for the prediction of what will happen to them in the future. Darlington's work goes a long way in making clear the significance of these keys. H. J. Muller.

USE OF MATRICES IN AERONAUTICAL COMPUTATION

Elementary Matrices
and some Applications to Dynamics and Differential Equations. By Dr. R. A. Frazer, Dr. W. J. Duncan and A. R. Collar. Pp. xvi+416. (Cambridge: At the University Press, 1938.) 30*s*. net.

ONE of the serious limitations to scientific development is the amount of labour involved in computation, and the authors of this book on matrices have put on record processes which they have found of value in dealing with certain difficult problems arising in aeronautics. The general class of research in which progress has been made by the authors is that in which elastic deformation of the structure of an aircraft under aerodynamic reactions leads to forced vibrations known technically as 'flutter'. The prevention of flutter in aircraft is obviously important, and the later chapters of the present volume deal with the most recent aspects of flutter research.

Although matrices provide a valuable method of investigation, it should not be concluded that their use is simple in all cases; on the contrary, much labour may be involved, and some energy is being devoted to the provision of a machine for the performance of the multiplication of matrices and the storing of the products for subsequent use.

Using the standard dynamical equations, Routh and others showed that the equations for the disturbed motion of a steady state could be reduced to forms having well-known solutions. In the case of aeroplane stability as well as of flutter, this line of attack has led to valuable results; an essential feature, however, is an inability to predict oscillations of constant amplitude. The use of matrices has enabled the authors to extend analyses to this case; one of the results is to show that frictional resistance may reduce the flying speed at which flutter occurs.

Computation by means of matrices is probably very unfamiliar, and for that reason the book may seem to make heavy reading; each of the steps is easy to follow, but the number of new processes to be absorbed by anyone coming to the subject for the first time is large. The matrix itself is a simple quantity consisting of a number of rows and columns of figures such as would be found in the better-known determinant—with this difference, the rows and columns need not be equal in number. The matrix consists simply of these numbers and, unlike the determinant, has no simple meaning corresponding with the numerical value of the determinant. Theorems are built up for the addition and multiplication, etc., of matrices, and the definition in the case of multiplication leads to a product which depends on precedence; there are, in fact, two processes, pre-multiplication and post-multiplication of matrices.

The earlier part of the book, almost half, is devoted to the detailed consideration of processes with symbolical and numerical illustrations. In Chapter iv, consideration of the use of matrices in connexion with the solution of mathematical equations is begun. One of the early examples is the evaluation of a determinant and another the closely related problem of the solution of simultaneous linear algebraic equations. It is when attempting to follow such solutions in detail that it is brought fully home that a new technical language has been developed, and that this must perforce be learned before independent progress in computation is possible. On the other hand, the methods, once learnt, seem to be powerful.

The book finally leads up to the use of matrices in solving statical and dynamical problems, and Chapter x gives a clear indication of the nature of the problems for which matrices have been found valuable; the examples include oscillations of a triple pendulum, symmetrical vibrations of an annular membrane, the static twist of an aeroplane wing under aerodynamic load. The last three chapters of the book deal with the effects of friction on motion, and the illustrations are taken from aeronautical engineering; it was the difficulty of dealing with this problem which seems to have led the authors to consider the use of matrices.

There can be little doubt that the book has put into the hands of computers a collection of processes which will help in the extension of knowledge, and although the number of interested workers may at present be small, it is to be expected that it will increase.

L. B.

OCEANOGRAPHY OF THE EAST INDIES

The Snellius Expedition
in the Eastern Part of the Netherlands East-Indies, 1929–1930, under Leadership of P. M. van Riel. Vol. 1: Voyage. Chapters i–iv. Pp. viii+178+31 plates. 20 guilders. Vol. 2: Oceanographic Results. Part 4: Surface Observations, Temperature, Salinity, Density. By S. W. Visser. Pp. viii+62. 5 guilders. (Leiden: E. J. Brill, Ltd., 1938.)

To the oceanographer the eastern part of the Malay Archipelago is one of the most interesting regions of the world. The *Challenger*, *Gazelle*, *Siboga* and *Planet* showed that it consists of a number of enclosed seas, often of great depth, which are separated from one another or from the surrounding oceans by much shallower sills. They are filled from sill level downwards with the densest water which can gain access to them, the water at the depth of the sill. Thus the Sulu Sea has a temperature of more than 10° C. from 400 m. to the bottom in 4,400 m. The oceanography of such a region must depend to a very large extent on the contours of the bottom, but no detailed survey was possible until the invention of the echo sounding gear.

The *Willebrod Snellius* was built by the Netherlands Navy as a surveying ship for use in the East Indies and was fitted with all the latest apparatus for hydrographic and scientific work; the expedition was her first commission. The leader of the expedition was P. M. van Riel, a retired naval officer and the director of the branch of the Royal Netherlands Meteorological Institute at Amsterdam. In the first chapter of vol. 1 he writes on the general plan of the expedition and the voyage out. In the third chapter he gives a short account of the scientific cruises in the survey area with notes on some of the most interesting observations. A remarkable feat was a wire sounding in Emden Deep with a 54-cm. core of red clay and a temperature and water sample from 10,068 m. In the same volume the commanding officer, Lieut.-Commander F. Pinke, describes the ship and her equipment, and the first officer, J. P. H. Perks, deals with the deep-sea anchoring gear, which was very successful. The surface observations of temperature, salinity, and density are discussed in detail by Dr. S. W. Visser.

The reports are well illustrated by charts and photographs, and the two volumes are a valuable contribution to oceanography.

ATMOSPHERIC TURBULENCE

Atmosphärische Turbulenz
Von Dr. Heinz Lettau. Pp. xi+283. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 18 gold marks.

The appearance of Dr. Lettau's book on atmospheric turbulence is a definite indication of the way in which the scientific study of the atmosphere is progressing. Many books have attempted, with varying success, to cover the whole field of what is known as meteorology, but so far there have been few books which have covered in detail one aspect of the subject. Lettau has done this for atmospheric turbulence. He has done it well, and this book will probably remain for some time the standard treatment of its subject. It gives all the essential mathematical treatment in a clear and concise form, and offers numerous comparisons with the facts of observation.

The names which recur most frequently are those of G. I. Taylor, W. Schmidt, L. F. Richardson, and of Prandtl and his disciples of the Göttingen school. The vast volume of detailed research in the field of aerodynamics published in recent years is not capable of direct application to the motions of the atmosphere, since these motions are complicated by varying roughness of the ground, and especially by varying degrees of vertical stability. The Reynolds number is therefore not in itself sufficient to determine what will happen in the atmosphere, and Lettau makes considerable use of the Richardson criterion, or the Richardson number,

$$Ri = \frac{g}{T}\left(\frac{\partial T}{\partial z} + \Gamma\right) \Big/ \left(\frac{\partial u}{\partial z}\right)^2,$$

where g is the acceleration due to gravity, T the absolute temperature, Γ the dry adiabatic lapse-rate, and u the wind velocity at height z.

Lettau gives a very readable account of the Prandtl theory of the laminar boundary layer, and of its extension to turbulent flow by von Kármán. He gives the logarithmic law of variation of wind with height, and summarizes concisely the extension of the theory to stable atmospheres by Rossby and Montgomery and by Sverdrup. The work of the last three has led to relationships which are in striking agreement with observations, but the physical basis on which it has been constructed is by no means clear. We should have welcomed fuller discussion of this basis.

Lettau gives the name 'planetary boundary layer' to the layer extending to a height of the order of 1 km. above the ground, at which the wind attains the value which gives a balance with the pressure gradient. The variation of wind with height within this layer can be discussed satisfactorily, but the transfer upwards of the daily wave of temperature change cannot be satisfactorily discussed on the basis of turbulence alone. Complications due to radiative transfer enter into this problem, and at the moment it is not possible to decide the precise nature of these complications. Moreover, the *austausch*-coefficient to be applied in this problem must be a function of height, and effectively of time of day.

Later chapters of the book, dealing with the dissipation of the energy of the air-streams by turbulence, and the general circulation of the atmosphere, describe problems which are in the main unsolved. The jump from what is normally regarded as an eddy to an entity as large as the cyclone or anticyclone appears to demand some justification. Dr. Lettau has rounded off his task by including a most valuable bibliography of 246 items, containing what appears to be a really complete list of the fundamental work in his subject.

D. Brunt.

SPECTROGRAPHIC ANALYSIS OF EAST INDIAN ROCKS

Contributions to the Knowledge of the Chemical Composition of the Earth's Crust in the East Indian Archipelago

1: The Spectrographic Determination of the Elements according to Arc Methods in the Range 3600–5000 A.; 2: On the Occurrence of Rarer Elements in the Netherlands East Indies. By Dr. W. van Tongeren. Pp. xi+181. (Amsterdam: D. B. Centen's Uitgevers-Maatschapij N.V.; London: H. K. Lewis and Co., Ltd., 1938.) 4.50 fl.; 11*s*. net; Part 1, separately, 3 fl.; 7*s*. net.

THE main object of the research described in this monograph was to ascertain the amounts of many of the less common elements, including certain members of the rare earth series, in the minerals and rocks of the East Indian Archipelago.

The first part deals with the method adopted. This consisted in preparing spectrographs of the pure elements over the range 3600 A.–5000 A., using standard mixtures of varying concentrations of the pure oxides with quartz. The apparatus is described in considerable detail together with the operating technique, and the effects of possible errors are carefully assessed. A full and valuable discussion follows on the relative intensities of the characteristic spectral lines, and detailed tables are appended.

Similar sets of spectrographs were obtained with the rock specimens and, by a process of comparison, estimates were made of the approximate contents of the different elements.

The second part discusses the results obtained from some three hundred specimens from the Netherland East Indies, including Java, Sumatra, Borneo and numerous other localities less well known to British readers. All the specimens were selected from those in the possession of the Geological Department of the University of Utrecht, and their authenticity was thus guaranteed. The data are valuable, but contain little of exceptional interest; one feels the author did not receive the luck he deserved. The rare earths were present only in minute amounts; vanadium varied up to a maximum of 0·3 per cent (pentoxide); germanium was not found, whilst indium occurred exclusively in zinc ore from Borneo.

The amount of work involved must have been great; the author is to be congratulated on having completed successfully so laborious a task.

J. Newton Friend.

THE NATURAL GEOGRAPHICAL REGION

By A. Stevens
University, Glasgow

THE most conspicuous geographical concept, the enunciation of which is associated with British geographical thought, is that connected with the phrase, 'natural geographical region'. In spite of much—rather sporadic—discussion, the concept remains obscure. Many who would like to employ the term are shy of it: they shorten it to 'natural region', and some limit the meaning of the epithet 'natural' to the physical, the inorganic; they distinguish the geographical region; they refer to economic, to 'human use' regions. All this hedging about terms is a sure indication of uncertainty of grasp as well as of diversity of view.

The term originally used by Herbertson was 'natural geographical region'. In most writing the middle word is dropped. Roxby says that a natural region is characterized by a particular set of physical conditions. But a uniform set of conditions is hard to find extended over a region of any considerable area. This is to be expected, of course: in a sufficiently small region one would find uniformity, or 'practical' uniformity, but in a large one it is necessary to search for unity within diversity. For large areas the 'dominant' physical condition becomes the criterion. Herbertson regarded climate as dominant in the characterization of his major natural regions of the globe, and this lapse in logic evoked serious criticism on the occasion on which he first propounded his views. The criticism was as immature as the thesis. No one, so far as we know, has entered on a systematic consideration of the geographical relevance of the various physical conditions, and an examination of this relevance would seem an essential preliminary to the establishment of dominance. Such occasional—and usually disingenuous—flirting with the question as occurs would indicate what is probably true, that any attempt in this direction is, in practice, hopeless.

The ultimate fallacy underlying this kind of thought or procedure is that it begins by assuming a duality, the physical and the non-physical, the human and the non-human, the natural and the artificial. It brings geography to the stage reached by the Schoolmen when they disputed between form and matter, matter and spirit, and questioned the possibility of knowledge. We are not concerned about absolute knowledge or complete knowledge, but only about a particular kind of knowledge and only about the attainable extent of that. We are concerned with physical and biological nature only in so far as it may be regarded as human environment and only with man in so far as he has demonstrable relationships with the environment.

Many will agree well enough with this last statement, but some of them, if not all, will insist that the method of geographical study is a synthesis or an integration.

Synthesis is not addition: it is a complex process for which there are no general rules. The chemist performs it successfully, but in special and individual cases. The mathematician is our best integrater. He may begin with a function of x and is as likely to end with a new branch of mathematics as with a reasonably simple new function of his variable. Neither of these magicians can operate with dissimilar things.

Something analogous to synthesis might be said to go on between man and his environment. If this analogy do not lead us astray once more, we might say that man is the synthetic influence. History is a spectator of the process, more or less blinding itself to everything but the time element. The geographer does not synthesize, because he cannot, but he also is a spectator of the process primarily interested in its development in space. Man must be looked at objectively by the geographer, and even his significant antics must be taken to be as natural as the physical environment. The natural geographical region is a result of what, for want of a better word, we may agree to call synthesis proceeding in Nature, under our eyes, but not by our voluntary action. There are two aspects of this synthetic product: the environmental aspect, essential to which is man himself, and the human aspect, which is much the same as to say the functional aspect, using the language of ecology.

The boundaries of the natural region (in our sense) are definite enough; which does not mean that they are necessarily simple or easy to trace. Where they are common to another natural region they are clearest. These boundaries indicate a state of equilibrium which may be stable but cannot be static. Change may occur in their position or in their condition. The most active normal change occurs when they are advancing unto unorganized country or relatively unorganized country. Such advances occur during colonization, even if that proceeds overseas. Their tendency is

---

* From the presidential address to Section E (Geography) of the British Association delivered in Dundee on September 1.

centrifugal, their actual development in space is limited by conditions. Organization by Rome was more or less regularly centrifugal, the advance of Germanism was eastwards. The boundaries of a natural region may be indifferent to natural (physical) boundaries. For an organism must have continuity in its medium, but continuity does not preclude variety. So the boundary of a natural region may cross a mountain range, partition a river valley, divide a coalfield; and it may be a better boundary for so doing. The time factor (*relative* time) is important here, for the question of stability, equilibrium, is a question of adjustment. It is no hardship to the economic structures concerned that France, Belgium, Holland and Germany share one coalfield. Their political frontiers antedate their industrial development. For the Romans the Rhine divided, for the Germans it unites, for the French it still separates. The flanks of a mountain range separate and are easily held; the passes connect.

For Herbertson with his analogies, man represented the nerves of a natural region. Not so: man is the living principle. The nature of that principle is not the subject we are called to study. The nervous system, if we must have analogy, is the means of communication in the widest sense; and the analogy is unduly narrow, for means of communication have nutrient as well as co-ordinating functions. In this place, it is true, we are less concerned with the former, for the purpose is to define the natural geographical region.

The unity of the natural geographical region is achieved, maintained and developed by organization, by cohesion, and this cohesion is attained and extended by intercourse, at first within and later beyond the region, provided the organic development is an indigenous growth. Since the fourteenth century the means of communication of the type associated with Western Europe has been undergoing continuous but uneven development. This development was stimulated by overseas discovery, but its progress gained speed of a new order in the nineteeth century with the concurrent development of railways and large-scale manufacture, and the acceleration has progressively increased until our day. In consequence the range and intensity of organizing ability and power have increased. The most satisfactory natural regions to contemplate, and to appreciate from geographical writing, had been fully organized and had their identity recognized before the modern era began. One has but to think of the French *pays*, and the deterioration of the work of such a master as Vidal de la Blache beyond the Paris Basin. No doubt the conservatism of the French countryside and the degree to which it was able for so long to preserve its archaic cohesions has made it a specially favourable field for regional studies. But traces of such a division of the country are not wanting in Scotland. Even in the Midland Valley names like Menteith and Lennox have not completely lost regional content, while names of regional significance are common enough north of the Highland Line. Elsewhere, access to extraneous sources of necessities and the means of establishing wider loyalties have obliterated local character and submerged local unity. What are the *pays* of the Rhone Valley? The speed of modern change has confused a great deal of thought.

There are minimum and maximum sizes for natural regions. The minimum is determined by the least extensive area, in extent and variety of natural endowment, capable of being organized and maintained, by its resources—physical, biological and human—for cohesion, sustenance and defence. The maximum is determined by the efficiency and range of means of communication. Both maximum and minimum vary in time.

Two types of organization must be distinguished and we shall call them conscious and self-conscious respectively. The former is primitive and appears less artificial. The latter is very modern. It is a development made possible by progress in general, especially in the knowledge of the possibilities of 'planning', and of the 'management' of environmental conditions; and in the development of means of communication in particular. The objective view of man excludes the possibility of regarding his actions as artificial. Some of them we may think ephemeral or capricious, but they have their source in the nature of man.

Natural regions must change in extent and otherwise with time, but the changes need not be continuous. At times of specially rapid change in human life the natural division into regions may almost suffer a revolution. But a true revolution, a sudden and catastrophic change, has occurred only in extra-European countries. In North America there must have been natural regions—or, if it is preferable, an analogue of a system of *pays*—of Indian times. The traces of these have been swept away, except what may be gleaned from such knowledge of tribal distribution as has persisted. We must distinguish natural regions of continuous and of discontinuous development.

Difference in scale would appear to be due to difference in topographic fragmentation—before due consideration has been given to the matter, so long as we consider the physical more fundamental and permanent. But it is neither. What is fundamental is relativity to man. Space, height, slope, areas at the time unproductive, all these represent difficulties in the problem of instituting and operating means of transport. At the present moment all of them within terrestrial limits have their price in time, labour, ingenuity and risk. If the price is commercially—and even strategically—still too high, the practical possibilities are still of commercial magnitude. It is only a hundred years since the scale of land transport began to approach that of water transport. Crossing the Alps by forces of great military significance was almost as great a marvel in the days of Napoleon as in those of Hannibal. It was less perilous than the invasion of Muscovy. What strength in men and material could be launched across these obstacles of space and altitude to-day? What 'fifth column' of 1940 can be certainly held at bay by the most powerful or secluded or distant people?

The 'natural geographical region' is an active organism. The size of a region growing freely is determined by the range of the means of cohesion. At a given time that range depends on the state of technical development of the community occupying the region in relation to the problems presented by the nature of the medium. If technical development is relatively stagnant, but territorial development is undisturbed, the 'organism' will expand up to boundaries which for topographic reasons, but also, it may be, on account of mere distance, are insuperable at the time. The state of equilibrium so reached in empty, barren or distant areas will be fluctuating. Improvement in the means of communication will produce an expansion of the organism, provided it is free to expand. In a 'new' country like the United States, that is, where the history of development is discontinuous, to the expansion of regional units are set the very wide limits compatible with modern means of communication.

Efficiency of communication may become uneven. Long-distance communication and bulk movement of commodities have undergone hypertrophy, while the more intimate contacts which produce 'neighbourliness' are weak. Very large areas may be fed, policed and defended. National organization is in a stable condition. In such conditions natural regions of the order of *pays* are never likely to develop, or, at least, to have more than a very ephemeral existence, until population densities are very different from their present condition. If regional unities of the nature of *pays* develop they will be on a vaster scale.

Some, at least, of the commonly recognized regional divisions of both Russia and the United States are represented, mistakenly, of course, as regions of monoculture with a characteristic crop produced under suitable climatic conditions. In fact, the corn belt is as much a region of mixed farming as the dairying belt and there is a great deal of pasture, largely unimproved, in both. The pressure of population on the land is low, and the region-community organism is far from the condition to which the ecologists apply the term 'climax association'. A state of equilibrium has not been attained. Two propositions follow from these considerations: the relation between the community is so loose that its activities do not fully reflect the conditions of the environment; the more intimate and less organizable contacts within the community are so indefinite that what we may call regional consciousness is rudimentary.

At the same time, what we have referred to as self-consciousness is of an advanced type. The 'human use' region, as usually distinguished, is an area of undeveloped economy. The natural geographical region emerges from chaos only when it has evolved to the stage at which it can be clearly recognizable as a synthetic whole with what the French would call 'personality'. When this stage of climax association has been attained, we are able to assess the relative significance of environmental (physical and other) factors; for this cannot be done satisfactorily except by using the nature and activity of the community as an index in the same way as the natural vegetation of a region has been employed as a climatic index. The climax condition, when it has been attained, is not necessarily permanent. It may change with greater or less rapidity in time, and the obvious reasons for change are human progress, chiefly technological, or the reverse, and exhaustion of resources, notably mineral resources, absolutely or due to alteration of values.

In the more westerly parts of Europe the centrifugal processes were propagated from a number of centres during the course of development to present conditions. Through a great deal of it something like climax conditions were reached before the railway era, and to these conditions belong the French *pays* and the German *Gau*. Such entities occur east of the Rhine only within the sub-Hercynian belt of dense population, and not throughout the belt. In the extreme west they expanded territorially up to natural limits which, being narrow, kept them small. Had these close natural limits been wider the *pays* would have been limited by the advancing peripheries of other organisms, and conflicts would arise which would be stilled only by coalescence into larger organizations by one of the methods known to history. Indeed the *pays* as we know it is no doubt a product of coalescence: as the smallest organism of the type, available for study, it may, merely for convenience, be regarded as indicating the practicable minimum. In areas more remote from the influences active in western Europe, and to the east in particular, slower progress in indigenous technology, greater obstacles to cultural importation, and correspondingly less rapid growth in population, absolutely and in relation to the extent of available territory, deferred to a comparatively recent date the attainment of the climax condition. The broader fragmentation of the country was a concomitant, but not at all necessarily the dominant determinant of the territorially larger organism.

Long before the railway era, France and Great Britain had achieved the more self-conscious organization of the nation-state by coalescences of various kinds. The process was less satisfactory in Spain. All three were able to relieve the unease to which increasing efficiency of means of communication made them liable by overseas adventure keeping step with that growing efficiency. The relief was illusory in the case of Spain. Germany had respite of a similar kind because she had her colonial area to the eastwards, and there she still has colonial spaciousness even within her present restricted bounds. In that direction also lie some of her deracinated offshoots, as others share the United States with ours and the French are to be found especially in Canada.

It is suggested that the European nation-state is a community occupying a natural geographical region as its immediate environment, because it is a natural growth limited by its geographical circumstances Not only so, it is an organic phenomenon so characteristically European in its genesis, to be found nowhere else in a state of mature development ; and therefore any European geography which failed to take account of it, indeed of which it was not the central object, ought to be unthinkable. The swing away towards the novelty of the physical region was a vain pursuit of novelty. If the real natural region for geographical study is as we have held, and if the nation-state-country organism of Europe is the achieved synthesis of European geography, then the region which is characterized by a set of physical attributes is, geographically, a misconception. For not only have many European States partitioned one of the main 'natural divisions' of the Continent among them by stable frontiers, but also it is unthinkable that any one community could develop that area as a whole and remain restricted to it. We refer to the North European Plain ; but there have been attempts enough to unify the 'Mediterranean' region, and there is sufficient division now and throughout historic time both there and in the Alpine region, where physical conditions favour severance rather than unity, to justify the same statement with regard to them. Physical conditions are neither more permanent nor more fundamental in geography than human. If in themselves they change less quickly than the characters of the living partner in the symbiosis, their significance and value change rapidly, even suddenly, and sometimes disappear We do not really believe in the permanence or significance we predicate For we approve and wish to maintain the further political subdivision which has taken place so recently in the North European Plain, we see reason in the demand for access to the sea or to a navigable river, but we boggle about allowing more than one nation access to a coalfield.

We see the countries of Europe as natural regions, natural because they exist as phenomena demanding study, demanding it with a special urgency in these days. Their territorial development seemed to have culminated before the War of 1914–18, and before the present unrest it underwent readjustment which seemed to offer some prospect of stability. We must look for objective explanations of failure. These States grew into contact with each other and organization permeated the whole of, or the more 'European' part of, the Continent. Not natural boundaries, but convergence of organisms set limits to expansion, especially for the later developed units, at a time when means of organization were developing rapidly. The proper scale of organization is no longer represented by the European nation-states but rather by the United States Disturbance of equilibrium shows itself by unrest in the newer countries which have not been disciplined by long confinement within narrow bounds and had their views of hegemony chastened by such a loss of territory and influence as the French suffered in the complete rape of an earlier empire, the British in the loss of their earlier colonies in America and by the development of increasing independence in the Dominions. For the countries east of France the region of colonial expansion has been continuous with the homeland ; the peoples of slower development whom they have replaced have been Europeans and have survived the disturbance of colonization. These countries do not appreciate the barbarity of applying in 1939 the moral principles applied by others in ruder times two centuries ago.

In Germany we can distinguish extensive areas over which the mean density of population is comparable to that of Great Britain But to the east, especially, the Reich has extensive areas of relatively recent occupation which we have called its natural colonial region, that which it has in fact exploited, whether of choice or of historical necessity. There the mean density of population is scarce half as great. On the other hand, the former kingdom of Saxony has proved capable of maintaining a mean density twice that of Great Britain. The urgency of any problem of *Lebensraum* is fanciful Straitness of living space is commonly relieved by more or less free movement of commodities from abroad, compensated by similarly free exportation. Voluntarily or involuntarily, Germany has to a large extent renounced this relief. The *malaise* seems by no means untreatable by other means

NEUTRONS AND RADIO-ELEMENTS AND THEIR BIOLOGICAL APPLICATIONS[*]

THE spontaneous radioactivity of a number of heavy elements has been known for a generation, but it is only within the last decade that attempts to induce radioactivity in stable elements have succeeded. Since the first successful experiments of Curie and Joliot, however, progress has been rapid and radioactive isotopes of the majority of the stable elements have been made. Now that powerful high-voltage plants are available, the quantity in which these artificial radio-elements may be obtained is in some cases comparable with the quantities of natural radio-elements which are available, and the artificial radio-elements are already beginning to compete with the naturally radioactive elements as sources of beta- and gamma-rays for physical purposes, and will probably soon be used on an appreciable scale for medical purposes for which radium is at present in use.

Economically, there is probably at present not much to choose between the use of radium and of artificial radio-elements, the interest charges on the capital invested in radium being of the same order as the costs of maintenance of a cyclotron. The special importance of the use of artificial radio-elements in biological experiments lies in the possibility of using active isotopes of elements already present in the organism and taking part in its metabolism.

There are at present two methods of producing artificial radio-elements in quantity, the first being the direct bombardment of inactive material with protons, deuterons or alpha particles, and the second the activation of inactive materials with slow neutrons, the latter being produced by the slowing down in paraffin or water of neutrons generated in some reaction such as the bombardment of deuterium or beryllium with deuterons. Either method thus starts with the production of a beam of fast charged particles. The direct way of obtaining such a beam is to generate the requisite high voltage and apply it to a vacuum tube in which the ions are accelerated. This was the method used by Cockcroft and Walton, and the Cavendish Laboratory now has a generator of the Cockcroft and Walton type operating at two million volts. Apparatus of this type, in which the full voltage is applied to the accelerating tube, would become very cumbersome at still higher voltages, on account of the large clearances necessary to prevent spark-over, and further extension of this method is likely to proceed along the lines of enclosing the apparatus in a high-pressure or oil-filled tank. When considerations of finance limit the voltage to a million or less, however, it is the best type of machine, since the fact that ion currents as high as one milliampere may be obtained counter-balances to some extent the diminished disintegration yield at these relatively low voltages.

Dr. J. Read and Dr. L. H. Gray have installed a machine of this type at the Mount Vernon Hospital, London, producing neutrons by the D + D reaction and operating reliably at 300–400 kv. with ion currents up to 900 microamperes. This plant has so far given an output of neutrons equal to that produced by 30 curies of radon plus beryllium, which is sufficient for investigating the more sensitive biological reactions of radiation. It was built at a cost of £600, and has been operated for two years at the very modest figure for maintenance of £80 per annum, both figures being of the order of one tenth the corresponding costs for a large cyclotron. The deuterons are drawn from a low-voltage arc, and after acceleration fall on the target, which is at earth potential. The target is a film of heavy paraffin wax deposited on a copper plate water-cooled on its underside; the material to be irradiated can be brought to within 1 cm. of the focal spot. The bombardment of the paraffin wax rapidly causes chemical changes to a less saturated hydrocarbon of only half the deuterium content, with consequent loss in neutron output. After the initial fall, however, the output remains constant for some months of use.

When particles of very high energy are required, the method *par excellence* is the cyclotron developed by Prof. E. O. Lawrence, in which ion energies of millions of volts are attained by repeated impulses of 100 kv. or so given twice per revolution as the ions execute a spiral path between the poles of a large electromagnet. The largest cyclotron at present in operation is that recently completed at Berkeley, California, and with this machine deuterons of 18 Mv. and alpha particles of 38 Mv. have been obtained. The neutron intensity from this machine is adequate for therapy at distances from the target of the order of 1 metre.

---

[*] Based on a discussion in Section A (Mathematical and Physical Sciences) of the British Association, which took place on August 31 and September 1, those taking part being Dr. J. Lawrence, Dr. W. B. Lewis, and Dr. J. Read and Dr. L. H. Gray.

With the smaller Berkeley cyclotron, which gives particles of about half this energy, a considerable amount of biological work has already been done. The effect of neutrons in killing mice, Drosophila eggs, bacteria and fern spores, in producing chromosome abnormalities and in inhibiting growth in wheat seedlings has been compared with similar effects produced by X-rays and gamma-rays. The effects are in general qualitatively similar, but suggest that in most of these cases the biological effect per ionization in the tissue is greater for neutrons than for X-rays. That this is not a general phenomenon is shown, however, by the experiments of Timoféeff-Ressovsky and Zimmer, who find that neutrons are somewhat less effective per ionization than X-rays in the production of gene mutations in Drosophila. The investigation of the dependence of the biological efficiency per ionization upon the specific ionization of the ionizing particle is one of the most promising methods of investigating the mechanism of the biological action of radiations.

Following the experiments on animal and plant material, the treatment of cancer patients with neutrons has now begun at Berkeley. A satisfactory degree of collimation of the neutron beam, which is essential for cancer treatment, has been obtained by the use of a lead-lined channel in a water tank. It is not yet known how successful the use of neutrons will be in the treatment of cancer, compared with X-rays. Encouraging therapeutic results have, however, already been obtained in another direction, namely, in the treatment of leucæmia by the oral administration of radiophosphorus. A marked fall in the white cell count and improvement in the condition of the patient follows the dose, which is repeated at intervals when called for by a rise in the white cell count.

Numerous uses for the artificial radio-elements in experimental biology have already been found, particularly in investigating metabolic problems. The admixture of a small quantity of a radioactive isotope with a larger mass of inactive atoms serves as a tracer for these atoms, and enables one, for example, to find out what proportion of a particular element administered orally is excreted immediately, and what proportion is taken up by each organ. If sodium chloride containing some radioactive sodium is swallowed, sufficient will find its way into the hand in ten minutes to affect a Geiger counter shielded from the rest of the body. Injected intravenously in one arm, its presence can be detected in the other arm some twenty seconds later, an experiment having possible applications in the investigation of circulatory disorders.

THE HABITS OF SALMON

In recent years, intensive investigation of the life-history and habits of salmon and trout has been carried out in all the countries where the species are of importance. The results of the investigations were recognized by a symposium on salmon at the summer meeting of the American Association for the Advancement of Science in Ottawa in 1938, and by a morning devoted to the subject at the recent meeting of the British Association at Dundee.

Salmon spend from one to five, and normally two or three, years as parr in fresh water. Here recent investigations have shown that growth is not entirely seasonal but that, contrary to expectation, a marked slowing down, if not cessation, of growth occurs in August when conditions might normally be expected to be favourable. This coincides with the experience of trout anglers, to whom August is often anathema, and of fish farm operators who, however, recognize a close connexion between water temperature and food intake and digestive activity. Mr. K. R. Allen has already noticed this fact and, at the Dundee meeting, Dr. K. Carpenter argued that the diminution of growth and, concomitantly, of the intake of food organisms, was directly associated with a marked decrease in the number of organisms available in the streams.

It has long been recognized that in their second year, or for those that remain so long, in their third autumn, certain male salmon parr may become sexually mature and may spawn with adult females. That the spermatozoa of these precocious fishes functioned successfully was shown at least fifty years ago. Prof. J. H. Orton and Mr. J. W. Jones have recently pointed out that a quite considerable proportion of the male parr may be ripe, and Mr. Jones stated at Dundee that by dissection it is possible to trace during the smolt stage in the following year those which had spawned some six months earlier. The significance of this precocity is not yet understood. It is unlikely that it forms an important contribution to the continuance of the stock, but it is quite possible that it may affect the length of life spent in the sea. The fish concerned may return after a shorter, or longer, period of sea feeding than those which did not spawn in the parr stage, among which are included all the females. The present writer, however, recently examined a female salmon which had apparently become voluntarily landlocked in a long and deep Scottish loch, and in the course of its seven years of life had spawned at least twice.

Once the parr become smolts and descend to the sea they are lost in the widths of the ocean, but something may be learnt of their routes of travel when, their feeding finished, they touch the coast and continue onwards to fresh water. From Ardnamurchan Point on the west coast of Scotland, the salmon either stay in the locality or travel south, it may be as far as the Liffey in Eire or the Conway in Wales. But, from only thirty miles farther north at the island of Soay off the south coast of Skye,, and then up through the Minch to Cape Wrath, the majority of fish which strike the coast do not belong to the neighbouring rivers and do not travel south. They go north to Cape Wrath, along the north coast and, in many cases, down the east coast. From the middle area (near Bergen) of the outer island belt on the Norwegian coast, the fish spread both north and south, some to very considerable distances: one fish travelled some 1,600 miles from the place of marking before it was recaptured on the inner shore of the White Sea. From another marking station near the North Cape, on the other hand, Prof. Knut Dahl and Dr. Sven Somme have found that the fish made no long migrations southwards, but many were re-taken, like the salmon marked in the north-west of Scotland, to the eastwards. They travelled along the north coast of Sweden, Finland and Russia as far as the eastern limit of *Salmo salar* in the River Petchora. On the other hand, the movements of the salmon captured, marked and released at the east end of the north coast of Scotland, on the Scottish east coast and close to the mouths of the Norwegian fjords, are limited close to their original locality or the immediately neighbouring rivers.

The inference to be drawn from a consideration of all the marking experiments and other relative data is that the feeding ground for the European salmon is not in the North Sea. The movements revealed are not inconsistent with the probable journeys of fish from an area some distance to the west or north-west of the British Isles. It would, further, seem probable that the majority of the fish going to the rivers flowing into the North Sea enter that area by the open channel between Shetland and Norway, and some possibly by the Fair Island Channel, but relatively few through the Pentland Firth.

In spite of the distances which many of the marked fish travel, it would appear that they do so not in random wanderings but in the course of a definite journey to their native river. Every angler and net fisher of experience knows that different rivers contain salmon of different character. Some rivers, for example, have salmon early in the season, and some only later in the spring and summer; some rivers contain essentially grilse, others chiefly older and larger salmon. Such differences might be ascribed to selection by the fish on account of physical characteristics of the river itself. But Mr. P. R. C. Macfarlane stated that other evidence such as the lengths of the fish at the end of each year of life, as shown by measurements of the scales, the condition factor (the relationship of weight to length), and the type of scale growth, points to the existence of separate biological communities in each individual river. As cases in point, a salmon marked in Scotland and recaptured in Norway had scales with parr growth of a very characteristic Norwegian type, while others marked on the Norwegian coast similarly showed parr growth exactly comparable with the known type of the Scottish rivers in which they were recaptured

W. J. M. M.

OBITUARIES

Dr. G. J. Robertson

DR. GEORGE JAMES ROBERTSON, senior lecturer in chemistry in the United College, University of St. Andrews, died suddenly on September 5 at the age of forty-one years. A son of the late Mr. James Robertson, head master of Colinsburgh School, Fife, he entered the University of St. Andrews from the Madras College, St. Andrews, in October 1916. He undertook military duties soon afterwards, and held a commission in the Gordon Highlanders, 51st Highland Division. He was on active service in France from September 1917, and in March 1918 he was taken prisoner at Cambrai and interned in Germany until the end of the war.

Robertson returned to the University of St. Andrews in 1919, and graduated M.A. (1921) and B.Sc. with first-class honours in chemistry (1922). He held in succession a Carnegie Research scholarship, fellowship, and teaching fellowship in the Chemistry Department at St. Andrews. In 1924 he was awarded the degree of Ph.D. for a thesis entitled "Investigations on Cellulose". Since 1927 he had been senior lecturer in the Department, and in this capacity he carried out and directed a considerable amount of research work in carbohydrate chemistry. In 1936 he was awarded the degree of D.Sc. for a thesis entitled "Walden Inversions in the Sugar Group"; this thesis also gained him the Sykes Medal for outstanding merit. His investigations, most of which were published in the *Journal of the Chemical Society*, dealt largely with the interconversion of simple sugars through anhydro-derivatives and the problem of the natural formation of lactose, glucosamine and allied substances.

Courteous and considerate to his colleagues and students, Robertson has been described as "an excellent teacher endowed with unusually fine powers of expression and easy fluency". His military training enabled him to render valuable services to the University O.T.C. throughout his period as a member of the University staff. He leaves a widow and two sons of school age.

Mr. H. Young

BY the death of Mr. Henry Young on September 23, the Royal Institution loses its last surviving link with Faraday. Mr. Young used to say that Faraday was a frequent visitor to his home, and as a child he must have seen him, though he was too small to remember meeting him.

Mr. Young was engaged as assistant in the library of the Royal Institution in 1879 and ten years later was appointed assistant secretary and keeper of the library, which double post he held until his retirement in 1929. He was also assistant secretary of the Davy Faraday Research Laboratory from its foundation in 1896. At their meeting on December 2, 1929, the managers elected Mr. Young a member of the Royal Institution, and at the general meeting on the same day Sir James Crichton-Browne, on behalf of the members, presented him with a silver rose bowl and a cheque as a mark of their appreciation of his long services. After his retirement, he was a frequent visitor to the library which had been under his care for so many years. Mr. Young compiled valuable bibliographies of the scientific work of Tyndall and Dewar, under both of whom he served. Afterwards, as librarian to the Duke of Bedford, Mr. Young was fortunate in finding a congenial and not too strenuous occupation for his leisure hours in the library at Woburn Abbey.

Modest and retiring in disposition and of a genial nature, Mr. Young had a remarkable knowledge of the history and inner working of the Royal Institution, which he loved and to which so many years of his life were devoted.

WE regret to announce the following deaths:

Dr. J. D. Comrie, lecturer in the history of medicine, University of Edinburgh, and president in 1927 and 1930 of the Section of the History of Medicine of the British Medical Association, on October 2, aged sixty-four years.

Prof. Harvey Cushing, For. Mem. R.S., emeritus professor of neurology in Yale University, known for his work on the surgery of the brain, on October 7, aged seventy years.

Dr. Heinrich Karny, formerly of the Botanical Garden, Buitenzorg, Java, an authority on the Orthoptera, on August 7.

Prof. Charles Peabody, formerly curator of European archæology in the Peabody Museum, Harvard University, on August 17, aged seventy-one years.

NEWS AND VIEWS

Prof. A. McKenzie, F.R.S.

AT a graduation ceremony held on October 6 in the Old Parliament Hall of the University of St. Andrews, and presided over by Sir James Irvine, principal and vice-chancellor of the University, the honorary degree of LL.D. was conferred, amongst others, upon Emeritus Professor Alexander McKenzie, professor of chemistry in University College, Dundee, from 1914 until 1938. In presenting him for the degree, Prof. John Read, the present occupier of the chair of chemistry at St. Andrews, said that McKenzie, when he was appointed to the chair of chemistry in University College, Dundee, in 1914, was already well known as a distinguished graduate of the University of St. Andrews, with a brilliant record of original research, begun with Purdie at St. Andrews, continued with Marckwald at Berlin, and extended independently in London and Birmingham. His later researches, together with those of his many collaborators, published during his twenty-four years at Dundee, are familiar to chemists all over the world; for he was a skilful chemist and philosophic thinker of international renown, who has brought light into many of the dark places of stereochemistry. His pioneering researches with the Grignard reagent; his work on asymmetric synthesis and on the migration of organic radicals; his isolation of optically active benzoin: these, and other achievements, are characterized by a subtle elegance and a rare combination of fastidiousness and delicacy. In attacking the refined secrets of the organic molecule, he discards the ponderous weapons of men of grosser mould for the light rapier of the "chymicall Artist". By his brilliant and untiring investigations, McKenzie has brought renown to his university and his college; by his stimulating teaching he has inspired successive generations of his students; by his wise counsel he has aided his colleagues of Court, Senatus, and Faculty; and by his gifts of sympathy, kindliness, and understanding he has gained the esteem and affection of all.

Mojsisovics von Mojsvar (1839–1907)

On October 18 occurs the centenary of the birth of the distinguished Austrian geologist and palæontologist Johann August Georg Edmund Mojsisovics von Mojsvar. The son of a surgeon, he studied law at Vienna, taking his doctor's degree in 1864. Three years later he entered the Geological Institute with which he was connected until his retirement in 1900. From 1892 until 1900 he was vice-director of the Institute. His first geological tours were taken in the Salzkammergut with his famous teacher Suess. For more than thirty years he devoted much attention to the Austrian Trias and among his principal writings was his work entitled "The Dolomite Reefs of South Tyrol" published in 1879. He was instrumental in furthering the systematic collection of fossils from the Eastern Alps, and his own work on the Cephalopods, said von Zittel, "is an achievement of permanent value and general scientific interest", conferring a boon on Alpine geology and zoological knowledge. For many years, with Melchior Neumayr (1845–90) he conducted the *Beiträge zur Palæontologie und Geologie Oesterreich-Ungarns*; and he assisted in founding the Austrian and German Alpine Clubs. He died at Mallnitz on October 2, 1907.

William Morrant Baker (1839–1896)

Mr. William Morrant Baker, a prominent London surgeon of the pre-aseptic era, was born on October 20, 1839, at Andover, where he was educated at the Grammar School. He received his medical training first by serving as an apprentice to a local surgeon and later entered as a student at St. Bartholomew's Hospital, London. He obtained the qualification of M.R.C.S. in 1864, and became F.R.C.S. in 1867. Between the years 1862 and 1892 he obtained a number of appointments at his hospital, including those of demonstrator of anatomy, lecturer in physiology, surgeon to the skin department, casualty surgeon, assistant surgeon and full surgeon. He was also surgeon to the Evelina Hospital for Children, examiner for the Royal College of Surgeons and of the Universities of London and Durham, and associate editor of Kirke's "Handbook of Physiology". He retired from the staff of St. Bartholomew's Hospital in 1892. Under the term of "Baker's cysts" his name is attached to hernial protrusions of the synovial membrane of a joint through an aperture in its fibrous capsule. He also invented a flexible tube of red rubber for tracheotomy which is named after him.

Animals during War-time

The importance of safeguarding animal life under war conditions has been fully realized by the Government and a useful and effective scheme has been worked out. The Home Office has appointed a National Air Raids Precautions Animals Committee. In each district or danger zone, all the local veterinary surgeons and the animal clinics and depots of the local animal welfare societies are co-operating under regional organizers appointed by the Home Office. These regional organizers are usually qualified veterinary surgeons. The Government A.R.P. Handbook No. 12 dealing specially with animals has been widely circulated, and the People's Dispensary for Sick Animals purchased 100,000 copies for free distribution to people who cannot afford them.

In a circular just issued to its members, the Zoological Society of London directs attention to the "many grave problems" war conditions have brought to its collections, which include a serious drop in revenue. Drastic staff and general expenditure reductions have been made; the aquarium has been closed owing to the danger of air-raids breaking the glass tanks, and the reptile and tortoise houses are being closed to avoid the expense of heating them. A beginning has been made in the destruction of animals, and substitute foodstuffs not required for national needs are being used for the nucleus collection it is hoped to preserve. The North of England Zoological Society has so far withheld the destruction of its collection at Chester Zoo, and under an 'adoption' scheme has already had the cost of upkeep of many of its animals promised under weekly subscriptions, some for the duration of the war, from animal-lovers over a wide area. It has recently accepted a large donation of waterfowl and geese from Mr. S. P. B. Frame, and a foreign bird collection. It has used its educational value by admitting thousands of evacuees free. Dudley Zoo has offered most of its animals for sale.

National Rat Week

In view of the serious depredations on food stocks by rats, the Ministry of Agriculture and Fisheries considers that the annual Rat Week should be held this year notwithstanding the war. The Week will begin on November 6, and the Minister asks everyone to make a special effort during the week to destroy any rats on their own lands and premises and to take all possible steps towards securing concerted action against these vermin. The Rats and Mice (Destruction) Act, 1919, places an obligation upon every occupier of 'land', which term includes buildings on or under land, to take steps to destroy rats and mice on the property which he occupies and to prevent such property from becoming infested. The Ministry's Advisory Leaflet No. 49—"The Destruction of Rats and Mice" contains information and advice on methods for dealing with rats. A copy may be obtained free of charge from the Offices of the Ministry, 10 Whitehall Place, London, S.W.1. Further information on the subject of rats is contained in Bulletin No. 30, "Rats and How to Exterminate Them", copies of which are obtainable through any bookseller, or direct from H.M. Stationery Office, York House, Kingsway, London, W.C.2, price 6*d*. (7*d*. post paid).

First Aid Posts and Workers

A very useful "Memorandum for the Guidance of Medical Officers and other Personnel at First Aid Posts" has been issued by the Ministry of Health (H.M. Stationery Office. 3*d*. net). The functions and staffing of first aid posts, and the duties of first aid workers, are first dealt with, after which general directions are given for the use of dressings and treatment of injuries and burns. Injuries and their first aid treatment are then dealt with in detail of various regions of the body. Finally, some valuable hints are given for the treatment of patients who may be suffering from fright, fear or nervous shock. The appropriate opium dosage to be used for cleansing burns and scalds is given in an appendix.

Psychiatry in the Punjab

IN his chairman's address at the inaugural meeting of the Indian Division of the Royal Medico-Psychological Association (*J. Ment. Sci.*, 85, 381; 1939) Lieut.-Colonel C. J. Lodge Patch gives a striking account of the inhuman treatment of the insane in India which has persisted down to the present day. During the last hundred years, though there have been flashes of intelligence, interest and humanity in the 'forties, 'fifties and 'sixties associated with the names of Honigberger, Smith and De Renzy, there have been frequent returns to a state of almost primeval darkness. On his appointment as medical superintendent of the Punjab Mental Hospital in 1922, Colonel Patch found a deplorable state of affairs. Nearly all the male patients were allowed to go about stark naked, handcuffs and fetters were applied on little or no provocation, and the patients were living in a reign of terror. His first act was to collect two hundredweight of handcuffs and send them in a bullock cart to the central jail. His next was to dismiss a swarm of undesirable attendants, and then to remove the bolts and bars which gave the hospital the aspect of a prison. Within the last few months a new hospital has been built to Colonel Patch's designs on modern lines and not containing a single bar, grill or grating. Throughout the whole of India, abuses in the treatment of the insane still exist, as is shown by the fact that Colonel Patch has admitted to his hospital hundreds of patients with scars of beatings, blisterings, bleedings and other brutalities administered to drive out the devil supposed to have taken possession of the madman's mind. There is therefore much that can be done in India by spreading knowledge of the nature, prophylaxis and treatment of insanity.

Dust and Disease

IN his inaugural thesis (*Thèse de Paris*, No. 522; 1939), Dr. André Assémat remarks that the inhalation of dust is the cause of various lesions in the respiratory system, but that the gravity of the pulmonary involvement is mainly due to its effect on the general condition. He adopts Teleky's classification of the modes of action of dust in the following eight groups: (1) A microchemical action giving rise to characteristic lesions, especially in the case of silicosis and asbestosis. (2) An action which does not produce any changes in the lung until after intense and prolonged inhalation, as in the case of coal and non-siliceous mineral dust. (3) An action affecting the respiratory tract rather than the lung, as in the case of coarse wood dust, textiles and cereals. (4) A carcinogenic action caused by the dust of chromates, nickel and radioactive substances. (5) A sensitizing or allergic action. (6) A chemical action favouring the development of inflammatory processes. (7) An infective action when the dust is associated with micro-organisms and fungi, etc. (8) An intoxication of the system, as in the case of manganese. Apart from its own action, dust may be an aggravating factor in the course of lung disease. The tuberculosis problem is closely connected with that of pneumoconiosis, and especially silicosis, which always aggravates the prognosis. Occupational diseases due to dust represent an important cause of temporary or permanent incapacity for work and therefore have a bad effect on the general activity of a country. Before studying the means of repairing the damage done by certain forms of dust, it is important to secure the prevention of these diseases by the use of all the methods capable of protecting the worker, such as interception of the dust at its source, ventilation and the wearing of masks. The medical officer should play an important part in the engagement of workers and should reject any who suffer from pulmonary disease, especially tuberculosis, as well as those with a defective naso-pharynx. After enrolment, the workers should undergo periodical examination, and skiagrams should be taken and kept for future reference.

Destruction of Rabbits

IN days of war, our stock of wild rabbits has value as a food-supply, but the experience of the War of 1914–18 was that the absence of game-keepers and rabbit-trappers permitted an excessive increase; and their food value did not balance the damage to crops they did. Accordingly, in 1917 it was found necessary to legislate for the prevention of damage by rabbits, the emergency legislation being repealed in 1921. The experience of the last war is likely to be repeated in the present conflict, but now the situation is more favourable from the nation's point of view, since there has been on the statute book since July of this year a Prevention of Damage by Rabbits Act, which offers facilities for dealing with the rabbit pest. For the successful carrying out of the obligations of the Act, the Universities Federation for Animal Welfare has published a revised and enlarged edition of its "Instructions for Dealing with Rabbits". This 20-page pamphlet gives much information about rabbit-proof fencing, fumigation, long-netting, ferreting, shooting, catching with dazzle-light (an impracticable method under 'black-out' conditions), catching in enclosures, and it naturally omits reference to the less humane method of the steel-trap against which the Federation has waged constant warfare. The pamphlet is a handy and reliable guide to methods of keeping down rabbits, and its value is increased by the inclusion of the text and a brief explanation of the provisions of the new Act. Single copies of the pamphlet may be had free on enclosing a stamped and addressed quarto envelope to UFAW, Gordon House, 29 Gordon Square, London, W.C.1, or larger quantities will be supplied at cost price (3*d*. each).

Tuberculosis in Cyprus

THE final report on investigations on tuberculosis in Cyprus, conducted by Dr. N. D. Bardswell for the National Association for the Prevention of Tuberculosis, has been issued (*Tubercle*, 20, 97, 165; 1939). An intensive study of the disease in the Larnaca district indicates that actually the incidence of pulmonary tuberculosis is low, 140 cases in a population of 42,000, with an average death-rate of 0·69 per 1,000 population. There is little non-pulmonary, and no bovine, tuberculosis, and the disease in distribution is sporadic and largely familial. These figures fall far short of estimates by the Cyprus authorities prior to the National Association's mission. The Cypriot has a high resistance to the disease, which appears to be transmitted to an unusual degree from one individual to another. This is dependent upon the national habits; families almost invariably live and sleep in one room, and, in winter, houses are always completely closed at night. The standard of living of the people is low and poverty almost universal, though the nutrition of the people appears to be adequate. Tuberculosis in the Larnaca district and in Cyprus generally, though low in incidence and benign in type, is difficult to control owing to the general conditions existing in the island. The most effective measures would be the establishment of dispensaries in various parts of the island, and of a small sanatorium for education and treatment of the more favourable cases. A comprehensive tuberculosis scheme on these lines is in process of organization.

The Government Laboratory

REPORTING on the work of the Government Laboratory for the year ending March 31, 1939, the Government Chemist, Dr. J. J. Fox, surveys the scientific work which is carried on at the laboratory in Clement's Inn Passage, at the Custom House, London, at the chemical stations at certain seaports, at the Geological Survey Museum, at the Office of Works Stores, and at the War Office Supply Reserve Depot, Deptford. Substantially more than half a million examples were dealt with, although the number was about seven thousand less than in the preceding year. As is well known, these samples are drawn from an extremely wide range of products; foodstuffs and medicinal substances are tested for purity and for conformity with specification, beverages, oils, etc., are assessed for duty, metals, coal, rubber, cement and many other materials purchased by Government Departments are submitted to examination, and expert assistance is rendered in the detection of fraud. In addition, the Government Laboratory makes a very substantial direct addition to chemical science as a result of the many investigations which its normal work necessitates, of its participation in international oceanic research, of the pure research work which is constantly in hand, and of the personal contributions of members of the staff to the deliberations of various councils and committees which deal with scientific and industrial problems.

Farm Electrification

THE recent trends in research and development which characterize farming to-day are discussed in an article contributed to the *Electrical Review* of September 15 by A. G. H. Dent. The types of farming in Great Britain are now very varied; there are few large fields of wheat and barley; but the average farm produces dairy produce, poultry, market gardening and livestock and a certain amount of grain for consumption by the livestock. The electrical authorities giving a supply to some areas have little difficulty in showing farmers that they can get an economic return by using electricity, but in other areas the problem is a difficult one. The cost of giving facilities to a farm at some distance from the supply may be high, and there may be little evidence of an annual return which would justify the authorities in giving these facilities. Notwithstanding drawbacks, the development of rural electrical supply in Great Britain has reached a position comparable with that in any other country. We are glad that the British Electrical and Allied Industries Research Association is now examining the standardization problem of supply to isolated farms and is putting into action schemes of experiment and research applied to various farm processes. These schemes cover both agricultural and horticultural experimental work. The plans of research are both technical and economic in character. They aim at establishing the best and most practical technique of doing a farming operation, the most suitable apparatus for the job and the proper method of application. On the economic side, the aim is to find the exact cost of the electrical method in comparison with other methods and to find out what modifications of practice are desirable to obtain the maximum efficiency from the electrical method.

Science and Fruit Growing

RECENT issues of the *American Fruit Grower* contain several brief announcements of successful applications of science to the fruit-growing industry. The issue for May describes the use of solidified carbon dioxide in addition to the usual wet ice for the cooling of strawberries during transit from Louisiana to New York. The new method saves 25–40 per cent in refrigeration costs, and has the additional advantage that the gas resulting from evaporation enhances the keeping quality of the fruit. Prof. M. A. Blake of the New Jersey Experiment Station shows, in the same issue, that stout vegetative growth of the apple shoot is more to be desired for fruit bud production than long slender shoots. The formation of such buds depends upon the presence in the wood of more starch and sugars than are utilized in growth and respiration. This excess cannot be stored while succulent or rapid growth continues, but only after growth in length is arrested. R. J. Cohen, in another direction, has used the oil from grapefruit seeds as a mordant in textile dyeing, whilst Dr. W. M. Neal has tested the residue from such seeds as a possible food for livestock. The

July number contains a brief account of the investigations of Dr. E. N. Cory of Maryland into the insect pests of chestnut, hazel nut and walnut trees. A new departure in control practice lies in the use of synthetic cryolite and barium fluosilicate, applied as a spray or dust against the walnut husk maggot. A fascinating study of codling moth damage has been made by John A. Callenbach of Wisconsin University. He found that such injury was greatest near dusty roads. Dust upon the fruit prevented the proper covering of spray fluids, and it has been shown that roads can be rendered dustless by the use of calcium chloride spread upon the surface.

Check-Lists of Forest Trees in Ceylon

THE Imperial Forestry Institute at Oxford has been issuing a series of check-lists of the forest trees and shrubs of the British Empire, under the editorship of Dr. J. Burtt Davy and Mr. A. C. Hoyle. The fourth of the series is entitled "Draft of First Description Check-List for Ceylon". These monographs are chiefly designed for the use of forest officers. So far, although there has been a forestry department in Ceylon for more than half a century, all the forest officer has had to consult is Trimen's "Handbook of the Flora of Ceylon", consisting of six large tomes, published some thirty-five years ago, with a supplement by Alston issued in 1931. The Check-List in question has been compiled from published records and herbarium material. Some 832 species of trees and shrubs are included. In addition, a list of exotic conifers introduced into Ceylon, comprising twenty-five species (genera, Callitris, Cupressus, Juniperus, Widdringtonia, Abies, Picea, Pinus, Pseudotsuga, Sequoia, Taxodium, Tsuga), is included in an appendix. There is also an indispensable list of vernacular names.

Science Progress

THE editors and publishers (Messrs. Edward Arnold and Co.) of *Science Progress*, founded by Sir Ronald Ross in 1907, announce with regret that the October number will be the last to appear for the present. The purpose of this well-known quarterly review is to record recent advances in pure science and to publish articles by those who have played a leading part in such work; as research of this kind is bound to be seriously diminished in war-time, it has been reluctantly decided to suspend publication until conditions are more favourable.

The Faraday Society

THE Faraday Society will continue its normal activities so far as possible during the war. Roughly 60 per cent of the members are normally resident in the United Kingdom, and 40 per cent overseas, including 8 per cent resident in German territories. The Society's services to its members consist mainly in the regular publication of the *Transactions* and in the provision twice yearly of meetings of such importance that it is worth while coming from all parts of the world to attend. This latter activity must obviously be suspended for the time being, but it may be possible to organize 'general discussion' in writing, and to publish the final record. The papers which were to have been discussed in Cambridge during September 25–27 will be published early in 1940, and it can then be seen whether a written 'discussion' is practicable and useful. The *Transactions* will appear regularly every month and the policy of publishing all papers as soon as they have been refereed and accepted will be continued. It is hoped, moreover, that the flow of papers from overseas will continue to increase. It should be emphasized that, though the *Transactions* are printed in English, the Society will, if desired, bear the cost of translating any accepted paper which may be written in another language. The usual arrangements for exchange of membership with the Electrochemical Society, the Nederlandsche Chemische Vereeniging and the Société de Chimie Physique will be continued for 1940.

Institution of Electrical Engineers

IT has been decided by the Council that as many as possible of the activities of the Institution of Electrical Engineers should be carried on during the period of the war in the same way as hitherto, and that the library and headquarters of the Institution should remain for the time being in the present building at Savoy Place, W.C.2. All meetings that were to have been held in London for the reading and discussion of papers have been cancelled. Most of the local centres have also suspended their programmes. As an alternative to meetings, a complete list of the papers that were to have been read will be issued to members at the end of October, and advance copies can be obtained on application to the Secretary. Copies of the presidential address, which was to have been delivered by Mr. Johnstone Wright at the opening meeting in London on October 26, will be circulated. As already announced, the associate membership examination arranged for November next will take place, and it is hoped that it will be found practicable to continue to hold this examination at the usual intervals in future.

The Linnean Society

THE Linnean Society of London has decided to carry on its functions at Burlington House, London, during the war, so far as is possible. The rooms of the Society will be open from 10 a.m. until half an hour before sunset. Three meetings have been arranged to be held before Christmas, on October 26, November 9 and 23, beginning at 2.30 p.m. The Council of the Society is particularly anxious that the rooms of the Society shall be maintained as a central meeting place for biologists for the purpose of both formal and informal discussions.

British Psychological Society

THE work of the British Psychological Society is being carried on at 20 West Avenue, Hendon, London, N.W.4, where correspondence and inquiries should at present be sent. Meetings of the Society have been suspended, but it is hoped to hold the annual general meeting on December 9, at 2 p.m.

Imperial College of Science and Technology

The following Departments of the Imperial College of Science and Technology will reopen on October 17 for the categories of students mentioned: Engineering, Mathematics, Physics (second and third years and postgraduates); Chemical Engineering, Geology and Oil Technology (third and fourth years and postgraduates); Mining, Mining Geology and Oil Technology (second year). In addition, the Chemistry Department will open on October 24 for second and third year and postgraduate students, and it is hoped that the postgraduate course in aeronautics may be reopened at an early date. The third and fourth year mining and mining geology students are at Camborne, and the third and fourth year metallurgy students at Swansea. Such students of biology as can be accommodated will assemble at the College Biological Field Station at Slough. It has not been found possible to continue the first year work leading to the Intermediate B.Sc. and B.Sc.(Eng.).

Colonial Service: Recent Appointments

The following appointments and promotions have recently been made in the Colonial Service: P. A. Gething, agricultural officer, Nigeria; R. Smith, superintendent of agriculture, Gold Coast; W. S. Biggar, veterinary officer, Northern Rhodesia; J. B. Randall, veterinary officer, Uganda; J. I. Taylor, veterinary officer, Northern Rhodesia; D. G. White, veterinary officer, Tanganyika Territory; W. L. Ricketts, personal assistant to the Director of Agriculture and Fisheries, Palestine; G. Griffith, (Chemist, Agricultural Department, Uganda), chemist (soils), Agricultural Department, Straits Settlements and Federated Malay States; U. J. Moffat (agricultural officer), senior agricultural officer, Northern Rhodesia; T. G. Strangeways (superintendent of agriculture, Gold Coast), agricultural officer, Northern Rhodesia; C. B. Bisset (field geologist), senior geologist, Uganda; A. E. P. Kershaw (senior inspector of mines), chief inspector of mines, Federated Malay States; E. B. Thomas (inspector of mines, Nigeria), inspector of mines, Federated Malay States; R. H. C. Higgins (veterinary officer), senior veterinary officer, Tanganyika Territory; W. Allan (entomologist), assistant director and entomologist, Agricultural Department, Northern Rhodesia; W. A. Macky (formerly meteorological officer, Malaya), meteorologist, Bermuda.

Announcements

Lord Stamp, chairman of the London Midland and Scottish Railway, and president in 1936 of the British Association, has been appointed adviser on economic co-ordination to a committee of Ministers, under the chairmanship of the Chancellor of the Exchequer, dealing with the co-ordination of departments in relation to economic and financial policy.

Sir Frank Smith, formerly secretary of the Department of Scientific and Industrial Research, has been appointed director, and Mr. R. S. Whipple, chairman of the board of directors of the Cambridge Instrument Company, Ltd., deputy director, of production of scientific instruments, Ministry of Supply.

Sir Joseph Barcroft, Sir Harold B. Hartley and Sir Frank E. Smith have been appointed members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. The Right Hon. Lord Cadman and Sir James Jeans have retired from the Council on completion of their terms of office.

On account of prevailing war conditions, the Council of the Zoological Society of London has decided for the present to discontinue the fortnightly scientific meetings.

Dr. Joseph Rigney D'Aunoy, dean and professor of pathology, Louisiana State University Medical Centre, New Orleans, has been decorated with the Order of Commendatore of the Crown of Italy in recognition of his achievements in the fields of medical research and education.

On the recent occasion of the celebration of the Mikado's birthday the Empress of Japan gave half a million yen for the foundation of a campaign against tuberculosis.

The following awards of the North-East Coast Institution of Engineers and Shipbuilders have recently been made: Institution Shipbuilding and Engineering Gold Medals to Dr. T. W. F. Brown, of Messrs. R. and W. Hawthorn, Leslie and Co., Ltd., for a paper entitled "Vibration Problems from the Marine Engineering Point of View" (Engineering Medal); Mr. Arnold Emerson, of the William Froude Laboratory, National Physical Laboratory, for a paper entitled "Special Trials of the *Beacon Grange*: the Effect of Steering on Propulsion" (Shipbuilding Medal); M. C. James Memorial Medal to Dr. S. F. Dorey, chief engineer surveyor of Lloyd's Register of Shipping, for a paper entitled, "Strength of Marine Engine Shafting"; R. L. Weighton Memorial Medal to Johan Boele, student at King's College, Newcastle-upon-Tyne; Institution Scholarship for 1939 (value £100) to William Taylor Atkinson, apprentice of Messrs. Richardsons, Westgarth and Co., Ltd., Hartlepool; George Mitchell Harroway Scholarship for 1939 (value £100), to James Dawson, apprentice of Messrs. Smith's Dock Co., Ltd., South Bank on Tees.

Erratum. In Nature, October 7, p. 635, col. 2, second line of legend to the graph, for "1 mol. of $0 \cdot 1$ *M* sugar or ester solution" read "1 ml. of $0 \cdot 1$ *M* sugar or ester solution".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 674.

Correspondents are invited to attach similar summaries to their communications.

Evaporation of Built-up Molecular Films

Evaporation of built-up molecular films opens up a promising field of research, and we have applied it successfully in the following cases:

(1) *Determination of condensation coefficients.* The accurately known area[1], and state of molecular orientation[2] of the surface are of great advantage, whilst the evaporation may be readily followed by watching the change in colour. So far we have carried out determinations with films of stearic and arachidic acids deposited on stainless steel slides in the usual manner from a trough adjusted to *p*H 3 by means of acetic acid (no metallic ions present). The films are submitted to high vacuum in a glass tube 'oven' maintained at the required temperature, closed at one end and terminating at the other in an orifice opening into a space immediately connected to the pump, and with a surface cooled by solid carbon dioxide about 5 mm. distant from the orifice. Two films composed of the same number of layers, with areas S_1 and S_2, are evaporated together in ovens with *different* orifice areas A_1 and A_2 respectively. The times t_1 and t_2 required for the complete evaporation of the two films are observed.

Let ν be number of molecules evaporating from a slide per cm.² per sec. into high vacuum ('ideal evaporation'); N be number of molecules per cm.² forming a complete monolayer; $\mu = \frac{N_0}{\sqrt{2\pi MRT}}$ where N_0 is Avogadro's Number, M is the molecular weight and R and T have their usual meanings; α is the condensation coefficient, that is, the fraction of the molecules impinging on the film from the vapour phase which condense; n_1 and n_2 are the number of layers disappearing per sec.; and p_1 and p_2 are the vapour pressures of fatty acid in the ovens.

Now the first film evaporates at a rate $S_1\nu$ but receives molecules by condensation at a rate $S_1\alpha\mu p_1$, so that the net rate of evaporation is $S_1(\nu - \alpha\mu p_1)$ molecules per sec. This rate is also measured by the reduction in the thickness of the film, and is $S_1 n_1 N$ molecules per sec. When a steady state is reached, the number of molecules evaporating per sec. from the film is equal to the number escaping through the orifice in the same time, that is, $\mu A_1 p_1$. Thus

$$S_1(\nu - \alpha\mu p_1) = S_1 n_1 N = \mu A_1 p_1;$$

and similarly

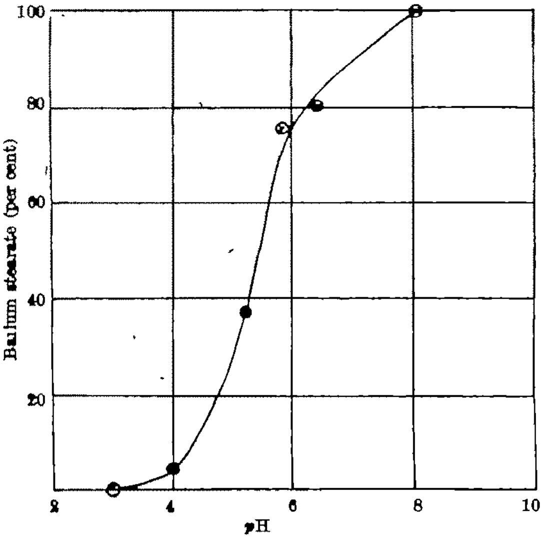
$$S_2(\nu - \alpha\mu p_2) = S_2 n_2 N = \mu A_2 p_2.$$

$$\text{Hence}\quad \alpha = \frac{n_1 - n_2}{S_2 n_2/A_2 - S_1 n_1/A_1};$$

$$= \frac{1/t_1 - 1/t_2}{S_2/A_2 t_2 - S_1/A_1 t_1}.$$

Thus α can be obtained without a determination of the saturated vapour pressure—an advantage since this is of the order of 10^{-5} mm.

Preliminary results show that the values of α for stearic and arachidic acids are both equal to 0·01 ± 0·004. This figure is small, but not improbably so. Alty and Mackay[3,4] obtained 0·17 for camphor and 0·036 for water. Moreover, the most significant factor in producing low α-values is probably the steric or orientation effect (Volmer[5]), and this is certainly of particular importance in the case of fatty acids, consisting as they do of a polar head which must fit into a predetermined place in the lattice, and a very long chain.



It is hoped to extend these measurements to other fatty acids and also to other suitable volatile substances. It should then be possible to throw further light on the correlation between α-values and molecular structure, already tentatively discussed by some authors (Alty[6], Volmer[5]).

(2) *Determination of the free acid content of built-up soap films.* The mixed film is subjected to high vacuum in the oven described above, when the free acid vaporizes and the neutral soap remains. The colour of the film changes owing to the fall in refractive index, and from the values of the initial and final apparent thicknesses, measured by comparison with a standard-step-gauge, the proportions of neutral soap and free fatty acid in the original film can be calculated. Results for barium stearate deposited on stainless steel slides from troughs containing 2×10^{-4} *M* sodium bicarbonate, 6×10^{-5} *M* barium chloride, and adjusted to the required *p*H by the addition of ammonium hydroxide or acetic acid, are given in the accompanying graph. Our values differ somewhat from those obtained by Langmuir and Schaefer[7] for the composition of barium soap films on the *trough* surface—that is, before deposition—

being in fact closer to their values for calcium soaps. The difference may be due to the adsorption of Na+ ions; this was suggested by Langmuir and Schaefer to account for the difference between their own values for barium and calcium respectively. Measurements are in progress for 'soaps' composed of various other metallic and higher fatty acid ions.

Built-up films of volatile substances should also prove useful in molecular ray technique: the rate of effusion can be observed directly by matching the change in colour of the film within the transparent oven as already described.

S. J. Gregg.
E. E. Widdowson.

University College,
Hull.
August 29.

---

[1] Bikerman, *Proc. Roy. Soc.*, A, 170, 130 (1939).

[2] Clark, Sterrett and Leppla, *J. Amer. Chem. Soc.*, 57, 330 (1935).

[3] Alty and Mackay, *Proc. Roy. Soc.*, A, 149, 104 (1935).

[4] Alty, *Proc. Roy. Soc.*, A, 161, 68 (1937).

[5] Volmer, "Kinetik der Phasenbildung", 29 (1939).

[6] Langmuir and Schaefer, *J. Amer. Chem. Soc.*, 58, 285 (1936).

Large Anisotropy of the Electrical Conductivity of Graphite

Graphite is a hexagonal crystal with a perfect basal cleavage. The carbon atoms in it are arranged in layers parallel to the basal plane, the atoms in each layer forming a regular hexagonal net-work[1]. The distance between adjacent layers is 3·4 A., which is much larger than the distance between adjacent atoms in the same layer, namely, 1·42 A. The crystal exhibits some remarkable magnetic properties. Whereas its susceptibility along directions in the basal plane is about $-0·5 \times 10^{-6}$ per gm., which is nearly that of diamond, the susceptibility along the normal to the plane is more than forty times greater, being equal to -22×10^{-6} per gm. at room temperature[2]. The abnormal diamagnetism along the latter direction shows a striking temperature dependence[2], and is structure-sensitive[3].

Associated with the abnormal diamagnetism along the normal to the basal plane, we should naturally expect a much larger electrical conductivity in the basal plane than along the normal to the plane. On examining the available literature, we find that conductivity measurements on single crystals of graphite have been made along directions in the basal plane only[4]. We have therefore made measurements both along these directions and along the normal to the basal plane, using some well-developed single crystals from Ceylon. We find that the conductivity in the basal plane is at least *ten thousand* times larger than that along the normal to the plane. Whereas the specific resistance in the basal plane is of the order of 10^{-4} ohm-cm., the specific resistance along the normal to the plane is 2–3 ohm-cm.

K. S. Krishnan.
N. Ganguli.

Indian Association for the
Cultivation of Science,
Calcutta.
Sept. 1.

---

[1] Bernal, *Proc. Roy. Soc.*, A, 106, 749 (1924).

[2] Krishnan, Nature, 133, 174 (1934); Ganguli, *Phil. Mag.*, 21, 355 (1936).

[3] Krishnan and Ganguli, Nature, 139, 155 (1937); *Z. Krist.*, A, 100, 530 (1939).

[4] Koenigsberger and Weiss, *Ann. Phys.*, 35, 1 (1911); Roberts, *Ann. Phys.*, 40, 453 (1913); Ryschkewitsch, *Z. Elektrochem.*, 29, 474 (1923).

Life-time of the Mesotron

In a recent note[1], Prof. P. M. S. Blackett seeks to link quantitatively the observed life-time of the mesotron to other constants of Nature. I should like to propose what seems to me a simple and direct deduction of this quantity by relating it to the theory of the nature of the mesotron which I recently advanced[2].

This theory suggests that a heavy electron may be thought of as a quasi-stable state of an ordinary electron moving at a speed such as to enable it to fulfil a simple resonance condition with an atomic nucleus near which it chances to pass. Thus the 'birth' of a mesotron is connected with the approach of a moving electron to within a distance a of a nucleus, where $a \approx e^2/m_0c^2$ represents the range of nuclear forces.

It is natural to assume that, in addition, the annihilation of such a particle may be conditioned by close approach to a nucleus. The mean free path of a very fast electron moving among the nuclei of gas atoms is given by an expression of the form

$$l = \frac{1}{\pi n a^2}, \qquad (1)$$

where n is the number of atoms per unit volume and a has the value given above. Then the life-time of a mesotron moving with essentially the velocity of light will be

$$\tau_0 = \frac{l}{c} = \frac{m_0^2 c^3}{\pi n e^4}. \qquad (2)$$

Substitution of numerical values, using for n the number of atoms per unit volume in air, leads to $\tau_0 = 2·48 \times 10^{-6}$ sec., in remarkable agreement with the experimental value of about $2·5 \times 10^{-6}$ sec.

Speculations as to the fate of the excess energy (mass) of the mesotron upon its annihilation must be reserved until more extensive experimental information is available.

Ira M. Freeman.

Central College,
Chicago.
Sept. 2.

---

[1] Nature, 144, 30 (1939).

[2] *Phys. Rev.*, 53, 606 (1938).

Dipole Moment and Alkyl Chain Length

Baker and Groves[1] have recently determined accurate values for the dipole moments of toluene, ethyl benzene, isopropyl benzene, and tertiary butyl benzene, by the gas temperature method.

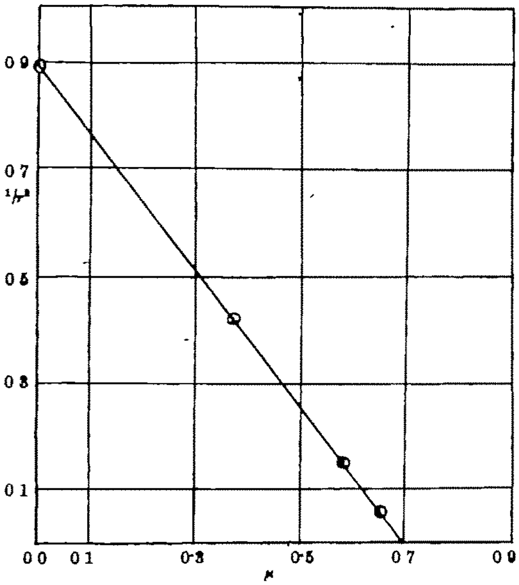
Baker has also pointed out[2] that the observed sequence of dipole moments is represented by a graph of exponential form (μ being plotted as ordinates against arbitrary equal abscissa increments).

Werner[3] has expressed the moments of a homologous series $C_nH_{2n+1}CN$ by means of an exponential series, but no relation exists between dipole moment and side-chain length as a homologous aromatic series is ascended. It is now found that if μ is plotted against $1/r^2$, where r is the distance between the carbon of the ring and the terminal carbon atom (H in the case of benzene) for C_6H_6, $C_6H_5CH_3$ and $C_6H_5.C_2H_5$, a straight line results:

	r_r(A.)	$1/r^2$	$\mu(D)$
C_6H_6	1·06	0·890	0·00
$C_6H_5CH_3$	1·54	0·422	0·37
$C_6H_5C_2H_5$	2·53	0·156	0·58
$C_6H_5C_3H_7$	3·95	0·064	0·65

Limiting value, $\mu = 0·69\ D$.

Extrapolation of this line (see diagram) predicts a limiting value for the dipole moments of the series of 0·69, in good agreement with 0·70 *D* found by Baker and Groves (*loc. cit.*) for tertiary butyl benzene. Assuming also that μ for *n*-propyl benzene is reasonably the same as that found for iso-propyl benzene,



and calculating the root mean square value for r using Eyring's formula[4], $\overline{r^2} = c_1^2 \{n + 2(n-1)\cos\theta + 2(n-2)\cos^2\theta \ldots\ldots + 2\cos^{n-1}\theta\}$, where c_1 is the distance between consecutive carbon atoms and $\theta = 71°$, the figure shows that conformity to the relation results.

H. O. JENKINS.

35 Grand Avenue,
Ely, Cardiff.
August 29.

---

[1] Baker and Groves, *J. Chem. Soc.*, 1144 (1939).

[2] Baker, *J. Chem. Soc.*, 1150 (1939).

[3] Werner, *Z. phys. Chem.*, B, 4, 371 (1929).

[4] *Phys. Rev.*, (2) 39, 746 (1932).

Removal of Fluorine from Potable Waters

FLUORINE as the etiological factor in the production of a destructive hypoplasia of human dentition, known as mottled enamel, was established beyond doubt by Smith *et al.* This resulted in a universal recognition of fluorine toxicosis as a public health problem. Numerous methods whereby the soluble fluorine fraction of natural waters can be reduced to a safe level are encountered in the literature. The majority of these methods, however, are costly and impracticable. Several workers reported the value of tri-calcium phosphate as a defluorinizing agent. The solute fluorides are either absorbed or thrown out of solution as the fluoapatite. However, the use of various types of tricalcium phosphate in filter beds in conjunction with waters of high salt content results in a rapid impregnation and inactivation of the active principle. The result is that a continual check on the fluorine content of the effluent water is imperative.

I have observed that in the determination of the titratable acidity of aqueous solutions of superphosphate, the soluble fluorine fraction suffers a reduction. MacIntire and Hammond stressed the possibility of exploiting commercial superphosphates as a source of calcium phosphate to effect the removal of fluorides from natural waters. This method will, however, result in a marked increase in the fluorine content of the water before treatment and a very high subsequent sulphate content of the treated water.

It has been shown in this laboratory that there is a marked reduction in the solubility of both the sulphate and fluoride compounds present in superphosphate at very high aqueous concentrations.

By simply introducing a small volume of the highly concentrated solution into a fluoride-contaminated water and precipitating tricalcium phosphate in a flocculent state in the medium by the addition of lime, the resultant treated water will contain a mere fraction of one part per million of fluorine while the sulphate in solution amounts to a trace. In practice this method of removing fluorine is inexpensive and simple, and gives reliable results.

P. K. VAN DER MERWE.

Onderstepoort,
South Africa.
Aug. 24.

Myosine and Adenosinetriphosphatase

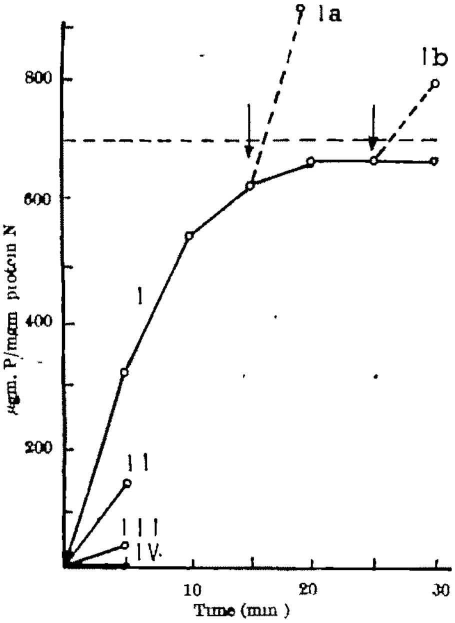
ORDINARY aqueous or potassium chloride extracts of muscle exhibit but a slight capacity to mineralize adenosinetriphosphate. Even this slight liberation of phosphate is mainly due, not to direct hydrolysis of adenosinetriphosphate, but to a process of secondary, indirect mineralization, accompanying the transfer of phosphate from the adenylic system to creatine, the corresponding enzymes (for which the name 'phosphopherases' is suggested) being readily soluble.

In contrast to this lack of adenosinetriphosphatase in the soluble fraction, a high adenosinetriphosphatase activity is associated with the water-insoluble proteins of muscle. This enzymatic activity is easily brought into solution by all the buffer and concentrated salt solutions usually employed for the extraction of myosine. On precipitation of myosine from such extracts, the adenosinetriphosphatase activity is always found in the myosine fraction, whichever mode of precipitation be used: dialysis, dilution, cautious acidification, salting out. On repeated reprecipitations of myosine, the activity per mgm. nitrogen attains a fairly constant level, unless denaturation of myosine takes place. Under the conditions of our experiments (optimal conditions have not been determined) the activity of myosine preparations ranged in different experiments from 350 to 600 microgram phosphorus liberated per mgm. nitrogen in 5 min. at 37°. Expressed as

$$Q_P \left(= \frac{\mu\text{gm. P}/31 \times 22{\cdot}4}{\text{mgm. N} \times 6{\cdot}25 \times \text{hour}} \right),$$

this gives values of 500–850.

Acidification to *p*H below 4, which is known to bring about the denaturation of myosine[1], rapidly destroys the adenosinetriphosphatase activity. Most remarkable is the extreme thermolability of the adenosinetriphosphatase of muscle: the enzymatic activity shown by myosine solutions is completely lost after 10 min. exposure to 37°. This corresponds with the well-known thermolability of myosine[2]. In respect of its high thermolability adenosinetriphosphatase resembles the protein of the yellow enzyme, which when separated from its prosthetic group is also rapidly inactivated at 38° (Theorell[3]). Evidently in the intact tissue of the warm-blooded animal (all experiments were performed on rabbit muscles), some conditions must exist which stabilize the myosine against the action of temperature. A marked stabilizing effect on the adenosinetriphosphatase activity seems to be produced by the adenylic nucleotide itself. As can be seen from the accompanying graph, in the presence of adenosinetriphosphate the liberation of phosphate proceeds at 37° over a considerable period (Curves I, I*a* and I*b*), whereas the same myosine solution warmed alone to 37° for 10–15 min. shows on subsequent addition of adenosinetriphosphate an insignificant or no mineralization whatever.



Crude buffer extracts accomplish a quantitative hydrolysis of the labile phosphate groups of adenosinetriphosphate; myosine, reprecipitated three times, liberates but 50 per cent of the theoretical amount of phosphorus (see figure). It acts as true adenosine-*tri*-phosphatase and yields adenosinediphosphate, which is not further dephosphorylated and has been isolated in substance. This may serve as a convenient way of preparing adenosinediphosphate, instead of using crayfish muscle[4]. The adenosinediphosphatase is thus associated with the more soluble proteins, occupying an intermediate position between adenosinetriphosphatase and the most readily soluble phosphopherases.

Under no conditions tested could we obtain a separation of adenosinetriphosphatase from myosine. Either the activity was found in the myosine precipitate or else it was absent from the precipitates and from the remaining solution. This disappearance of the enzymatic activity we regard as the result of the start of denaturation of the very unstable myosine.

We are led to conclude that the adenosinetriphosphatase activity is to be ascribed to myosine or, at least, to a protein very closely related to and at present not distinguishable from myosine. Thus the mineralization of adenosinetriphosphate, often regarded as the primary exothermic reaction in muscle contraction, proceeds under the influence and with the direct participation of the protein considered to form the main basis of the contractile mechanism of the muscle fibre.

W. A. Engelhardt.
M. N. Ljubimowa.

Institute of Biochemistry,
Academy of Sciences of the U.S.S.R.,
Moscow.
August 7.

---

[1] v. Muralt, A., and Edsall, J. T., *J. Biol. Chem.*, **89**, 351 (1930)
[2] Bate Smith, E. C., *Proc. Roy. Soc.*, B, **124**, 136 (1937).
[3] Theorell, H., *Biochem. Z.*, **272**, 155 (1934); **278**, 263 (1935)
[4] Lohmann, K., *Biochem. Z.*, **282**, 109 (1935).

Trans-amination of *l*- and *d*-Amino Acids in Normal Muscle and in Malignant Tumours

As stated in a previous paper[1], glutamic aminopherase from muscle tissue is absolutely specific for amino acids of the *l*-series. Slight trans-amination effects with the artificial *d*-amino acids (optically pure) in the presence of native muscle pulp, then considered as requiring additional proof, have since been observed almost regularly in some twenty-five experiments with *d*-glutamic acid and pyruvate or with *d*-alanine, *d*-valine, *d*-leucine and *d*-isoleucine and α-ketoglutarate. The mean ratio of the trans-amination values of the optical antipodes (*l*/*d*), computed from the experiments with glutamic acid and with alanine, amounts to 7·3 (Table 1)

Table 1

Enzyme preparation	Number of expts.	Average values of transamination, % of total added amino-nitrogen		Ratio *l*/*d*
		With *l*-amino acids	With *d*-amino acids	
Muscle pulp	13	37 8	5·2	7·3
Glutamic aminopherase	7	38 1	0	∞

The study of the rates at which *l*- and *d*-amino acids are trans-aminated in the presence of malignant tissues has acquired exceptional importance in the light of the remarkable results obtained by F. Kogl and H. Erxleben[2] indicating that tumour proteins contain appreciable amounts of *d*-amino acids, and large amounts of *d*-glutamic acid in particular. A few incidental experiments bearing upon this question, reported by Euler and associates[3], are essentially qualitative and allow of no definite conclusion.

We have carried out an extensive series of experiments on the trans-amination of *d*- and *l*-amino acids in the presence of minced tissue from various experimental malignant tumours In Table 2 a summary is given of *all* our experimental results (in view of the considerable degree of variation, depending upon the very heterogeneous kind of material).

It is seen that malignant tumours completely failed to effect trans-amination in some instances, as we have found before[4]; in all other cases, the rates of amino-nitrogen transfer were markedly inferior to those observed with normal tissues (usually less than 15 per cent in 2 hours). But only the extent of trans-amination of the *l*-amino acids is lowered, while the conversion of the *d*-forms appears to proceed at the same low rate as in muscle tissue, and sometimes more rapidly (in some instances the *d*-form is not attacked at all, in other cases the *l*-form alone fails to react). On the average, there results for malignant tumours a ***relative shift*** of the configurational selectivity of glutamic aminopherase in favour of the *d*-enantiomers, owing chiefly to the lowered intensity of *l*-amino acid trans-amination. The mean ratio of trans-amination values (*l*/*d*) amounts to 1·11. The experiments are being continued.

Table 2.

Trans-amination in minced tumour tissue, 2 hours at 37°.

Type of tumour	Amino-nitrogen donator	Trans-amination values, % of total added amino-nitrogen	
		With the *l*-form	With the *d*-form
Brown-Pearce carcinoma (rabbit)	Glutamic acid	1·9	0
" " "	" "	0	0
" " "	" "	8·1	4 0
" " "	" "	2 0	0
" " "	" "	0	2 8
" " "	" "	10·8	3·4
" " "	" "	0	0
Jensen sarcoma (rat)	" "	0	7·4
" " "	" "	13 6	15·0
" " "	" "	0	14·0
Smelnikov-Krichevsky sarcoma (rat)	" "	6·2	0
Rous sarcoma (fowl)	" "	0	0
" " "	" "	3·4	9·2
" " "	" "	1·5	4·0
" " "	" "	0	0
Fischer sarcoma (fowl)	" "	20 0	0
Brown-Pearce carcinoma	Alanine	16·2	21 6
" "	Valine	16 2	8·9
" "	Leucine	20·0	12·0
Jensen sarcoma	Alanine	5·4	0
" "	"	4·1	1·2
Fischer sarcoma	"	2·1	14·0

Average with *l*-form, 6 0; with *d*-form, 5·4. Ratio *l*/*d* = 1·11

There is a certain conformity between our findings and the data of Kögl and Erxleben on partial protein racemization in tumours. But if the weak trans-amination capacity of the tumours and the relative nature of the shift in optical specificity is considered, it seems unlikely that this shift should be of fundamental significance for the genesis of the stereochemical abnormality of tumour proteins.

A. E. Braunstein.
R. M. Azarkh.

Dept. of Physiological Chemistry,
The A. M. Gorky Institute of
Experimental Medicine,
Moscow.
Aug. 12.

---

[1] Braunstein, A. E., Nature, 143, 609 (1939).

[2] Kögl, F., and Erxleben, H., *Z. physiol. Chem.*, 258, 57 (1939).

[3] Euler, H., *et al.*, *Z. physiol. Chem.*, 259, 201 (1939).

[4] Braunstein, A., and Kritzmann, M., *Enzymologia*, 2, 144 (1937).

Reduction of the *d*-Amino-Acid Oxidase Content of Rat Tissues in Riboflavin Deficiency

It has been demonstrated that a riboflavin deficiency in the rat produces a marked derangement in those enzyme systems which are involved in the oxidation of certain intermediates of carbohydrate metabolism (Axelrod and Elvehjem, unpublished results). The possible effects of such a deficiency upon the metabolism of amino-acids have been suggested by the discovery of Warburg and Christian[1] that the prosthetic group of the *d*-amino-acid oxidase of Krebs[2] is a flavin-adenine dinucleotide.

Rats were depleted for six weeks on the *K*-12 ration described by Elvehjem, Koehn and Oleson[3]. At the end of this period, the feeding of the various supplements was begun and the rats grouped in the following manner: (1) *K*-12 basal; (2) *K*-12 plus factor *W* concentrate; (3) *K*-12 plus synthetic riboflavin; (4) *K*-12 plus riboflavin plus factor *W* concentrate fed *ad lib.*; (5) *K*-12 plus riboflavin plus factor *W* concentrate, food intake restricted to that of rats receiving only *K*-12.

The rats were fed supplements for two weeks previous to sacrifice. Twenty micrograms of riboflavin and 0·4 ml. of a factor *W* concentrate (equivalent to 0·4 gm. of liver extract) were fed daily. The factor *W* concentrate was prepared from liver extract (Wilson) by butanol extraction, the riboflavin being removed from the butanol extract by absorption on fuller's earth (Sargent) and irradiation of the filtrate in alkaline solution. The riboflavin determinations were carried out by the microbiological assay method of Snell and Strong[4]. The *d*-amino-acid oxidase was determined manometrically using an homogenized tissue suspension as the source of enzyme and *d*.l-alanine as the substrate.

The following results were obtained:

(1) The livers of rats fed *K*-12 and *K*-12 plus factor *W* concentrate showed a marked decrease in their riboflavin content. A slight decrease in the riboflavin content of the kidney was observed in both groups.

(2) The livers of rats fed only the basal *K*-12 ration contained greatly decreased amounts of *d*-amino acid oxidase The kidney showed a slight decrease.

(3) Supplementing *K*-12 with riboflavin, although restoring the riboflavin content of the liver to its normal level, raised the *d*-amino-acid oxidase content to only 50 per cent of its normal value. Complete restoration of both the riboflavin and *d*-amino-acid oxidase content of the kidney was accomplished in this group.

(4) The addition of the factor *W* concentrate to *K*-12 produced effects in the *d*-amino-acid oxidase content of the liver and kidney which were very similar to those obtained with the addition of riboflavin.

(5) The addition of riboflavin and factor *W* concentrate increased the riboflavin and the *d*-amino-acid oxidase content of both the liver and the kidney to their normal level. Similar effects were noted in the group receiving the same supplements, whose daily intake was restricted to that of the *K*-12 animals.

The results of the enzyme analyses are summarized in the accompanying table:

Q_{O_2} in Presence of *dl*-alanine as Substrate*

Group	Liver	Kidney Cortex
K-12 (6) †	0·5	17·0
K-12+*W* (7)	1·9	24·5
K-12+flavin (7)	1·7	24·1
Normal (stock) (5)	2·2	26·0
K-12+*W*+flavin, *ad lib.* (6)	2·3	25·0
K-12+*W*+flavin, restr. (5)	2·9	27·0

* Average values after subtraction of the no-substrate readings were used in the calculation of Q_{O_2}.

† Values in parentheses indicate the number of animals in each group.

These results indicate the importance of riboflavin in the synthesis of the prosthetic group of *d*-amino-acid oxidase, and that other members of the *B* complex may also be related to the formation of this enzyme.

Ball[5] has shown that xanthine oxidase is an alloxazine protein. Preliminary experiments indicate that the tissues of rats raised on the *K*-12 ration show similar decreases in their xanthine oxidase activity.

A. E. Axelrod.
H. A. Sober.
C. A. Elvehjem.

Department of Biochemistry,
University of Wisconsin,
Madison, Wisconsin.
Aug. 23.

---

[1] Warburg, O., and Christian, W., *Biochem. Z.*, 298, 150 (1938)

[2] Krebs, H., *Z. physiol. Chem.*, 217, 191 (1933).

[3] Elvehjem, C. A., Koehn, C. J., and Oleson, J. J., *J. Biol. Chem.*, 115, 707 (1936).

[4] Snell, E., and Strong, F., *Ind. and Eng. Chem.*, 11, 346 (1939).

[5] Ball, E. G., *Science*, 88, 131 (1938).

Ambisexual Action of Progesterone as Observed in the Common Australian Opossum

In contrast to the generally accepted theory that progesterone has only definite effects in females, we have found that this hormone produces readily demonstrable changes in the intact male as well as in the female Australian opossum (*Trichosurus vulpecula*).

In the immature female opossum, progesterone increases the size of the mammary glands and of the pouch. This increase may be as much as two to three times that of the pre-experimental size. In the immature male progesterone may bring on what we term testicular 'ascent', that is, the testicles which were pre-experimentally confined to the scrotum of these animals were observed to leave the scrotal sac and to ascend as far as the inguinal area. This was observed in two pouch embryos of about four months of age (body weight 0·18 kgm. and 0·2 kgm.), where after one injection of 2 mgm. of synthetic progesterone the testicles were found to have left the scrotum. A similar observation was also made in two almost fully grown male opossums of about one year of age (body weight 1·3 kgm. and 1·4 kgm.), in which broadening and relaxation of the neck of the scrotum was noted after one to two weekly injections of 2 mgm. of synthetic progesterone, and after one or two more weekly injections the testicles were found to have left the scrotum.

This ascent, however, which is made possible by a widening of the neck of the scrotum, as brought on by the administration of the progesterone, is not permanent, and on inspection the testicles may sometimes be found in front of the inguinal area or sometimes in the scrotum of the same animal. In the latter case, however, the testicles are quite easily pushed out of the scrotum under the abdominal skin. Testicles and scrotum underwent no gross atrophic changes during an experimental period lasting about two months, following which it becomes impossible to bring on testicular ascent in the almost fully grown animals because the testicles had become too large to pass through the opening provided by the scrotal neck. This is in agreement with observations made on fully grown opossums, where it was found that the neck of the scrotum was widened after the injection of progesterone but testicular ascent could not be accomplished.

The testicular ascent as produced with progesterone is entirely different from that obtained in the same species with œstrogens. In this case, the testicular ascent as brought on in immature opossums injected with œstrone or œstradiol is permanent, and the scrotum as well as the testicles undergo marked atrophic changes[1].

By continuing the weekly injections of progesterone into the almost mature animals for a period exceeding two months, a frankly androgenic reaction was obtained. The penis of these animals, which with the exception of a few days during breeding seasons is hidden in the cloaca, becomes visible and may protrude to its full length (3–4 cm.). This erection is almost permanent in the resting animal which, however, particularly on handling, is capable of retracting the organ. This observation, which indicates the androgenic nature of progesterone when administered to the intact animal, has also been demonstrated recently by Greene, Burrill and Ivy[2] following the administration of "relatively enormous quantities" to castrated male rats.

A. Bolliger.
A. Carrodus.

Gordon Craig Research Laboratories,
Department of Surgery,
University, Sydney.
Aug. 29.

---

[1] Bolliger, A., and Carrodus, A., *Australian and New Zealand J. Surgery*, to be published in October, 1939.

[2] Greene, R. R., Burrill, M. H., and Ivy, A. C., *Endocrinology*, 24, 351 (1939).

Preference of Dalmatian Dogs for Particular Positions in Coach Running, and Inheritance of this Character

Perhaps the most widely known characteristic of dogs of the Dalmatian breed is their habit of following horses and of running underneath the axles of moving carriages. Recently our attention has been directed to some observations with regard to differences in the specific positions under a carriage favoured by individual Dalmatians and the probability that these preferences are inherited.

In one large colony of Dalmatians where training for coaching has been practised for more than twenty-five years, individual animals have been permitted to choose the position beneath the carriage which he or she preferred. Some dogs consistently run with their noses very close to the heels of the horses (position *A*). Some insist on having their head just under the front axle (position *B*), while some prefer to have the head between the two axles (position *C*). Others insist upon staying underneath the rear axles (position *D*) or entirely behind the carriage (position *E*). A few animals have been so little interested in horses and carriages that their training had to be abandoned (position *F*).

Data upon the preferences of sixty-five animals have been made available to us. These have been classified in the accompanying table:

Positions	Animals preferring positions
A	12
B	34
C	2
D	4
E	12
F	1

In this it can be seen that dogs of the Dalmatian breed definitely differ with regard to the eagerness with which they follow horses and carriages. Since approximately 70 per cent of the animals tested choose those positions which entitled them to be rated as 'good' coaching dogs, it is evident that this trait is deeply entrenched in the breed.

We have also grouped these individuals according to their family relationships. Such classification shows that among the descendants of parents having a 'good' rating similar ratings predominated. On the other hand, matings of a strain headed by a champion Dalmatian who was 'poor' at following a coach gave descendants who also were 'poor' through three generations.

Thus it appears (1) that the tendency of Dalmatians to follow horses and carriages falls into several different grades and (2) that these gradations may be transmitted to descendants. It is planned to publish our data and their analysis in detail later. Meanwhile, since training of Dalmatians for running with carriages has nearly disappeared in America, we appeal to readers of NATURE who have observations upon the responses of Dalmatians to training for coaching to communicate with us.

HARRY C. TRIMBLE.
CLYDE E. KEELER.

Harvard Medical School,
Boston, Massachusetts.
Aug. 14.

Oligodynamic Control of Eelworm (*Heterodera marioni*)

FURTHER researches relative to Nägeli's discovery (1893) of the oligodynamic action of various metal ions revealed that the silver ion in strongly diluted solutions (0·9–0·01 mgm. silver per litre) possesses high germicidal properties.

Various countries are already applying this principle to the sterilization of preserves, drinking water and swimming baths as well as for medical purposes.

Even small animal beings, the size of fish larvæ, etc., are exterminated by these solutions, whereas higher organisms are not detrimentally affected.

At the Tobacco Research Station, Trelawney (Southern Rhodesia), these data were made a starting point for an entirely new method of practical eelworm control as against the 'classical' chemical and agricultural methods, which hitherto have not succeeded in solving the problem.

The first tests were made *in vitro* with a solution of silver nitrate (1 mgm. per litre). From one to three quarters of an hour was sufficient to kill all larvæ. In the tobacco plant no harmful influence could be detected with solutions weaker than 1 : 10,000. The practical application, however, presented some difficulties: (*a*) because of the photosensitive property of silver salts, rapidly rendering the solutions inactive to a large extent; (*b*) because of the strong affinity of silver ions as regards organic matter adsorbing the silver. These difficulties could be overcome by the application of soluble, organic silver compounds. In a field experiment the best results were obtained with *silver proteinate*. Of the plants treated only 7 per cent ($= B$) were infested as compared with $B = 90$ per cent in the controls. Moreover, the average degree of infestation ($= A$) of the diseased, treated plants was less than 5 per cent, while A constituted 26 per cent in the controls. This gives us the following relative figures: $\frac{A \times B}{100} =$ 0·36 in the plants treated as against $\frac{A \times B}{100} = 23$ in the controls, that is ± 1 : 64. Only 500 gm. silver proteinate per acre (± 0·1 gm. per plant) was used at a cost of 21*s*. per acre. The silver proteinate was mixed with the fertilizer and applied in standard cups. As the controls had not reached 100 per cent and the outlay allowed for a larger dose per acre, hothouse tests were afterwards made with 0·3 gm. per plant (about 3 metric pounds per acre). This gave the required 100 per cent control.

Further research is in progress to determine the minimum quantity of silver proteinate with optimal effect, the action on the latent stages (for example, the ova) and the application of silver proteinate to the disinfection of river water, utilized for watering seed-beds, as well as the action of other, possibly preferable, silver compounds.

J. W. H. HOVY.

Tobacco Research Station,
Trelawney,
Southern Rhodesia.
Aug. 23.

Propagation of the Agent of Measles in the Fertile Hen's Egg

IN the several reports in the literature concerning attempts to propagate the agent of measles in the fertile hen's egg, data on the demonstration of the agent by experimental inoculation into those species which are generally regarded as susceptible, namely, humans and monkeys, have been lacking or inconclusive.

In the course of experiments on measles, we have initiated several independent sets of serial egg transfers with Seitz filtrates of throat washings (obtained through the courtesy of Dr. Joseph Stokes, jun., and Dr. Aims C. McGuiness of the Children's Hospital, Philadelphia) collected in broth from different measles patients on first appearance of the rash. Despite the fact that lesions in the chorioallantois or viscera of the embryo were not regularly observed, pooled broth emulsions of these tissues have been passed from egg to egg by the method of Burnet[1], and rhesus monkeys have been inoculated in order to detect the presence of virus. With the first strain after four such egg transfers, and with two other strains (each initiated with washings from different patients) after five egg passages, the monkeys inoculated with embryonic material showed after variable inoculation periods coryza, malaise and a typical maculo-papular rash[2] with subsequent branny desquamation. Two of the monkeys also showed a definite neutrophilopenia.

A characteristic maculo-papular rash without other accompanying symptoms was observed in a monkey on the 12th–16th days after infection with 12th egg passage material of one strain and on the 10th–11th days in a monkey given 29th egg passage material of another strain initiated by unfiltered human measles blood. Two monkeys inoculated with material from normal eggs showed no symptoms other than some neutrophilopenia and, like normal animals, developed the typical disease of experimental measles when both groups were tested with active virus from human cases. Two monkeys previously recovered from infection with 4th or 5th measles egg passage material respectively, when retested at the same time as the above normals and those previously given normal egg material, remained perfectly normal.

We are investigating whether the milder syndrome produced in monkeys with later egg passages is due to modification or disappearance of the agent of measles.

In association with Dr. Joseph Stokes, jun., and Dr. Gerald O'Neill of the Children's Hospital, Philadelphia, a study is being made of the effects produced in several groups of children by inoculation with egg passage material.

Geoffrey Rake.
Morris F. Shaffer.

Division of Microbiology
Squibb Institute for Medical Research
New Brunswick, New Jersey.
August 30.

---

[1] Burnet, F. M., *Med. Res. Coun., Spec. Rep. Ser.* No 220 (1936).

[2] Blake, F. G., and Trask, J. D., *J. Exp. Med.*, 33, 385 (1921).

Names of some Atlantic Loggerhead Turtles

Mr. H. W. Parker in commenting upon my letter to Nature[1] disagreed with my opinion that the turtle Schöepff[2] had figured as *Testudo caretta* Linn. was the olive-backed Mexican loggerhead and not the common brown-red form.

My reasons for this opinion are that I have not come across any brown-red loggerheads with four enlarged inframarginal scutes, whereas de Sola[3] figures an undoubted Mexican olive-backed loggerhead showing exactly the reverse arrangement of inframarginals to Schöepff's figure, namely three on the right and four on the left. There is no doubt that de Sola's photograph depicts the Mexican form, since it possesses only a single enlarged mandibular scale on each side, as does Schöepff's figure, whereas the brown-red loggerhead generally possesses three, sometimes two[4]. It will also be noticed that Schöepff's other figure, a carapace in dorsal view, possesses the subcircular outline characteristic of the Mexican, whereas the carapace of the brown-red form possesses a relatively compressed pygal area[5].

I consider this evidence sufficient for regarding Schöepff's figure a representation of the Mexican loggerhead. Parker[1] has already explained that Linné's description of *Testudo caretta* is too vague for specific identification, consequently this name should be available for the first recognizable specific account of a loggerhead described as *Testudo caretta*. The first to do so was Schöepff[2], who figures the Mexican olive-backed loggerhead. I agree with Parker[1] that Daudin's name *Testudo caouana*[6] is inapplicable to this turtle, but he gives a good reason for applying it to the brown-red loggerhead of the Atlantic.

P. Deraniyagala.

Colombo Museum,
Ceylon.
August 16.

---

[1] Parker, Nature, 144, 156 (1939).

[2] Schoepff, "Historia Testudinum" (1792).

[3] de Sola, *Bull. N. York Zoo. Soc.*, 34, 137 (1931).

[4] Deraniyagala, "Tetrapod Reptiles of Ceylon", 1 (1939).

[5] Hay, *Proc. U.S. Nat. Mus.*, 34, 183 (1908).

[6] Daudin, *Hist. Nat. Rept.*, 2, 54 (1802).

There appears to be no authority for the belief that, where the original description is unrecognizable, the name is applied on the basis of the first recognizable account which appears afterwards under the same name. If the work of subsequent authors is taken into account at all, that of Lacépède, Bonnaterre and Daudin must also be considered. They proposed the specific name *caouana* as a substitute for the Linnean *caretta* and in doing so might be considered to have fixed the Linnean name.

H. W. Parker.

British Museum (Natural History),
Cromwell Road, London, S.W.7.
September 7.

Training of Engineers

The reference to the training of engineers which appeared in the issue of Nature of July 29, p. 218, is of special interest at the present time in view of the forthcoming conference convened by the Institution of Civil Engineers for February 1940, and of the grave shortage of engineers, not only in Great Britain, but also in the Dominions. The remark made in the latter part of the article on the perfunctory interest shown by the governing bodies of our engineering institutions in this question can be fully endorsed from long personal experience. Thus the Institution of Municipal and County Engineers examines many hundreds of candidates yearly, but remains solely an examining body, and offers no official assistance to those candidates who are not in a position to go to a university or recognized technical college for their training, and this applies also to the Institution of Civil Engineers itself.

The only way in which such candidates can obtain their technical training is either by private study, a most difficult task at best, or by means of a correspondence course, and I have been unable to find a single engineering college in Great Britain catering for such men which possesses any backing of a statutory nature such as is possessed by universities and technical colleges. In other words, candidates of this category are forced to obtain their technical training by means of a correspondence course organized by a 'college' trading solely for private profit. Many of these establishments are no doubt efficient enough as regards the getting of candidates through examinations, but this does not necessarily produce well-trained engineers, and up to the present there has been no provision whatsoever in Great Britain for correspondence courses organized by authorities financed by public funds.

In the Union of South Africa, such provision is made by the Witwatersrand Technical College, with the special object of reaching those men who by reason of position or the location of their work are unable to obtain their technical training at a university or technical college, and similar provision is made in certain respects by the University of Melbourne, Australia. In my opinion, the immediate need is the inclusion on education committees of engineers who are really interested in the training of this class of man, and the active co-operation of education authorities with the view of meeting their need by the provision of adequate correspondence courses entirely divorced from considerations of private profit.

Bernard H. Knight.

University of the Witwatersrand,
Johannesburg.

Dr. B. H. Knight's letter is welcome as emphasizing the apathy which exists on this subject. What has been done in South Africa and also in Australia for students out of reach of teaching institutions should be possible in England. The aspect of private profit is a bogy that obsesses the professional educationist, but the fact that the practical training of engineers is far more influenced by commercial considerations causes no concern whatever. While it is the case that correspondence colleges in Great Britain have no official recognition, it can be said that at least one, the Technological Institute, has received the encouragement of both the Institution of Civil Engineers and the Royal Aeronautical Society.

What has to be feared is the 'dead hand' of officialdom, as is shown by the following case. A lad working in the country received an elementary training in classes held in the works and then went to a technical institute in the near-by town. Having there completed the equivalent of the first two years of the National Certificate course, he took the third-year subjects in the county borough, 10–12 miles away, travelling three nights a week, and passed the examination. He was not, however, awarded the certificate. The verdict was that he must now attend the second-year course—in effect, a sentence of one year's educational imprisonment. While the system is controlled with such lack of vision that a better way out could not be seen, any prospect of an enlightened policy must be dim, but it is to be hoped that the forthcoming conference will deal fairly with the case of those hapless students who are, as it were, 'without the gate'.

THE WRITER OF THE ARTICLE.

Points from Foregoing Letters

USEFUL results can be obtained by submitting built-up molecular films to high vacuum; S. J. Gregg and E. E. Widdowson have determined by this method the condensation coefficients of stearic and arachidic acids, and the free-acid content of built-up films of barium soaps.

K. S. Krishnan and N. Ganguli find that the specific resistance of a single crystal of graphite in the basal plane is at least one ten-thousandth of that along the plane normal to the basal plane.

Using the assumption that a heavy electron may be regarded as a quasi-stable state of an ordinary electron, Ira M. Freeman derives a formula for the life-time of a mesotron which gives a result in good accord with experimental deductions.

H. O. Jenkins has found a linear relation between dipole moment and $1/r^2$, in the series C_6H_6, $C_6H_5CH_3$, $C_6H_5C_2H_5$, etc., where r is the distance between the carbon of the ring and the terminal carbon atom of the side chain (H in the case of C_6H_6). This relation also gives the correct limiting value of μ for the series.

P. K. van der Merwe describes a simple and inexpensive method of decontaminating water of its fluoride by the addition of superphosphate and precipitating tricalcium phosphate by the addition of lime.

W. A. Engelhardt and M. N. Ljubimowa state that they have extracted adenosinetriphosphatase of muscle. It is precipitated with and has all the properties of myosine. Thus the primary energy-yielding reaction in muscle, the hydrolysis of adenosinetriphosphate, seems to be associated with the protein forming the anisotropic contractile part of the muscle fibre.

In an extensive series of experiments. A. E. Braunstein and R. M. Azarkh have shown that transamination of *d*- and *l*-amino-acids is either not effected at all by minced tissue from various malignant tissues or at a much lower degree than it is by normal tissues.

A. E. Axelrod, H. A. Sober, and C. A. Elvehjem have demonstrated a decrease in the *d*-amino-acid oxidase content of liver from rats fed on a diet low in both riboflavin and factor *W*. When the basal ration was supplemented with riboflavin alone or a factor *W* concentrate alone, there was some increase in the oxidase content of the liver, but the value returned to normal only when both riboflavin and the factor *W* concentrate were given.

Ambisexual action of progesterone has been observed by A. Bolliger and A. Carrodus in the common Australian opossum. In the female, progesterone was found to increase the size of the pouch; in the male, broadening of the neck of the scrotum was observed, followed in immature specimens by testicular ascent. After prolonged administration the penis remained in a state of erection.

H. C. Trimble and C. E. Keeler report that over a period of twenty-five years Dalmatian dogs inhabiting a large colony have shown differences in the eagerness with which they have followed horses and have had individual preferences for particular positions when running beneath a carriage. These differences and preferences appear to have been transmitted to offspring through several generations to an extent which seems to have genetic significance.

J. W. H. Horry describes a new method of practical eelworm control by the use of soluble, organic silver compounds. The best results were obtained with silver proteinate.

Filtrates of throat washings collected from measles patients on first appearance of the characteristic rash have been used by G. Rake and M. F. Shaffer to infect fertile hens' eggs. Broth emulsions from such infected embryonic tissue have been passed from egg to egg, and even after five such transfers are still able to produce measles symptoms in rhesus monkeys.

Referring to an article in NATURE on the training of engineers B. H. Knight endorses, from personal experience, the statement made as to the perfunctory interest shown by the professional institutions in education. For those out of reach of approved colleges he recommends the establishment of correspondence courses as have been arranged in South Africa and Australia. Our contributor, by way of comment, directs attention to the way in which the approving authority at present deals with cases not conforming to the system, and to the need for a more enlightened attitude towards such students as are hampered by distance.

RESEARCH ITEMS

Ancient Metal Objects

The Research Committee of the British Association engaged in the analysis of ancient metallic objects and their comparison with naturally occurring ores (formerly the Sumerian Committee) prepared a report for the Dundee meeting on its work in 1938–39. The method of micro-analysis has been mainly employed, but recently time and cost have been saved by quantitative determinations by means of the spectrograph. Standard alloys of known composition make it possible to give actual figures, in place of approximations, of an accuracy approaching that of chemical analysis. A further twenty-five specimens from Troy (Prof. Blegen) have been examined, and a large number remains which will be examined spectroscopically. Broadly speaking, the specimens from Troy I–IV are of copper, mostly with high arsenic, but including two bronzes, while from Troy VI and VII bronzes greatly preponderate, and the proportion of arsenic is less, indicating a different source for the copper. Analyses of ores from many of the possible sources of copper are still lacking. Fifteen knives and spears from Cyprus (J. R. Stewart) included only one bronze, which contained several per cent of zinc, as did one of the specimens free from tin. Arsenic and silver were prominent impurities. Nine objects from Tell Duweir were: gold, three; electrum, one; copper, three; and bronze with varying impurities, two. Eleven objects from Hureidha, south Arabia (Miss G. Caton-Thompson) were: copper, six; bronze, three; iron and silver, one each. An axe-hammer from Hungary (H. J. E. Peake) was of native copper. Two fragments of pottery with black glaze (Mr. Peake), one Tell Halaf ware from Arpachiyah, and the other al'Ubaid ware from Nineveh, showed the pigment in both instances to be magnetic oxide of iron.

Kiliwa Indians of Lower California

Visits on three occasions between 1928 and 1936 paid by Peveril Meigs, 3rd. to the group of Indians in Lower California known by variants of the name Kiliwa in the records of several writers, have added to the records of a people of whom in 1929 only thirty-six individuals, mostly members of five families, were still living (*Ibero-Americana*, 15; 1939). The Kiliwa territory covered an area of some 1,500 sq. miles, with a diversity of natural landscape. The principal inhabited part was a semi-arid area lying between two great forested plateaux. In the southern part of Kiliwa territory is the San Felipe Valley, a wide alluvial floored structural basin some 1,500 ft. above sea-level. The only part occupied to-day is the Arroyo Leon Upland, a rough granitic upland with an elevation of 3,000 ft. The existence of an early population is indicated by rock-carvings or petroglyphs. The Indians have no legends to explain by whom they were made. Descent is reckoned patrilineally, and the sibs or lineages are definitely associated in the minds of the people with specific geographic localities. A taboo on mentioning names of the dead made it difficult to obtain information about the lineages. The principal movements of the Kiliwa consisted of their annual treks to the piñon groves and to San Felipe for food. Feuds with neighbouring tribes restricted travel. Certain foods were outstanding, at the head of the list being the agave, or mescal, plant, cooked by the usual roasting pit method of the south-west. Rabbit and deer were probably the most important meat animals, and were hunted with throwing sticks or bows and arrows. Large-scale slaughter took place in co-operative hunting, when the game was scared by bush-fires lit by the hunters.

New Breeding Place of Gannet

For so many centuries the gannet remained restricted to a few nesting sites that any fresh evidence of the remarkable extension of range now taking place is of unusual interest. In July 1939, the Rev. J. M. McWilliam and Lord David Stuart saw three or four gannets on the Scar Rocks in Luce Bay, Wigtownshire; and on a subsequent visit on August 1 they found a nest containing a young gannet. The Scar Rocks are only about a hundred yards in length and about fifty feet high, but the south-east end is precipitous, and there the birds could nest in security. It is possible, therefore, that the nest of 1939 indicates the beginning of a new colony (*British Birds*, 33, 105, Sept. 1939). We would add that the successful nesting of this small number of gannets lends no support to the suggestion recently made upon rather slender evidence that successful nesting in a new colony is associated with a stimulus due to the group reactions of a considerable number of birds.

The Four-Eyed Blenny

The suggestion that the horizontally divided eye of Anableps is related to the double function of vision in air and in water, led C. M. Breder and E. B. Gresser to study the four-eyed blenny, *Dialommus fuscus* (*Zoologia*, 24, 239; 1939). The specimens examined were obtained at Indefatigable Island, Galapagos. In outward appearance each eye seems to have two pupils, but this is due to the presence of a vertical band of pigment in the cornea, and the internal structure of the eye, with its single lens, is like that of typical fishes. The purpose of the pigment band is unknown, though it obviously makes vision possible only through a fore and an aft opening. But since the focus of the eye of a fish is altered by back and forward movements of the lens, it is just possible that the four-eyed blenny might be able so to adjust the lens that the anterior portion was in focus for aerial vision while the posterior portion was in focus for vision in water. This suggestion could hold only if the fish was in a vertical position, and it has been observed that a habit of the blenny is to climb out of steep-sided pools by scaling the vertical walls of rock. Clearly a decision about the function of this curious eye arrangement must await further observation and experiments in an aquarium.

Adaptation in a Dolphin's Backbone

In his very thorough description of the skeleton of *Prodelphinus graffmani*, a species which he himself first described in 1934, Einar Lönnberg directs attention to the varying stability of the backbone in its different regions (*Ark. Zool.*, 30, No. 20; 1939). From the arrangement of the articulations of the vertebral elements and the angle of the spinous processes it would appear that the anterior three fifths of the backbone has almost no power of bending in a dorsal direction up to the 32nd vertebra. From that point to the 40th vertebra, in the lumbar region, vertical mobility has been gained by modifications in the articulations. Then follows a second less movable area, in the proximal part of the caudal region, which is succeeded by the terminal half of the tail region which is capable of strong movements in any direction. The total number of vertebræ in the specimen examined was 77.

Blowfly Research in Australia

The sheep blowfly problem is well known to be one of major importance in Australia. A considerable amount of valuable research has been carried out by the staff of the Federal Council for Scientific and Industrial Research. These investigations come under two main categories, namely, the collection of information on these insects and their relation to their environment, and the study of the susceptibility of sheep to blowfly strike. An essential requirement for much of this work is a large and regular supply of blowfly larvæ. This in turn involved the development of a simple synthetic medium as the food supply for the larvæ. The Council's Pamphlet No. 90, 1939, by F. G. Lennox, is entitled "The Development of a Synthetic Medium for Aseptic Cultivation of Larvæ of *Lucilia cuprina*". The basal medium contains only yeast and sodium chloride, in addition to agar, which is added to give a suitable gel consistency. While the larvæ attain their full size on this medium, their growth is more rapid on one in which the agar is replaced by fresh egg-white. The production of fully grown blowfly larvæ on a yeast medium has, it seems, rather upset preconceived ideas as to their supposed nutritional requirements. The author states that he knows of no previous record of the successful rearing of "flesh-fly larvæ" in the total absence of animal protein.

Genetics of Streptocarpus

W. J. C. Lawrence, R. Scott-Moncrieff and V. C. Sturgess (*J. Gen.*, 38, 299–306; 1939) make an interesting comparison between the history, the genetics and chemistry of plant pigments in the genus Streptocarpus. The acaulescent group of species differ in morphology and geographical distribution from the caulescent group. The former group has 32 chromosomes and the latter group has 30 chromosomes. All the species contain anthocyanins derived from delphinidin, except *S. Dunnii* which contains cyanidin. In 1886 *S. Dunnii* flowered (brick red) at Kew and was hybridized with the species of the blue and ivory series. From these crosses called × *kewensis* and × *Watsoni*, new colours combining the red of *Dunnii* with the blue-flowered species were obtained. The genetics of garden hybrids agree with this historical account. Gene *A* is necessary for anthocyanin formation and alone gives salmon colour (pelargonidin derivatives). *RA* produces (rose) anthocyanins derived from cyanidin while *AO* gives (mauve) anthocyanins derived from delphinidin, *AD* (blue) produces the 3–5 dimonoside of pelargonidin in place of pentoseglycoside-dimonoside. *ARD* should and does give magenta (peonidin + cyanidin 3–5 dimonoside). *AR* is derived from *S. Dunnii* and *O* and *D* from the remaining species (for example, *S. Rexii*).

Genetics of Blackarm Resistance in Cotton

Bacterium malvacearum causes serious damage to Sakel cotton in the Sudan. R. L. Knight and T. W. Clouston (*J. Genetics*, 38, 133–160; 1939) have artificially infected Sakel cotton and hybrids with other strains. The authors have clearly shown that two factors B_1 B_2 control resistance. Sakel cotton has the constitution $b_1b_1b_2b_2$. In the authors' grading of twelve classes of susceptibility, different genotypes give characteristic and definite results. B_1 is dominant and confers "10·1" resistance on Sakel cotton, which is normally "12", while B_2 confers "7" resistance. Together B_1B_2 give grade "5". More resistance is given to the variety Uganda B31 by B_1 and B_2 than to Sakel and it is shown that this is due to a difference in modifying factors.

Peneplanation of South Africa

In a very detailed paper on "Some Observations in the Physiographical Development of Central and Southern Africa" (*Trans. Geol. Soc. South Africa*, 41; 1938), F. Dixey contends that the erosion of southern Africa did not advance steadily from early Jurassic until Tertiary times with the production of one great peneplain. He believes that the evidence he adduces points to two main stages each followed by a minor stage that was effective only in the softer formations and around the coasts. Furthermore, he suggests that in Cretaceous times there was a prolonged depression to the extent of several thousand feet, and that the uplift of late Tertiary and post Tertiary times did little more than restore southern Africa to its early Cretaceous level. He thinks that the Cretaceous transgression of the sea was due not to depression of the land but to a gradual rise in the level of the sea which was possibly due to continental drift changing the shapes of the ocean basins. On this interpretation, after the great late-Jurassic uplift, any continued slow elevation was more than counterbalanced by the rise in sea-level that caused a flooding of the coastal peneplain and the lower courses of the larger rivers. As the rise in sea-level waned in early Tertiary times, the continental uplift gained a slight lead, with the result that the Eocene and uppermost Mesozoic sediments were base levelled with the older rocks.

Melting of Granodiorite by Andesite

E. S. Larsen and G. Switzer describe (*Amer. J. Sci.*, August 1939) an obsidian-like rock that has been formed from the natural melting of granodiorite. The granodiorite occurs as an inclusion about 50 ft. long and 40 ft. wide in a Tertiary volcanic plug of andesite near Carlsbad, San Diego County, California. The product of melting looks very like a porphyritic obsidian. The glass is rhyolitic in composition, but contains 4·57 per cent of water. The addition of water was apparently necessary to bring about the fusion. The crystals that remained unmelted are about those which normally occur as phenocrysts in a groundmass such as this rhyolitic glass. The alkali felspar is completely resorbed, but some quartz remains. Biotite and hornblende, in spite of the high water content, have been changed to augite. The melting of an igneous rock, supplied with the appropriate mineralizers, should follow the reverse course of that of crystallization. The early material to become liquid should be the same as the late material to crystallize. The composition of the glass shows that this is true for the inclusion under discussion. The lack of any inversion of quartz to tridymite indicates that the temperature of melting was below 870° C.

Helium Ratios of Igneous Rocks

In an effort to extend the scope of geological age measurements based on the accumulation of helium in igneous rocks, researches were initiated at the Massachusetts Institute of Technology which have revealed serious errors in previously published results. Co-operative investigations undertaken by Evans, Goodman, Keevil, Lane and Urry (*Phys. Rev.*, May 15, 1939) show that the radium determinations on which the previous helium time-scale was based are incorrect by a factor of more than two. The magnitude of the downward revision of ages varies according to the thorium-uranium ratio of the individual specimens. The new age determinations have been made by two entirely different techniques, the alpha-helium method and the radon-thorium-helium method. The former is independent of radioactive standards and its results are in agreement with the new measurements by the radon-thorium-helium method. Precision radium standards in the region of 10^{-12} gram have been verified. These researches represent the first comparison of helium age-measurements on the same specimens by two or more observers. While the ages of many individual geological horizons are lowered by these new results, the total span of geological time remains unreduced. A Pre-Cambrian norite from the Stillwater Complex gives a helium age of 1850 ± 300 million years by the alpha-helium method and 1800 ± 200 million years by the radon-thorium-helium method. The reason for the remarkable discrepancies between helium ratios and lead ratios at lower ages remains unknown.

Volcano-seismic Activity at Montserrat (1933–1937)

Complementary to the publications of the 1936 Royal Society expedition to Montserrat there has now appeared a monograph by Frank A. Perret, the well-known volcanologist ("The Volcano–Seismic Crisis at Montserrat 1933–1937", Carnegie Institution of Washington Publication, No. 512; 1939). Montserrat is known to be one of a long chain of islands of volcanic origin, being really a mountain standing half drowned in the sea. Each of the mountain islands of the chain is thought to be connected by a common fissure system to a single parent magma. The surface sub-volcanic phenomena in the 1933–1937 period consisted of abnormal activity in pre-existing soufrières, being chiefly confined to the chemical intensity of the exhalations. In addition to the usual sulphurous and sulphuretted hydrogen emanations, there appeared a dangerous higher sulphide of hydrogen, probably the persulphide, which caused Mr. Perret considerable trouble and necessitated his taking medical treatment. Perret's hypothesis is that the whole of the geophysical phenomena were due to the efforts of the magma to re-establish old vents in supposedly extinct volcanoes and that much may be made of a conception of a "gas-sheeted magma in horizontal subterranean fissures" two of which were distinguishable in the region. The soufrières of Montserrat are considered as having been caused mainly by the penetration of meteoric water to a subterrain of sulphided limestone that had been reheated intensively by uprising magma. A time chart showing soufrière activity, earthquake activity, and the possible "lunisolar influences" has been drawn up. We are pleased to note the mention by Mr. Perret that the scientific work initiated on the island is being continued by local effort.

Cosmic Rays at High Altitude

T. H. Johnson and J. G. Barry (*Phys. Rev.*, 56, 219; 1939) have investigated the distribution in direction of the cosmic rays near the top of the atmosphere. The apparatus was carried by small balloons and radio signals were transmitted corresponding to the passage of a single ray through a system of counter tubes arranged at an angle of 30° to the horizon. As the balloons rotated slowly about the vertical, the azimuth was signalled to the ground station by an arrangement including a photocell on which the sun's rays fell. The experiments were made in equatorial latitudes. It is well known that the cosmic rays at sea-level show an asymmetry between east and west directions which at the equator amounts to several per cent. This asymmetry is ascribed to the hard component of the rays, and shows that the primary particles responsible for the hard rays are deflected in the earth's magnetic field and possess predominantly positive charges. No asymmetry was observed at the top of the atmosphere, so it appears that the incoming particles which give rise to the 'soft' radiation predominant at high altitude have positive and negative charges in equal numbers. It follows that these 'soft' particles, which are presumably electrons and positrons, cannot be the primaries for the 'hard' cosmic rays at sea-level, and the authors suggest that these primaries are probably protons.

Solar-Terrestrial Relationships

The fifth report of the International Commission for the Study of Solar-Terrestrial Relationships (Firenze: Tipografia Barbera) contains summaries relating to the present state of knowledge in this direction and to the results of recent collective and individual research. The subject matter falls under seven general headings: (1) researches in terrestrial magnetism; (2) solar phenomena; (3) propagation of wireless waves and phenomena of the ionosphere; (4) polar auroras; (5) the earth's upper atmosphere; (6) cosmic radiation; (7) meteorological phenomena. A number of contributions deal with the various aspects of the recently recognized relationship existing between bright eruptions in the sun's chromosphere and sudden disturbances in the ionosphere (ionospheric irruptions) which are especially evident in the *D*-layer at a height of 100 km. It is pointed out that the study of the effects of bright solar eruptions on the ionosphere does not support the ultra-violet theory of magnetic storms. Advances in geomagnetism have been made, but the precise location of the electric current-systems to which magnetic storms can be attributed cannot yet be inferred with certainty from observations of the magnetic changes at ground-level. Among the summarized results of investigations between solar and meteorological phenomena (1936–38) is stated the conclusion that no clear case has yet been shown for a close and persistent correlation between the variations of the levels of the great lakes and the sunspot cycle. Hitherto, the apparent correlation found between these phenomena has been considered one of the most promising in solar-meteorological relationships.

TRANS-ATLANTIC AIR SERVICES*

THE problem of trans-Atlantic flight has been viewed so often from a false angle as "so much nonsense has been talked and written" about it, that the technical aspects of the case were seldom appreciated.

With regard to the merits of the alternative routes, it must be remembered that the one offering the shortest stages, that is, technically the easiest, is not the most suitable commercially, as it would not be operable in winter. Also it is necessary to remember that bases in Canada for Empire air communications, and in the United States for the traffic between New York and Europe, must be used even though they do not lend themselves for the most suitable subdivision of the flight into stages. Further, the conditions at these and the English ends of route may impose a limitation upon the choice of type of machine, landplane or seaplane, that again may not be technically the most suitable for the flight itself. The route with the shortest stages, the most economical to operate, would be Southampton–Horta (Azores)–Botwood–Montreal or New York, but this is difficult because of lack of landing facilities at the Azores. The difficulties on each of the alternative routes suggest that the ultimate aim will have to be a direct flight from England (at present Southampton) to New York or Montreal. This presents many formidable technical difficulties to the aircraft designer, particularly with regard to strong winds and icing conditions during the winter. What would appear to be the easiest solution, by dividing the flight into stages of most suitable length by floating islands or seadromes, is considered to be impracticable.

With regard to the nature of the services provided, Major Mayo is of opinion that, owing to the short duration of the passage, there is no need to offer comfort comparable with a modern liner. A fast and frequent service of comparatively small aircraft would appear to be ideal. It should be possible to attain a daily overnight mail service between London and Montreal or New York. The difference between the conveyance of passengers and mail is very real, and points to the necessity of separating the two types of traffic. A passenger with reasonable luggage and the necessary equipment and furnishing for his comfort demands about 500 lb. weight. Mail, with a limit of half an ounce per letter, would give an equivalent of 20,000 letters, which would occupy much less space. Therefore a mail plane, being small, can be built in quantities to operate at high speed and high frequency, while the passenger machine must be larger, slower, and less frequent.

The time to be taken for the journey is affected by the prevailing wind of an average forty miles an hour against the west-going crossing, but the gain in time in travelling west is in favour of it. Surprisingly, the latter more than balances the former. The optimum transport conditions, to avoid bunching up of machines at one end, and the consequent uneconomical return of some of them, would be equal scheduled times for either way of crossing; but this would occur at a cruising speed of 156 miles an hour, which Major Mayo suggests is much too low for other aspects of the problem. He considers a speed of 300 miles an hour to be practicable, which would allow a letter posted in New York at 5 p.m. to be delivered in London at 12.30 p.m. the next day, and one posted in London at 8 p.m. to be in New York by 8 a.m. the following morning. The slower passenger machine could have a speed of 200 miles an hour, making the time of the average journey 21·3 hours, a not unreasonable figure for a passenger to endure physically, and a considerable gain on any other forms of transport.

The speed of the aircraft is governed, among other things, by the wing loading, and while the maximum for this type of craft is about 33 lb. per sq. foot at present, the author considers that a figure of 50 lb. should be possible with present-day refinements in design. Forecasts point to the ideal machine to this specification being a land plane of 60,000–70,000 lb. total weight. It is not considered to be any further risk to fly a land plane over water, as even the largest flying boat would not keep afloat for any considerable time in average Atlantic conditions in the event of a forced landing. The greatest difficulty with high wing loading is that of 'taking off' with maximum load, and Major Mayo then discusses the methods of dealing with this problem. There are three of these in use to-day, catapulting, refuelling in the air after taking off more lightly loaded, and a composite aircraft in which the long-distance craft is in effect taken up into the air on the top of another one and launched at a higher speed than that at which it could have left the ground with safety. He considers that the latter method is the most promising.

With regard to stratosphere flying, so far as can be foreseen, cruising speed can be increased by about 1·5 miles an hour per 1,000 feet of altitude. Meteorologists estimate that the prevailing westerly winds over the Atlantic increase at about 2 miles an hour per 1,000 feet of altitude, so that for the east to west crossing stratosphere flying would actually reduce the net speed.

* Abstract of a paper read before Section G (Engineering) of the British Association at Dundee on September 1 by Major R. H. Mayo.

PUBLIC HEALTH IN GREAT BRITAIN

THE twentieth annual report of the Ministry of Health dealing with the year 1938–39, published on September 14*, covers the whole range of the Ministry's work, including finance, public health, public assistance, housing, national health insurance, pensions, and—for the first time—certain aspects of civil defence. A report on the Welsh Board of Health is included.

In presenting his report, the Minister of Health, Mr. Walter Elliot, remarks that in spite of the strain of the present emergency, it has been possible to

* Cmd. 6089. H.M. Stationery Office. 5s. net.

maintain and develop the normal work of the Ministry, and that the main indexes of progress in health and public welfare during 1938 show no faltering in the upward tendency of every recent year.

Compared with the previous year, the standardized death-rate fell by 0·8 to 8·5 per 1,000 population. This is the lowest figure on record, and compares with a rate of about 12 twenty years ago. Infantile mortality fell by five points from the 1937 figure to a new low record of 53 per 1,000 live births. That most regrettable form of death, maternal mortality, fell for the first time below 3 (2·97) per 1,000 total births. The slight upward trend in the birth-rate, which first became apparent after the low record of 14·4 in 1933, carried the figure for 1938 to 15·1 per 1,000 population, though the latter figure is still below that of every year before 1933. Deaths from tuberculosis, numbering 26,176, were actually fewer by 2,353 than in 1937, the biggest fall in one year since 1934. The anti-tuberculosis service of local authorities, together with better general hygiene and housing, sanitary environment and protection of the milk supply, appear to be exerting a continuous and satisfactory effect in the reduction of this disease.

On the other hand, cancer mortality still gives cause for anxiety, for the total number of deaths attributable to cancer in 1938 is estimated provisionally at 68,600 as compared with 66,991 in the previous year. Cancer deaths, in fact, have been steadily increasing in every year, from 27,487 in 1901 to the present time. Cancer is, however, a disease to which young persons are less susceptible than the middle-aged or old, and it is common knowledge that the young are becoming proportionately less numerous in the population, and the increase in cancer mortality in recent years may, therefore, be more apparent than real. A disturbing factor is that investigations pursued by the Ministry show that, in spite of recent developments in cancer treatment, a large proportion of sufferers who could benefit from treatment, if it were given sufficiently early, either do not receive treatment at all, or receive it under unsatisfactory conditions or at so late a stage in the disease that cure, or even temporary relief, is impracticable. There is, moreover, a deficiency of accommodation at hospitals possessing adequate facilities for all forms of treatment. It is to be hoped that a new Cancer Act, passed in March last, may remedy this unfortunate position.

Of the infectious diseases, the number of notified cases of the enteric fevers decreased from 2,149 in 1937 to 1,322 in 1938, and the deaths from 206 to 163, the lowest ever recorded, except for 1934. Notified cases of pneumonia were considerably less than in the previous year, but an exceptionally large number of cases of acute poliomyelitis (infantile paralysis) occurred, namely, 1,489 compared with 768 in 1937, and still fewer in the previous three years. There were 65,000 notifications of diphtheria, 4,000 more than in 1937, though the deaths (nearly 3,000) remained practically the same. An efficient method of artificial immunization for the prevention of diphtheria is now available, by means of which this disease has been almost stamped out in certain American and Canadian cities. It is regrettable that immunization is not more widely practised in Great Britain, particularly as welfare authorities have, and local authorities can obtain, powers to adopt it. Eighteen cases of smallpox were notified in 1938, with three deaths, the first deaths from this disease to have occurred since 1934. Here again it is disturbing to find that infantile vaccination has been steadily declining, so that in 1937 only 34 per cent of that year's infants were vaccinated.

Much information is given in the report upon housing and town planning. Slum clearance and rehousing has been proceeding and continues to grow, together with abatement of overcrowding. The total number of houses completed by local authorities during the year was 101,744, the highest number in any year since 1927–28. The Housing (Financial Provisions) Act, 1938, which has come into operation, contains provisions for the encouragement of the building of new houses for the agricultural population, and should improve the conditions of agricultural workers and benefit agriculture, for "the lack of cottages supplied with modern amenities is one of the main factors which accounts for the desertion of the land, especially by the younger generation".

Other developments recorded during the year include the passing of the Food and Drugs Act, which brings together for the first time the statute law relating to the purity and soundness of food and drugs, and the receipt of 652,899 initial applications for admission to the new pensions scheme for 'black-coated' workers.

For the first time, a chapter on civil defence is included. This contains two sections, one on evacuation, providing for the movement of some 3,000,000 people in an emergency, which has been successfully carried out since the report went to press, and another on the Emergency Medical Services for the treatment of air raid casualties, which will provide 290,000 emergency beds in England and Wales.

PROGRESS IN SEISMOLOGY

THAT the study of earthquakes has been actively pursued in Great Britain during the year September 1938–September 1939 is indicated in the report of the Committee for Seismological Investigations to the British Association meeting at Dundee, which for the first time since 1912 is without the name of Sir Frank Dyson. His death has been a severe loss to the committee, as his wise counsel was always greatly appreciated by his colleagues.

This forty-fourth report of the committee has been edited by the chairman, Dr. F. J. W. Whipple, who states that another Milne-Shaw seismograph has recently been made for the British Association and sent, together with a high-precision clock, on loan to the Fiji Government at Suva. The need for this to replace the old Milne instrument was brought to the notice of the British Association by the newly formed Seismological Investigations Committee of the Australian and New Zealand Association for the Advancement of Science; and brings the number of such instruments owned by the British Association up to seven.

The records from the Suva station are particularly important for the study of deep-focus earthquakes, since these are frequent in the region to the south-east of Fiji. In the new Suva instrument and other Milne-Shaw seismographs of recent date, Mr. J. J. Shaw has made an improvement by having the agate cups surrounded by light aluminium bands so that the seismograph is not jerked out of action by severe local shocks.

Dr. A. E. M. Geddes has been making observations with the Milne-Shaw instruments at Aberdeen, using the method developed by Dr. A. W. Lee at Kew, to see whether the free motion of the seismograph was in accordance with the mathematical theory of damped periodic motion, and to find whether or not the period could be determined by removing the damping magnets. He found that the agreement with the theory was very satisfactory, but that an increase of the order of 10^{-1} sec. in the period may have been due to damping. Dr. Geddes suggests that this may have been on account of the boom of the pendulum being somewhat paramagnetic.

The Jagger shock recorder built for the Association at Bristol under the supervision of Dr. C. F. Powell has been installed at Dunira, Comrie, Perthshire, in a croquet house, through the courtesy of Mr. W. G. Macbeth. Its position is lat. 56° 23′ 19″ N., long. 4° 2′ 41″ W., three miles north northwest of the Highland boundary fault. The pendulum oscillates in a vertical plane orientated N. 76° E., is adjusted to a period of nearly a second, and is damped by means of a metal fin dipping into an oil bath. It is intended to record only local shocks; the records are obtained on smoked disks, which are changed every twenty-four hours. An anonymous donor has offered to provide for some years an honorarium to the keeper, and this has been gratefully accepted by the committee. During the year the chief local shocks recorded at Comrie have been October 15, and November 12, 1938, January 23, May 26, 31, and June 11, 1939. None of these was recorded by other seismographs in Great Britain or felt by people. They may be supposed to have been due to movements at the boundary fault. British tremors probably due to subsidences have been reported to Dr. Dollar as having occurred at Brierly, Yorkshire, on November 12, 1938, and at Porth, Glamorganshire, on December 18, 1938. From October 1939 Dr. Dollar will be pleased to receive observations of British earthquakes at the Geology Department, University of Glasgow.

At Oxford the work of the International Seismological Summary has continued, and through the courtesy of the American Museum of Natural History in New York, two Mollweide projection maps centred on 160° longitude have been prepared, one for deep focus epicentres and the other for all epicentres used in the I.S.S. during the years 1913–1933. Copies of these maps were sent to Washington for the meeting of the International Union of Geodesy and Geophysics held last month, and it is noteworthy that at this meeting a seismological committee under the chairmanship of Dr. S. W. Visser was to discuss technical details concerning the I.S.S., including the possible use of geocentric co-ordinates instead of geographic co-ordinates. Dr. H. Jeffreys, who has been appointed a member of this international committee, has been active recently in computation, chiefly from the data of deep-focus earthquakes, of the travel times of various phases of earthquake waves, including those reflected and refracted at the core. For this latter purpose the radius of the outer core had to be evaluated from the available data, and this is now estimated to be 3473 ± 4 km. Dr. R. Stoneley has continued his study of Rayleigh waves and Love waves, and now believes that significant differences in the relative frequency of these in different earthquakes imply differences in the types of initial movement at the foci. One of the pioneers of British seismology was the late Dr. John Milne, who wrote the book "Earthquakes and other Earth Movements". As a result of the progress made, often as the result of work initiated by Milne himself, Dr. A. W. Lee has practically had to rewrite this book though keeping to the form devised by Milne. The revised book has been published during the year under the title "Earthquakes and other Earth Movements" by J. Milne and A. W. Lee (see Nature, **143**, 872; 1939).

THE ETHYL-THIOGLUCOSIDES AND A NEW MONOACETONEGLUCOSE

In attempting to synthesize disaccharides from glucosediethylmercaptal, Brigl, Gronemeier and Schultz (*Ber. deutsch. chem. Gesell.*, May 1939) have obtained an ethyl-thioglucoside with properties very different from those of the α- and β-forms described by Schneider and Sepp (*Ber.*, 1916 and 1918). It is now maintained that the new strongly dextro-rotatory compound and the lævo-rotatory so-called β-form both possess the pyranose ring structure, whilst the dextro-rotatory α-form must be a furanoside. Convincing proof of the structure of this furanoside is obtained from experiments with acetone derivatives in which the 5.6 positions must be occupied by the *iso*-propylidene group. By condensation of glucose diethylmercaptan with acetone in presence of a finely powdered preparation of copper sulphate from which just half the normal water of crystallization had been removed, 5.6-monoisopropylidene mercaptal was prepared, from which, with the aid of mercuric chloride and cadmium carbonate, 5·6-acetonethioglucoside was formed.

Any doubt as to the positions occupied by the isopropylidene group is removed by the elimination in one stage of the two mercaptan groups of the mercaptal with formation of a hitherto unknown 5.6-monoacetoneglucose, which reacts with more acetone to give the well-known 1.2.5.6-diacetone derivative. Thus Schneider and Sepp's α-compound must be a furanoside and the new monoacetoneglucose a glucofuranose, since the possibility of forming a pyranose ring is definitely excluded.

An interesting reaction occurs between this glucofuranose and Schiff's reagent. The colour is restored slowly but clearly within a few minutes and fades again after long standing. This is explained by the tendency of the furanose to revert first to the aldehydic open-chain structure and later, after fission of the acetone group in the presence of acid, to the more stable pyranose ring. The β-pyranose structure of Schneider and Sepp's β-compound is inferred from its synthesis from acetobromglucose by interchange of halogen for the mercaptan group.

No definite proof of the structure of the new ethylthioglucoside is given, but its stability to acid leads the authors to infer that it must be the corresponding α-pyranoside. It was prepared by condensing glucose-diethylmercaptal with glucose in acid solution and was purified by conversion to its tetracetate, which was isolated in a pure state and hydrolysed by baryta to the α-thioglucosepyranoside. A remarkable property is its high specific rotation, +268·8°, which is about 100° higher than the value calculated from Hudson's rule.

ELECTRICAL EQUIPMENT OF BUILDINGS

THE new (eleventh) edition of the regulations of the Institution of Electrical Engineers for the wiring of buildings was published in June (London: Spon. Cloth 1*s*. 6*d*. net; paper cover 1*s*. Also from the Institution of Electrical Engineers).

These regulations enumerate the main requirements and precautions considered necessary for ensuring satisfactory results, including safety from fire and shock, in connexion with the distribution of electrical energy in and about all types of dwelling houses, business premises, public buildings and factories, whether the electric supply is derived from an external source or from private generating plant. With a public supply they are only applicable to the consumer's side of the consumer's terminals. In no circumstances are they applicable to telephone circuits other than radio circuits; and they only apply to radio circuits where such circuits are connected directly or indirectly to a public or private supply system. Primarily the regulations are intended to apply to low-voltage installations, but the cases of electrode water heaters, luminous discharge tubes and electric signs are mentioned. They are not intended to take the place of a detailed specification or to instruct untrained persons. Whenever applicable they are supplementary to statutory regulations, such as those issued by the Electricity Commissioners and by the Home Office, and they include also the requirements for theatres and for safety in mines.

Various methods of carrying out the electrical equipment of buildings are considered and in order to guard against the risk of fire and shock the method selected must be suitable for the voltage, the atmospheric conditions, the size of the installation and the type of building. There is no intention of discouraging invention or of excluding other materials and methods which may be approved in the future.

The Committee of the Wiring Rules is fully representative of all those connected with the industry. It has representatives from the Association of Consulting Engineers, the B.E.A.M.A., the Cable Makers Association, the Fire Offices Committee, the Home Office, the Electrical Contractors Association and others. The Committee holds meetings periodically and all difficulties are fully discussed and reported on. The revision has been carried out very thoroughly, but contractors whose work has hitherto been of the highest quality will not be affected.

REINFORCED CONCRETE COLUMNS

UNDER the usual applications of column theory the theoretical values for loads at failure are dependent on the elasticity of the material of which the column is made, and it is assumed in this theory that the material is both homogeneous and isotropic. In the case of reinforced concrete this assumption cannot be made, so that the applicability of the usual theories is not justifiable without experimental evidence of the actual failing loads. In particular, the effect of inelastic deformations of the concrete requires to be investigated.

An investigation, undertaken to determine the strength of long columns in short-period loading tests to destruction for cases where the initial eccentricity of loading is so small as to be capable of being regarded as 'accidental' in practice, has been carried out at the Building Research Station, Garston, in co-operation with the Reinforced Concrete Association and under the supervision of Dr. W. H. Glanville. A report has been published by the Department of Scientific Research by the issue of a Building Research Technical Paper (No. 24. H.M. Stationery Office. 9*d*. net), which is the seventh in a series of Studies in Reinforced Concrete.

Even for well-defined initial conditions of loading, it is impossible to carry out a rigorous mathematical analysis of the stress distribution which, by reason of the effects of creep, must be in some way a function of the time the material is under load. The experiments have shown, however, that a simple approximate analysis can be used to estimate the strength of long columns under the conditions specified. The paper opens by showing how an expression may be derived for the value of the ratio of the applied load to the short column load in terms of the Euler load, the short column load and a coefficient proportional to the slenderness ratio. The short-period tests to destruction are analysed and cited to show this formula to be satisfactory for particular values of this coefficient.

The tests were made on columns 6 in. square in section, but in some cases, where high values of the slenderness ratio were required, a 3-in. square section was used. The columns and the arrangements for testing are illustrated by photographs and the test results are set out in tables and diagrams in which are shown also comparisons between the theoretical and the practical figures.

SCIENCE NEWS A CENTURY AGO

Sir William Jardine's "British Salmonidæ"

"A work of considerable, and in some respects of national importance," said the *Athenæum* of October 19, 1839, "has long been in preparation, and one number published by Sir William Jardine on the 'Scottish Salmonidæ'. The announced intention was a series of plates, illustrating the different species, accompanied by an octavo volume of descriptive letter-press. . . . Though the work was nominally restricted to Scotland, because the numerous lochs, rivers and mountain streams in that country offered the greatest facility for extended observation, it would of necessity have included almost all the British species. . . . Now our readers will hear, as we did, with surprise, that notwithstanding the scientific interest which must attach to such a work—notwithstanding the direct pecuniary interest, which many persons must have in the subject, and even its legislative importance, for we have had at least half a dozen different committees of inquiry appointed by Parliament or the Government—the work is likely to be abandoned for want of patronage—even though Sir William Jardine has consented to proceed with it if but sixty subscribers could be obtained, sufficient only to secure him against direct pecuniary loss. Surely with so many noblemen and gentlemen interested in the questions to be resolved by such a work—so many Scientific Institutions, so many Societies professedly devoted to inquiries in Natural History, scattered over the three kingdoms, this announcement will be sufficient to ensure its completion."

The author of this work, which ultimately appeared under the title "History of British Salmonidæ", was the distinguished naturalist Sir William Jardine, Bart., who was born in Edinburgh on February 22, 1800, and died on November 21, 1874, in the Isle of Wight. Entering the University of Edinburgh at the age of seventeen, he attended the lectures of Prof. Jameson and devoted himself to natural history and anatomy. At the age of twenty-one he succeeded to the title and estates in Dumfriesshire. With Prideaux Selby (1788–1867) Sir Stamford Raffles (1781–1826) and others he published "Illustrations of Ornithology" and at his home, Jardine's Hall, Dumfriesshire, formed one of the largest collection of birds in the country. His other writings included the "Memoirs of Hugh Strickland" and an edition of White's "Natural History of Selborne", and for seven years he was joint-editor of the *Edinburgh Philosophical Journal*. In 1860 he was appointed commissioner on salmon fisheries.

The Royal Navy and Screw Propulsion

On October 16, 1839, an experimental trip was made in the Thames with the S.S. *Archimedes* fitted with the screw propeller of Francis Pettit Smith, the trial being attended by Captain Sir William Symonds, the Surveyor of the Navy, Captain Sir William Edward Parry, the head of the Steam Department at the Admiralty, Captains Basil Hall, Austin and Smith, R.N., Peter Ewart the chief engineer of Woolwich Dockyard, Joseph Miller, Charles Manby and others. In the following spring the *Archimedes* was tried against H.M.S.V. *Widgeon*, a paddle-wheel vessel employed on cross-channel mail service, and it was the success of the *Archimedes* which led to the introduction of the screw propeller into the Navy.

APPOINTMENTS VACANT

Applications are invited for the following appointments, on or before the dates mentioned:

Secretary (woman) for the Macaulay Institute of Soil Research—The Director, Macaulay Institute for Soil Research, Craigiebuckler, Aberdeen (October 21).

Headmastership of Epsom College—The Secretary, Epsom College, Epsom, Surrey (October 25).

Temporary Lecturer in Gardening—The Principal, Cheshire County Training College, Crewe.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

UFAW Monographs and Reports. No. 4B: Instructions for dealing with Rabbits. Compiled by Capt. C. W. Hume. Third edition, revised and enlarged. Pp. 20. (London: Universities Federation for Animal Welfare.) 3*d*. [209

British Museum (Natural History). Economic Leaflet No. 3: The Silver Fish and Firebrat. Pp. 4. (London: British Museum (Natural History).) 1*d*. [229

Planetary Co-ordinates for the Years 1940–1960 referred to the Equinox of 1950·0. Prepared by H.M. Nautical Almanac Office. Pp. xvi+150. (London: H.M. Stationery Office.) 17*s*. 6*d*. net. [269

British Chemicals and their Manufacturers: the Official Directory of the Association of British Chemical Manufacturers (Incorporated). Pp. 394. (London: Association of British Chemical Manufacturers.) Gratis. [289

Imperial Bureau of Horticulture and Plantation Crops. Technical Communication No 12: Plant Hormones and their Practical Importance in Horticulture. By Dr. H. L. Pearse. Pp. 88. (East Malling: Imperial Bureau of Horticulture and Plantation Crops.) 3*s*. 6*d*. [210

Emergency Medical Services. Memorandum No. 4: Memorandum for the Guidance of Medical Officers and other Personnel at First Aid Posts. Pp. 14. (London: H.M. Stationery Office.) 3*d*. net. [210

Other Countries

Union of South Africa: Department of Mines, Geological Survey. Sheet 173: Oliphants Hoek. 42 in. × 25½ in. Sheet 173: Oliphants Hoek, Economic Details of the Iron and Manganese Occurrences. No. 1: Geological Map of the Iron and Manganese Occurrences; No. 2: The Occurrences on the Farm Bishop. 36 in. × 24 in. (Pretoria: Government Printer.) [209

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 177: On the Sodium Line Reversal Method of Determining the Temperature in a Gasoline Engine. By Umesiro Yosida. Pp. 193–210+7 plates. 50 sen. No. 178: On the Simple-Chromatic Photograph. By Daizo Nukiyama. Pp. 211–272. 95 sen. (Tôkyô: Kôgyô Tosho Kabusiki Kaisha.) [229

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 200: A Trypanosome encountered in a Tigress *Tryp. hirdanii* n.sp. By Dr. Zaki Mohamed. Pp. 16+2 plates. P.T. 2. Bulletin No. 206: Bud-Shedding and its relation to Pollen Development in Cotton. By Abdel-Ghaffar Selim. Pp. 10+6 plates. P.T. 2. Bulletin No. 214: The Discovery of Rickettsia in a Fish. By Dr. Zaki Mohamed. Pp. 6+1 plate. P.T. 1. Bulletin No. 222: The Quantity, Distribution and Composition of the Organic Matter and Available Nitrogen in Egyptian Soils. By David S. Gracie and Dr. Fahmy Khalil. Pp. 42+4 plates. P.T. 5. (Cairo: Government Press.) [229

Reports of the Japan Institute for Science of Labour, Inc. No. 41: Employment Tests for Rayon Factory Hands, by Dr. Sigemi H. Kirihara and Kazuo Nakamura; Die Forschung der spezifischen Augenkrankungen in der Kunstseidenfabriken, von Goro Akagi. Pp. 14. (Tokyo: Japan Institute for Science of Labour.) 50 sen. [289

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 42, Part 4: Studien uber die Pilzmucken (*Fungivoridae*) aus Hokkaido. Von Ichiji Okada. Pp. 267–336+plates 15–18. (Tokyo: Maruzen Co, Ltd.) [209

Report and Accounts of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein) for the Year ending 31st December 1938. Pp. 28. (Kirstenbosch: National Botanic Gardens.) [210

Government of Iraq: Ministry of Defence, Meteorological Service. Annual Report of the Director, No. 3: Year ending 31st March 1939. Pp. ii+9+19. (Baghdad: Government Press.) [210

Advisory Committee on Education. Staff Study No. 12: Special Problems of Negro Education. By Doxey A. Wilkerson. Pp. xvi+171. (Washington, D.C.: Government Printing Office.) 25 cents. [210

U.S. Department of Agriculture. Farmers' Bulletin No. 1824: The Black Hills Beetle, a Serious Enemy of Rocky Mountain Pines. By J. A. Beal. Pp. ii+22. 5 cents. Leaflet No. 185: Elm Bark Beetles By T. H. Jones. Pp. 8. 5 cents. Technical Bulletin No. 693: The External Anatomy of the Larva of the Pacific Coast Wireworm. By H. P. Lanchester. Pp. 40. 10 cents. (Washington, D.C.: Government Printing Office.) [21

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 144 SATURDAY, OCTOBER 21, 1939 No. 3651

PLANNED INTERNATIONAL ECONOMICS

THE high position of the annual reports of the Director of the International Labour Office among current reviews of the industrial and economic condition of the world has been earned only in part by the large resources of knowledge upon which they can draw. It is equally due to their wide outlook, measured but unequivocal judgment and their lucid estimate of tendencies and conditions, free from excessive detail of the work of the organization. These are largely due to personal qualities, and it is indeed a high tribute to Mr. J. E. Winant that his first annual report so admirably maintains the high standard set by his predecessors*. The fact that this report was published before the outbreak of war in no way lessens its present value.

Under the title "The World of Industry and Labour 1939", Mr. Winant reviews in succession the economic setting, the conditions of work and the standards of life. He emphasizes the way in which research and discussions on business cycle policy have led to general agreement that, whatever the initial cause of a business decline, active steps can be taken to prevent the secondary effects which used inevitably to follow it, and that this can be achieved by maintaining consumers' demand and by well-prepared public investment to replace rapidly any decline in private investment. This new attitude is conspicuous in the United States, and economic policy in Great Britain has shown similar features. While, however, the recession of 1937–38 presented mainly a problem of getting unemployed people back to work, the general concentration on problems of national defence has given a new turn to the economic situation. In this situation the urgency of meeting essential needs of national defence tends to cut into the standards of living, which it is the work of the International Labour Organisation to endeavour to raise.

To minimize such an effect it is first desirable to increase armament production so far as possible by utilizing unemployed resources, so as not to disturb ordinary peace-time activities more than necessary. Secondly, when it is necessary to restrict other types of activity or production, care should be taken to confine such restriction to the minimum and to those fields which least jeopardize present and future standards of living. While both public spending designed as a recovery measure and expenditure on armaments cause an initial increase in activity, the latter must be accompanied by measures to prevent expansion of consumption and a rise in standards of living.

These threats to established standards and the growing pressure on resources accentuate the importance of international economic co-operation. The rising standard of living in modern times has been made possible by the expansion of markets and the world-wide exchange of raw materials, finished products and capital investment. The hope of further progress rests on the continuance of this process.

The main problem is always to organize world economy in a way that will utilize fully the capacities of mankind in the production of the goods and services needed to raise the standard of life. Mr. Winant's survey of conditions of work indicates how true this is of internal economy also. Political conditions have been the main factor determining the check on the movement for shorter hours and the hesitation in giving effect to the application of the principle of the forty-hour week adopted by the Conference in 1935. This remains, however, a permanent problem of social and economic policy, and the realization of shorter working hours is one of the great additional benefits that will be assured when nations will agree to a just and lasting peace.

---

*The World of Industry and Labour, 1939. International Labour Office. Report of the Director. (Geneva: International Labour Office. 2s.).

There are, however, directions in which progress has been made. The development and extension of social insurance and the widespread attention being given to problems of nutrition, whether from the scientific side or in Government efforts to raise the level of nutrition by means of education and publicity, are noteworthy examples. Housing also is a matter in which the State is taking a more active part.

What is of special interest in Mr. Winant's survey is the way in which he indicates the extent to which solutions of these problems were being attempted in many countries, and frequently by very similar methods, however different the objectives or main character of policy. This is scarcely less striking than the equally emphatic conclusion that success in this matter of improving standards of health and labour and living conditions can only be imperfectly achieved except through co-operation between the nations.

This report is, however, of further interest for the admirable review of the twenty years' work which has now been completed by the International Labour Office. This record of development as well as of achievement is a welcome reminder of the value of international co-operation. The continuous constructive effort by which the International Labour Conference has developed its technique is at least as impressive as the record of its achievement in establishing an international labour code and in assisting the organization and co-ordination of social policy on which the improvement in living and working conditions depends. The work of the Conference on Migration for Settlement and of the International Public Works Committee are striking illustrations of the latter tendency in the last two years.

Besides this, the International Labour Office has functioned as an international clearing-house of information on labour and social questions. All these activities are based on its research work, and this possesses two special advantages. In its research work the International Labour Office must of necessity use the method of international comparison. The comparative method is to the student of social science what the laboratory is to the physicist. The Office cannot make experiments, but it is able to study the same phenomena in many different countries and thus eliminate what is accidental in the experience of any particular country and emphasize those things which are fundamental to all. Further, the International Labour Office is well placed for bridging the gulf between theory and action by bringing the conclusions reached directly before those capable of acting upon them.

Such research work, coupled with the broad view and tripartite character of the International Labour Office which naturally follow from its constitution, have already assisted it, in such fields as economic depression and unemployment, or in that of industrial diseases, like silicosis, or the standardization of labour statistics and improvement of their comparability, to guide world opinion towards more effective methods.

The extent to which the International Labour Office has succeeded in the last twenty years in furthering steady social progress is at least reason for not losing confidence or hope. The full contribution of the Office to effective international collaboration is not to be measured only by such activities. In approaching labour and social problems, we are forced to face the economic consequence of war and peace, whether in relation to trade conflict or war economy. When the present war comes to an end, the countries of the world will have to face the tremendous problems of readjustment to a peace-time economy. Economic re-employment problems will demand urgent solution. Some means of absorbing workers thrown out of employment by the slowing down of armament production will have to be devised.

In facing such difficulties the International Labour Office already possesses resources of immense value, but if it is to render the greatest possible service its energies must be directed now to the problems that lie ahead. The research work required must be commenced in this period of tension and uncertainties if we are to ensure that the mistakes of the past are not to be repeated. It is on this fact as well as on the proved value of the Organisation that Mr. Winant bases his appeal for financial support and for the resources which will enable it to function effectively. The extent to which the services of scientific workers are being enlisted at the present time should not lead them to overlook their responsibilities for participation in the constructive work of thinking out and planning the implications of a real peace.

THE SCIENTIFIC STUDY OF SOCIETY

The Study of Society
Methods and Problems. Edited by F. C. Bartlett, M. Ginsberg, E. J. Lindgren and R. H. Thouless. Pp. xii+498. (London: Kegan Paul and Co., Ltd., 1939.) 10*s*. 6*d*. net.

SINCE the autumn of 1935, a competent group of British psychologists, anthropologists and sociologists, ultimately twenty-three in number, has been meeting twice yearly in discussion. This unique, invaluable book, comprising nineteen chapters written by seventeen members of the group, is the outcome of their deliberations. Each chapter, we are told in the preface, "was first written by the group member whose name appears at its head. It was then duplicated and sent to all the other group members, so that it could be criticized and discussed at the next meeting of the group. . . . The criticism has been free and often drastic, but mainly constructive. Every member of the group has played a part in this discussion, and the volume is thus, in a literal sense, a co-operative product."

The purpose of the book, the preface explains, is to offer guidance to would-be investigators of social problems who "ask 'What shall we do?' and 'How shall we do it?' . . ." The preface further states that "the idea which inspired the preparation of the present book" was to issue for the benefit of prospective workers in the field of complex societies a companion volume to the well-known "Notes and Queries on Anthropology", first published in 1874, the aim of which was "to promote accurate anthropological observation on the part of travellers and to enable those who are not anthropologists themselves to supply the information which is wanted for the scientific study of anthropology at home".

Prof. F. C. Bartlett, in his important, but admittedly difficult, chapter on "Suggestions for Research in Social Psychology", addressed mainly to the laboratory psychologist, has no doubt as to the value of the contributions which the untrained worker can make to the subject (p. 25); and this view is supported, although with less enthusiasm, by Dr. R. H. Thouless (pp. 126, 127) in his carefully written contribution, "Scientific Method and the Use of Statistics". Prof. Bartlett lightens the last three pages of his article by devoting them to the amateur investigator, giving him eight useful hints and cautions, and eight promising themes of research. But in the rest of the book, save in Dr. Nadel's contribution, "The Interview Technique in Social Anthropology", which makes several references to "Notes and Queries in Anthropology", the practical interests and limitations of the untrained worker are largely ignored.

The nineteen chapters of this book are written with a quite unusual degree and uniformity of ability. They vary widely in length from the seven pages of Mr. E. Farmer's too meagre article on "The Study of Social Groups in Industry" to the fifty-two pages of Dr. E. J. Lindgren's article on "The Collection and Analysis of Folk-lore", which, like Prof. M. Ginsberg's deeply philosophical and learned chapter on "The Problems and Methods of Sociology", would rank as a 'classic' had it appeared in an encyclopædia, but is only to be grasped thoroughly by an advanced student of the subject. Less excusable is the surprising latitude which has been allowed to each member of the group in the mode of treatment of his subject. Stricter and single leadership of the group would have resulted in greater formal homogeneity and in a closer adherence to the three cardinal objects of the book: description of methods, summary of results already achieved, and mention of the outstanding problems at present most deserving of attack.

The failure of certain contributors to fulfil these objects is due to different, and sometimes excusable, causes. For example, Prof. T. H. Pear's chapter on "Some Problems and Topics of Contemporary Social Psychology" covers far too many topics: it is necessarily diffuse and superficial and appears at first sight popular and at times even trivial, but a second reading reveals considerable thoughtfulness in its preparation. On the other hand, the very subject of Dr. J. T. MacCurdy's interesting, though provocative, chapter on "The Relation of Psychopathology to Social Psychology" precludes much reference to past results and future problems. Again, Dr. Audrey Richards's contribution, "The Development of Field Work Methods in Social Anthropology", which is a veritable mine of information, thoughtfully and practically presented, and containing more than a hundred and twenty references, deals, as perhaps its title justifies, only with methods, not with results; and in her chapter on "Modern Trends in Child Psychology", Dr. Mary Collins makes virtually no attempt to indicate to the future investigator what are the most pressing problems that demand study. Indeed, this is scarcely to be expected after the impression, produced on her by her survey, "of a somewhat disordered array of experimental and test results, statistics and minute observations. It is often difficult to understand with what aim a particular investigation has been undertaken, or what importance should be assigned to the conclusions which are claimed to be established" (p. 85). Perhaps the most stimulating chapter for the quite untrained worker is that contributed by Miss Clement Brown on "The Methods of Social Case Workers", obviously the product of mature and wide experience and of unusual wisdom; while for the general reader Mr. A. Rodger's succinct but excellent chapter on "The Work of the Vocational Adviser" could not be bettered.

So many excellent articles—some of them (especially those by Prof. Bartlett, Prof. Ginsberg, Dr. Lindgren and Dr. Richards) brilliant—deserve to have been presented in a more attractive *format*, on pages with ampler margins and less crowded with type. This might, in the reviewer's opinion, have been achieved by the omission of the subjects of certain chapters, for example, those on intelligence tests, attitude tests, rating scales and the use of statistics, which are scarcely suitable for such a volume as this or have already been at least as adequately treated elsewhere. Dr. C. J. C. Earl's contribution, "Some Methods of Assessing Temperament and Personality", written from the clinical point of view, a last-moment substitute for an article by Dr. R. B. Cattell who, owing to his departure for the United States, was unable to preserve his membership of the group, seems also scarcely suitable; and Dr. O. A. Oeser's contribution, disappointing in the scanty information it provides of the Dundee Survey of which he was in charge, might have been more briefly included in Mr. A. F. Wells's chapter on "Social Surveys".

"The first aim," claims the preface, "which the group has set itself is achieved." This is undeniably true. Nowhere will the reader find so complete, so reliable, so illuminating and so critical an account of the methods of psychology, anthropology and sociology applied to the study of the problems of complex—and primitive—societies. Only by the wise use of such methods can man come to a final understanding of the social factors that determine harmony and conflict between groups and nations.

COMMERCIAL DEVELOPMENT OF AFRICA

Capital Investment in Africa
Its Course and Effects. By Prof. S. Herbert Frankel. (Issued by the Committee of the African Research Survey under the auspices of the Royal Institute of International Affairs.) Pp. xvi + 487. (London, New York and Toronto: Oxford University Press, 1938.) 10*s*. 6*d*. net.

When Lord Hailey was formulating the plans for the African Research Survey, Prof. S. H. Frankel was asked to prepare a memorandum on the course of capital investment in Africa. At the time, he doubted whether it would be possible to gather sufficient information in the time available, but eventually he undertook the task. Soon the study outgrew its modest origin and has consequently been published as a separate volume. The work is very fully documented and has more than a hundred detailed tables as well as a number of graphs, but the innumerable footnotes make the book a difficult one to read, more especially as many of the footnotes form really an essential part of the text.

For centuries Africa south of the Sahara played but little part in world economy. Africans had little to offer and as little to demand from traders, and hence came the slave trade—a trade which automatically destroys all others. Even the temperate lands of South Africa were regarded only as important in guarding the routes to India. The change came with the discovery of minerals in South Africa, and in a single generation European powers established sovereignty over most of Africa (that is, Africa south of the Sahara, to which the whole work refers). So late as 1878 only a quarter of the continent was occupied by Europeans; now it is the whole, with the exception of Liberia. Prof. Frankel dismisses in a page and a half the natural factors which retarded the 'opening up' of Africa, so that the scientific worker must regard his study as complementary to the main work, Lord Hailey's "An African Survey", and not as complete in itself. Yet such an economic study confirms conclusions based on other grounds.

The task of developing tropical Africa proved beyond the resources of the chartered companies—even though patriotic investors continued to find money without any return for half a generation—with the result that half of the £1,222,000,000 invested in Africa has been invested by Governments or public authorities. Even in the temperate south, the story is one of constant struggle in a land of outposts—until diamonds and then gold brought the economic revolution to South Africa. The value of diamonds produced in the Union has exceeded £320,000,000; £80,000,000 has been paid in dividends and from 1911 until 1937 alone the Union Government received nearly £33,000,000 in taxation from the industry. That the Government revenue fluctuated from more than £4¼ millions in 1929 to less than £150,000 in 1916 or £350,000 in 1934 presents another side of the picture. Despite the very successful development of the world's greatest gold field, it is estimated that the net returns on capital in Rand investments is only 4·1 per cent.

In recent years, as British investments in foreign countries have decreased, the proportion devoted to African issues has increased to about a quarter of the total foreign issues made in London. In this connexion Tables 46–48 are particularly interesting. No less than 77 per cent of the total capital invested in Africa is in British territories (with 85 per cent of the total trade). The Union of South Africa has received 43 per cent of the total capital and has 55 per cent of the total trade (1935). In the general position, there has been extraordinarily little change in the last thirty years so far as the relative position of British and French territories are concerned, but from 1907 until 1935 the share in the trade of the Union decreased from 61 to 55 per cent, whilst East Africa increased from 6·3 to 9·7 per cent. Those countries which show the smallest return, as expressed by value of foreign trade, in proportion to the capital which has been invested, include Tanganyika, South-West Africa, Angola, Mozambique, the Congo and the Cameroons. The best figures are shown by West Africa (Gambia, Sierra Leone, Gold Coast, and the French Territories). These facts give much food for thought, and indeed the whole work is a remarkable commentary on what is known of natural conditions and resources. L. D. S.

PATHOLOGICAL PROBLEMS OF FRUIT AND HOPS

Diseases of Fruit and Hops
By Dr. H. Wormald. (Agricultural and Horticultural Handbooks). Pp. 290+40 plates. (London: Crosby Lockwood and Son, Ltd., 1939). 17*s*. 6*d*. net.

Any advance in the most important science of plant pathology is soon common knowledge to scientific workers through the medium of scientific papers, but there still remains the necessity of passing on such knowledge to the grower. Authentic and reliable information of this kind must always be of interest and value, but good books appear all too seldom, and in the volume here reviewed it is stated that none has been printed on this particular subject since 1920.

It is therefore pleasant to welcome this account of the "Diseases of Fruit and Hops", written by Dr. Wormald, who has been plant pathologist at the East Malling Fruit Research Station for many years. It is a companion volume to one written some two years ago on insect pests of the same crops by Dr. Massee of the same research station.

There are fifteen chapters, the first three being devoted to approaching the subject in a general way before dealing with the specific diseases. Chapter i opens by discussing the factors which influence the growth of plants for good or ill and so determine whether they will be healthy or otherwise, quite apart from the question of attack by disease organisms. Then follows a description of the types of disease that may occur, bacterial, fungal, or virus, and particular stress is laid on that class of disorder resulting from unfavourable environmental conditions, the so-called 'functional' diseases which hitherto have been somewhat neglected by investigators. General principles for avoiding such troubles are given in some detail. Chapter ii deals with the making and the application of fungicidal sprays, with advice on suitable machines for this work. Chapter iii is taken up with descriptions of about a dozen outstanding diseases, each affecting many kinds of fruit trees, although each is again mentioned under its various hosts.

In the next eleven chapters we find a score of fruit plants and the hop plant dealt with either singly or in groups of similar types of fruits. The arrangement is to group the diseases at the beginning of the chapter, and then for each host in turn to describe the symptoms of the various diseases which may appear on its organs, taken in the order root, stem, leaf and fruit. The intention is to help growers to recognize the symptoms easily and thus identify the cause of the trouble. After each symptomatic description, suitable remedial measures are briefly discussed and in each case a limited number of references to further literature is supplied.

The last Chapter (xv) contains descriptions of several important fruit diseases which have not yet been recorded in Great Britain, some of which are so destructive that it is unnecessary to emphasize the value of such information to growers. The end of the book contains three indexes, one of popular names, one of scientific names, and one of authors.

The book is up to date and the author has discussed control measures in a practical and simple manner that will be appreciated by growers. The descriptions of symptoms are good on the whole, though the grower may not find these so readable. The author in his preface expresses the hope that the book will be of some interest to students, but in our view these should be catered for in a separate book. It is unlikely that the average grower will appreciate descriptions of microscopic spores or their measurements in microns. We feel that much space occupied by technical detail could have been used to better purpose. In any event, the drawings of microscopic objects on pp. 57, 58, 188, 245 and 266, give no indication of the magnification and might be most misleading. An excellent feature is the provision of forty plates containing no fewer than 130 photographs, but in the case of several diseases the text contains no reference to the appropriate plates.

There are some outstanding omissions. For example, silver leaf disease is fully dealt with but there is no mention of the very common and externally similar appearance known as 'false' silver leaf which may call for very different treatment. Again, when discussing the serious virus disease known as 'yellow edge' of strawberries, little mention is made of those so-called 'carrier' varieties, which, though infected, show no obvious symptoms for a considerable time; yet it must be important for growers to be made aware of the danger of trusting such plants near stocks which may be rapidly destroyed by the virus. In dealing with glasshouse fruit plants there is much more that could have been included, but perhaps this is not of very great importance in a book principally concerned with hardy fruits.

Despite these criticisms, the book should be a very valuable asset to fruit-growers. The diseases have been dealt with in a clear and able fashion by one of the foremost authorities on pathological problems connected with hardy fruit production.

D. E. Green.

ANTHOLOGIA ANTHROPOLOGICA

(1) The Native Races of Australasia

Including Australia, New Zealand, Oceania, New Guinea and Indonesia. A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer. Arranged and edited from the MSS. by Robert Angus Downie. (Anthologia Anthropologica.) Pp. vii + 390. (London: Percy Lund, Humphries and Co., Ltd., 1939.) 35s. net.

(2) The Native Races of Asia and Europe

A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer. Arranged and edited from the MSS. by Robert Angus Downie. (Anthologia Anthropologica.) Pp. vii + 400. (London: Percy Lund, Humphries and Co., Ltd., 1939.) 35s. net.

(1) IN the second volume of extracts from Sir James Frazer's notebooks, the principle of selection remains unchanged. In the main, material which has been used as evidence in his works has been omitted; and preference has been given to early or obscure sources, which would be outside any but an almost exhaustive knowledge of the literature. Hence it has been possible to give due recognition to the careful observation which has been made by Dutch travellers and officials of the natives of Holland's possessions in Indonesia. In these extracts from early travels, or from records appearing in periodicals and publications difficult of access to English readers, much material will be found of the greatest value to the student for the less familiar peoples of Sumatra, Java, Celebes and others of the more remote islands of Indonesia.

Although the records of the natives of the geographical regions covered by this volume—for example, Australia, New Zealand, Melanesia and in a lesser degree Polynesia—are among those most familiar in ethnographical literature, it will nevertheless be found that Mr. Downie's editing has made a most successful gleaning from the less well-known fields; but most welcome among his citations are the extracts from manuscript sources communicated direct to Sir James by their authors. Among these, two in particular require mention—one a note on the existence of totemism in Fiji by the late W. H. R. Rivers, which is an instructive example of his care in inquiry and his cogent method in ethnographical argument; and the second some observations by the late A. W. Howitt on the natives of south-east Australia, which are drawn from an unpublished work by that distinguished Australian anthropologist, and of which Sir James promises early publication.

(2) In this volume of extracts, it will be found that though "The Golden Bough", the "Folklore of the Old Testament", and other of Sir James's works have drawn liberally on the sources, the store is

still far from depleted, and much has remained for inclusion here of interest and of value for the student of magic, ritual and belief. Especially interesting are the extracts from the records of early Catholic missionaries, whether they deal with Tibet, Indo-China, or the Chinese Empire. Among the Tibetan, Chinese and Japanese extracts, especially valuable are those which include some of W. W. Rockhill's less accessible notes; while the records of the Korean and Siberian peoples might well serve as a starting point for a study of 'possession' and shamanism. The extracts from John Richardson's travels in Persia, which deal with a little-known side of Persian traditional belief, the angelic associations of the months, are of noteworthy interest for the study of the developments of magical thought in the East.

It was, perhaps, inevitable that the European material should scarcely lend itself to the treatment, which has proved so favourable in dealing with the records of more primitive peoples. The literature is both too familiar and too extensive. Hence these extracts, by contrast, must seem scrappy. Nevertheless, there is much of interest and value, among the more notable being early accounts of the northern form of witchcraft in Lapland and Scandinavia, with the southern European vampires and witches in contrast, and of the survivals in Central Europe of the worship of pagan deities.

The work of editing these extracts has been carried out by Mr. Downie once more with meticulous care, and he has enhanced their utility by a series of illustrative maps and a comprehensive index.

ARTIFICIAL RADIOACTIVITY

(1) Atomes, radioactivité, transmutations

Par Maurice de Broglie. (Bibliothèque de Philosophie scientifique.) Pp. 270. (Paris: Ernest Flammarion, 1939.) 22 francs.

(2) Künstliche Radioaktivität und ihre kernphysikalischen Grundlagen

Von Prof. Dr. W. Hanle. Pp. viii+114+7 plates. (Jena: Gustav Fischer, 1939.) 12 gold marks.

(3) Künstliche Radioaktivität: Experimentelle Ergebnisse

Von Dr. Kurt Diebner und Dr. Eberhard Grassmann. Pp. xi+87. (Leipzig: S. Hirzel, 1939.) 12 gold marks.

(1) THE first of these books represents one of the most pleasing accounts of the present position of nuclear physics that the reviewer has read. It gives a most up-to-date description of the neutron and its properties, of natural and artificial radioactivity and of the new chemistry of the nucleus, couched in very clear language and eminently suitable for the general reader. At the same time, all important features of modern work in these branches of physics are covered in an extraordinarily complete manner. The work can confidently be recommended to all students, particularly those who wish to improve their knowledge of French.

(2) The second book is also meant for the general reader, but it is rather more restricted in its range of subject-matter. It gives a brief introduction to the fundamental conceptions of the structure of the atom, a description of the elementary particles of modern physics and their role in nuclear structure, and a short but very beautifully illustrated account of the experimental methods used in experiments on nuclear transformations. It is a sad reflection that in recent years Germany has taken so little part in the development of these methods. The book also describes in some detail the various types of nuclear changes and the methods of producing artificial radioactivity, a special section being devoted to γ-radiation. It concludes with a few remarks on possible applications of the results of nuclear physics experiments to chemistry, biology, medicine and technology, and contains a striking series of coloured graphs illustrative of the transformations of natural and artificial radioactive elements.

(3) The third book is really a very valuable set of physical tables. In it are set forth the data on artificial radioactivity published up to September 1938. There is no attempt at describing the methods of experiment or of analysing the results in a critical manner. The work is intended as a reference book for the research worker and the teacher who wishes to know whether a particular nuclear reaction has been studied, and so on. A list of nearly 350 references is given, and in addition to a full analysis of the separate nuclear reactions for each element under such headings as artificial radioactivity produced by α-rays, artificial radioactivity produced by protons, etc., the data is also set forth in tabular form. A very large coloured diagram or graph of the stable and radioactive isotopes is included.

L. F. Bates.

ENGINEERING BIOGRAPHY

Great Engineers
By Prof. C. Matschoss. Translated by Dr. H. Stafford Hatfield. Pp. xi+381. (London: G. Bell and Sons, Ltd., 1939.) 12*s.* 6*d.* net.

IN this entertaining volume of biographical studies of some forty mechanical engineers, mainly German and British, the last notice is of Oskar von Miller (1855–1934) who on his seventieth birthday, May 7, 1925, had the satisfaction of witnessing the opening of the "German Museum of Masterpieces of Science and Technology", otherwise known as the Deutsches Museum or the Munich Science Museum. As a young man Miller had visited Woodcroft's Patent Office Museum at South Kensington, and the Conservatoire des Arts et Metiérs in Paris, and had been impressed with the thought that no such museum existed in Germany. After a successful career as an engineer his thoughts again turned to the question of a technical museum for his native land, and in 1903 he was able to found a society for the promotion of such an institution. To this object he devoted his time and energy unstintingly and with great success. Germany now has a museum worthy of her own great contributions to industrial enterprise, and representive of mechanical progress throughout the world.

In the task of familiarizing German students with the work of the great pioneers Dr. Matschoss, the author of this volume of biographies, has played a part second only to that of von Miller, whose efforts he furthered in every possible way. As editor of the publications of the Verein deutscher Ingenieure, then as director of the society, as the author of historical works and as a lecturer he has become known in both hemispheres as an authority on engineering history. This latest work from his pen, therefore, is no ordinary compilation, but a series of studies by one familiar with every aspect of the subject. It is a volume which should be read by every engineering student. The men recalled came from all sorts of homes, began life under various conditions, but they one and all by the exercise of their talents made notable contributions to knowledge. But, says Dr. Matschoss, "the great deeds of great men are not bound up with their lifetime. They take ever-growing effect in course of time, far beyond the earthly existence of the individual". It is, however, only history which can give us a measure by which a just estimate of great achievements can be made.

The book is arranged in three sections. First there is a brief review of the great engineers of antiquity. This is too short to be of much value and the subject probably did not appeal much to the author.

In the second part is a most admirable chapter on the German gunsmiths and others on Gutenberg, Leonardo de Vinci, Agricola and Otto von Guericke. It is probable no British writer would have included Gutenberg or Otto von Guericke in a volume on "great engineers". The choice, however, can be justified, for as Dr. Matschoss says, "perhaps no technical advance in any field has had so great an effect in promoting development in all other fields of human labour as the invention of printing". Looked at in this light, printing falls within Tredgold's famous definition. Otto von Guericke, it is true, was more of an experimentalist than an engineer, but he carried out his experiments in the manner of an engineer and paved the way for engineering developments. Historians of physical science may be interested to learn that Guericke's experiments with the hemispheres were not made before the Reichstag in Regensburg, in front of the Emperor and the German princes, but at Magdeburg and at a later date than that usually given.

The third and longest section of the book begins with Watt and the pioneers of the steam engine, and the last five studies are of Parsons, Edison, Westinghouse, Carl von Linde and Oskar von Miller. Among the other British engineers dealt with are Trevithick, the Stephensons, Maudslay, Nasmyth, Bessemer, and Sydney Gilchrist Thomas. America is represented by Fulton and by Ericsson, who though born in Sweden passed the greater part of his life in the United States. As might be expected, the studies of German pioneers are particularly good, and those on Holtzhausen, Dinnendahl and Reichenbach contain much information not known generally. But the careers of Alfred Krupp, Werner von Siemens, Otto, Langen, Daimler, Maybach and Diesel, and of Carl von Linde are all equally interesting. One could have wished that Dr. Matschoss had spread his net a little wider and had included one or two sketches of the engineers and inventors of a country which can boast of Seguin, Montgolfier, Fourneyron, Bourdon, Schneider, Giffard, Hirn, Clapeyron, Rateau and many others. We are altogether too unfamiliar with the history of engineering in France.

The book is well printed, the portraits are excellent and there is a good bibliography. There are one or two slips in the text. George Stephenson is stated to be buried near Chester, instead of

Chesterfield, and Robert Stephenson is said to be buried next to Watt in Westminster Abbey. Watt is buried at Handsworth, and Robert Stephenson was laid next to Telford, in the Abbey, at his own request. The statement about Ericsson's *Robert F. Stockton* should be altered to show that she did not cross the Atlantic by steam.

On the whole, many engineers will think that Dr. Matschoss has given us the best volume of engineering biographies so far published. He is naturally proud of the pioneering work of his countrymen, but he says "we are indebted to other nations as much as they are indebted to us".

BIRDS OF BRITAIN

The Handbook of British Birds
Vol. 3. (Hawks to Ducks.) By H. F. Witherby (Editor), Rev. F. C. R. Jourdain, Norman F. Ticehurst and Bernard W. Tucker. Pp. x + 388 + plates 61–92. (London: H. F. and G. Witherby, Ltd., 1939.) 25*s*. net.

THE third volume of this exhaustive work has just made its appearance, and is not inferior to its two successors in its high standard. The value of this volume is heightened by a number of admirable coloured sketches of geese by Peter Scott, his pictures of grey lags and of barnacle geese being particularly fine. Credit is also due to the producers of the book for having brought out so well the fine points of these sketches, always liable to be lost in reproduction. Mr. J. C. Harrison's delicate and masterly delineation of birds also finds a place in this volume. His plates (81 and 82) showing the adult males and females of British ducks in flight are delightful. No bird artist can excel Mr. Harrison in bringing to the mind the sense of movement in birds. His pintail and long-tailed ducks in flight are particularly attractive and he has caught the wise expression in the eye of the tufted duck—an expression which I often noticed in the tufted duck of Fallodon-full-winged birds which had been tamed so completely by Lord Grey that they were entirely without fear.

The birds which are written of in this volume are, among raptores, the falcons, golden eagle and sea eagle, buzzards, harriers, osprey and kite. It is gratifying to know that the kite, which is still confined to strictly protected areas in Wales, has increased from five birds in 1905 to fifteen birds in 1938. Of these fifteen kites, twelve were paired and three young were reared. Of the osprey we have no such cheering news. The two ancestral nesting haunts of this fine bird were on Loch an Eilein on Strathspey, where the last eggs were laid in 1899, and Loch Arkaig in Lochaber, where the eyrie, on the oak tree on the island was last occupied in the year 1902. But there is some evidence that two eggs were laid and one young bird reared in a nest in the same district at a considerably later date than 1902, and even during the present year (1939) there are reports of ospreys being seen in the Highlands.

Geese and swans, herons and bitterns, find a place in this volume, and no fewer than 160 pages are devoted to the British ducks. Here is to be found an interesting map showing the nesting haunts of the eider around the British coasts. It is curious that this fine duck should be numerous at the southern fringe of its range; that it should nest plentifully on the Farne Islands—where it is known as St. Cuthbert's Duck and, it is said, owes its remarkable tameness to the work of St. Cuthbert—and on Coquet Island, and yet should be unknown as a nesting species south of that isle off the Northumbrian coast.

In the notes on the golden eagle—pp. 39 and 40—there are one or two mis-statements which may perhaps be corrected in a later edition. It is said that the golden eagle "formerly bred on sea-cliffs, but is now confined to moorland". This statement should be amended, for there are at the present day several golden eagles' eyries on sea-cliffs in Scotland. Then, again, we are told that the eyrie "in a few cases" is in trees, but in the Central Highlands a tree is a more usual nesting place than a cliff. The eyrie is a bulky structure, and during the summer of 1939 I saw an eyrie in an old pine, and estimated the depth of this eyrie as no less than fifteen feet: the nest must have been of very great age. To the statement that "in the west bracken is a much-favoured nesting material" I would say that in the many eagles' eyries I have examined I have never once found any trace of bracken. It is stated in the notes that fresh eggs are found usually about April 1–10, but in my experience the eggs are found during March 20–31, and any date later than this is unusual.

To the statement that both golden eagles provide food for the eaglets I would say that my wife and I have watched at hides at a number of eyries, and although our watching hours must have numbered many hundred, we *never* saw the female eagle bring in food. The hunting was done entirely by the male, but the female fed the young, and cleaned up the eyrie by carrying away any old carcasses of prey.

It is stated that the young eagles remain with their parents until winter, but I would say rather that the month of October is the time they usually separate; they may then often be seen perched on some tree or on some rock, and permit of a comparatively near approach. S. G.

MATHEMATICS OF THE ARMAMENTS RACE

Generalized Foreign Politics
A Study in Group Psychology. By Dr. Lewis F. Richardson. (*British Journal of Psychology*, Monograph Supplements, 23.) Pp. viii+91. (Cambridge: At the University Press, 1939.) 8*s*. 6*d*. net.

THE application of mathematics to group phenomena such as those of the kinetic theory of gases and statistical mechanics has long been accepted by physicists. The extension of such methods to biology, economics, and psychology is also widely accepted. Dr. L. F. Richardson, who is well known for his work in physics and meteorology, but who also holds a degree in psychology, makes the daring attempt to deal mathematically with foreign politics, particularly with the growth of armaments and the motives which produce this growth. The author's method is to take a verbal argument of a leading statesman and replace it by differential equations. Thus, Sir Edward Grey said: "The increase of armaments that is intended in each nation to produce . . . a sense of security, does not produce these effects. On the contrary, it produces a consciousness of the strength of other nations and a sense of fear." This statement is replaced by a pair of differential equations, the meaning of which is certainly not exactly the same as that of the original statement. The differential equations really assert that for two nations, the rate of increase of expenditure on armaments by either is directly proportional to the total expenditure on armaments by the other. This variation of Grey's words is adopted because it is easy to deal with mathematically. However, it is immediately corrected by adding other terms, with a negative sign, to represent the restraining influence due to the burden of expense and fatigue, an influence not mentioned by Grey. The next step is to take account of an objection by Mr. Amery: "It was . . . in those insoluble conflicts of ambition and not in the armaments themselves that the cause of the War lay." An additional positive constant term is added to each equation to represent the extra rate of growth of the armament burden due to national grievances or ambitions.

Having set up the differential equations, it remains to solve them, and then to give the political interpretation of the solution. The exact solution offers no difficulty to mathematicians or mathematical physicists, as the equations are of a well-known type. Curiously enough, somewhat similar equations occur in a paper on "The Ignition of Explosive Gases". To meet the needs of those without much knowledge of mathematics, Dr. Richardson gives also a simple graphical treatment, which is similar to Marshall's diagram for the economics of international trade. In both the mathematical and the graphical treatment, the most important part of the work is to find out in what conditions the solutions become infinite. An infinite cost of armaments is interpreted as denoting war, though it might have seemed more natural to have taken it as bankruptcy. The final conclusions are difficult to state accurately in concise form, but they are roughly that there is a general tendency for peace to be unstable. This instability can be reduced by removing grievances, decreasing threats, and increasing international trade and other forms of co-operation. It is emphasized that increase of armaments, though undertaken as a measure of defence, tends to lead to war.

Opinions will differ as to the validity of this reasoning. Some may think that the author has made the first rough approximations in a new branch of science, which can be polished and corrected later. The mathematician, who knows that a small change in a differential equation can sometimes produce a large change in the solution, may be distrustful of the way in which the fundamental equations were obtained. Students of human affairs will assert, perhaps too hastily, that foreign politics cannot possibly be treated mathematically. However, the subtitle of the monograph is "A Study in Group Psychology", and possibly the method may be valid so far as the effects are entirely due to the group mind, to which a kind of statistical mechanics may be expected to apply. The author gives a numerical test of his theory for the years 1909–14, and it seems to accord closely with the facts for that period. One great defect is that the theory does not include the effect of "intelligent aggression planned by a leader as moves in a game of chess". Unfortunately, this is the aspect of the question which is of vital interest to millions to-day. H. T. H. PIAGGIO.

FILM REACTIONS AS A NEW APPROACH TO BIOLOGY*

By Prof. Eric K. Rideal, M.B.E., F.R.S.,
University, Cambridge

TOWARDS the end of the last century the biologist and physiologist were agreed that the biological entity was the whole living unit. This century has seen an attack on biological problems by the physical and organic chemist. The study of the living unit has been dropped, and in its place we find investigations on specialized processes such as oxidation and reduction or catalytic reactions. It is an unfortunate fact, as the late Sir William Hardy clearly pointed out, that in this method of approach the mechanism of the co-ordination or the integration of the activities of an assemblage of cells must remain insoluble. It is this very point which I think deserves some consideration. We must conclude that the mechanism of integration is at any rate dependent on a pre-existing organization of at least the major operative portions of the assemblage of cells. This raises a number of important problems such as: what types of organization are to be found in living material; how far control over chemical reactions can be effected by modification of the type or extent of such organization; and again how far different types of organization can modify such important factors as the chemical or physical state of a material or chemical equilibria in reacting systems; and lastly, what new properties or reactions make their appearance as a direct result of organization.

Whilst it has been frequently stated that one of the chief characteristics of living matter is that it contains a relatively large proportion of matter in what we designate the colloidal state, a closer analysis indicates that in fact the colloidal properties of living matter are due to the fact that an exceptionally large fraction both of material and of energy is present in films, membranes, fibres, fine capillaries and the like. It thus seems pertinent to inquire a little into the properties of surfaces of separation between bulk phases or of matter in the boundary state. These surfaces of separation can be considered as a new phase—the interphase—and for our discussion we must examine this phase and find in what respect it differs from the enclosing bulk phases.

While we must pay attention to the static properties such as composition, form and orientation, we must not forget that it is the dynamic properties of ingress and egress, of flow and chemical action in and with the two-dimensional contents of the phase, that we are particularly interested in, but any integrating features of the former are of great importance if it can be shown that they produce effects in the dynamics of the system which are not to be found in non-structural liquid or vaporous phases.

We already know that the composition of the interphase differs from that of either of the bulk phases in contact with it, and the general principles governing relationship between its composition and its three-dimensional partners were clearly enumerated by Willard Gibbs and Sir J. J. Thomson. Equally important are the considerations of Sir William Hardy and Irving Langmuir, who showed that in many cases when dealing with an interphase we were actually examining a monolayer—a hypothesis suggested by Lord Rayleigh. Finally, we know the molecules contained in the monolayer are orientated with respect to one another and to the plane of the interphase.

We have referred to the fact that molecules in a monolayer are orientated relative to one another and to the substrate and that this orientation can be altered by extension or compression. If the molecules in the monolayer undergo reaction with a reactant dissolved in the substrate, the rate of reaction may be modified by the charge in molecular orientation of the former. This is equivalent to a control of the steric factor and determining the path of approach of a reacting molecule or ion to the reactive portion of the other reactant. In this way both the reaction velocity and the height of the energy barrier or apparent energy of activation may be altered.

In the following table is given an example of such a variation in reaction effected by change in compression of a monolayer.

Attack on Lecithin Monolayers by 0·001 per cent Black Tiger Snake Venom at 20° and pH 7·2.

No. of lecithin molecules per sq. cm. × 10^{-14}	Half-life in minutes.
1·04	0·5
1·27	4
1·67	32
2·11	90

It is interesting to observe that these film reactions can be carried out with minute concentrations of strongly adsorbed reactants. Thus in the case of the attack of lecithin by snake venom to form lysolecithin, a half-life of about one hour is obtained with a concentration of venom as low as $2 \cdot 5 \times 10^{-6}$ per cent. When cobra venom is examined by this method, it is found that only in extreme dilutions does any reaction occur. This inhibition at higher concentrations is due to proteins present in the cobra venom which are absorbed in preference to the enzyme by the lecithin monolayer. Egg albumin, although not so effective when added to black tiger venom, will produce a similar result. In addition to lecithinase present in snake venoms, other enzymes have been studied, and among them crystalline trypsin and crystalline pepsin, which rapidly digest monolayers of caseinogen, the former at *p*H 8 and the latter at *p*H 2. When the purified and crystalline enzyme preparations are employed, these enzyme actions on the protein monolayers behave exactly as in bulk phase, although the protein has undergone a process akin to denaturation. With unpurified proteolytic ferments, on the other hand, fatty acid protein complexes are invariably present which give rise to other phenomena.

---

* From the presidential address to Section B (Chemistry) of the British Association, delivered at Dundee on August

In the reactions which we have discussed, the chemical processes involved do not differ from those which would occur in similar systems in the disorganized state and the only effects of molecular organization into orientated monolayers are noted in the alterations produced in accessibility of the groups as revealed by the rapidity of the reactions and in the apparent energies of activation.

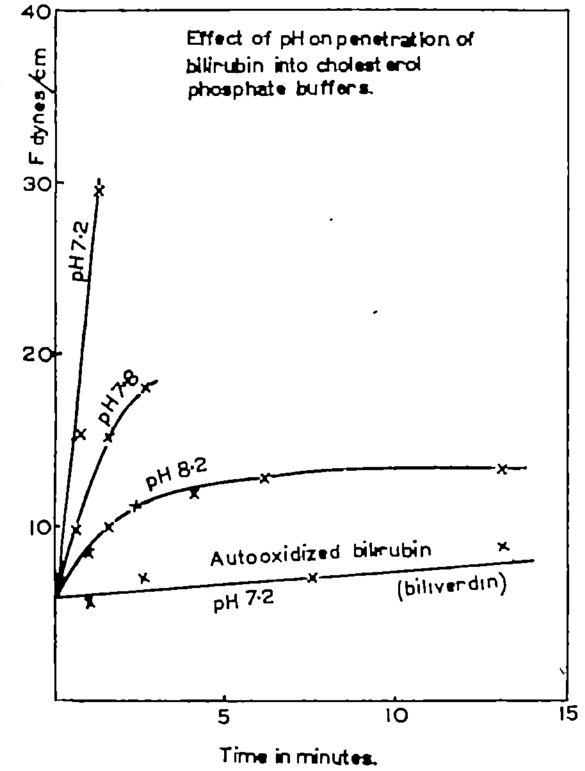
A further consequence of molecular orientation at interphases is found in those cases where radiation incident on the surface produces photochemical action after absorption of quanta by chromophoric groups in the monolayer. If, as is the case in ring compounds, the extinction coefficients are different along the three molecular or group axes, the photochemical reaction rate can be varied by alteration of the orientation by compression. Thus the rate of photochemical hydrolytic fission followed by oxidation in protein monolayers at those points along the chain where the chromophoric groups are situate can be varied within wide limits by simple expansion or contraction.

There are several processes in which an alteration in the properties of an interphase bring about a number of varied biological processes of great importance. I may mention the phenomena of lysis, agglutination, sensitization and the lethal activities of certain substances on various types of cells and micro-organisms.

Whilst the extent of mutual miscibility of two liquid phases is usually interpreted in terms of the relative internal pressures of the two liquids, we note from the molecular point of view, especially in the case of the large complex and the biologically important material, that we are really concerned with specific molecular interactions which may be identified as being due to those forces operative between the non-polar and the polar portions of the molecules respectively. In two-component monolayers the two molecular species are adlineated in respect to one another, and we should thus anticipate that it might be possible to form relatively stable two-component complexes which in three dimensions would only be detectable in terms of mutual solubility, and when a mutual solvent was present as a third component might not be observable at all. These conclusions are indeed fully borne out by investigations on two-component monolayers. It is found, for example, that strong complexes are formed in mixed monolayers of a variety of substances such as saponin with cholesterol or digitonin, or cetyl amine or sulphate with cholesterol.

Examination of a great variety of these systems has demonstrated that the free energy of formation of the complex is constitutive in the sense that its magnitude is dependent on the extent of interaction between the polar reactive groups and also that of the van der Waals interaction between the non-polar portions of the reacting species. The difference in properties of mixed films containing cholesterol on one hand and those containing, for example, epi-cholesterol is most marked, but when models are made of the two molecular systems, it becomes quite evident that the ease of adlineation of the hydrophobic portions of the molecule and the relative orientation of the polar group with respect to the axis of the molecule are the determining factors. The free energy changes involved in formation of these two-dimensional complexes are of the order of some 10,000 cal. per gm. mol. Complexes containing the constituents in ratios other than one to one can be prepared; thus cetyl alcohol and cetyl sulphate can form both a 1 : 1 and a somewhat unstable complex in the ratio of 1 : 3, whereas elaidyl alcohol produces an unstable 1 : 2 but no 1 : 3 complex. It is probable that with a more extended investigation of these interesting systems the basis for the most elementary form, that is, a two-dimensional crystallography of the type envisaged by Patterson, may be laid down.

I might mention in passing that the effects of cis-transisomerism on the free energies of the complexes are very characteristic and fully confirm the hypothesis we have advanced as to the importance of molecular adlineation; thus saturated aliphatic hydrocarbon chains with different reacting polar groups will form stable systems, likewise trans-olefinic chains can penetrate and pack both with one another and with saturated chains, but the cis- form is not capable of such adlineation. From the biological point of view, I think that the most interesting property of these systems lies in the mechanism of their formation, for on injection of one of the reactants beneath a monolayer of the other, it is found that penetration of the latter by the former will take place to form the complex monolayer. This penetration, if carried out at constant area, naturally involves a rise in the two-dimensional pressure, or if at constant pressure a rise in area is involved. We have indeed examined the formation of complexes under both these conditions, and the changes involved are frequently remarkable. Thus the injection of a few mgm. of saponin under a film of cholesterol compressed to a pressure of 10 dynes/cm. will cause an increase of pressure of more than 50 dynes/cm.; whilst a film of cetyl alcohol at 20 A.^{2} per molecule expands to no less than 78 A.^{2}, even when the pressure is maintained at 23 dynes/cm. on the injection of only 1 mgm. in 300 c.c. of cetyl sulphate.



In some cases a small alteration in the pH of the substrate may affect the ease of penetration of a reactant to a marked extent. In the accompanying diagram is shown the effect of such a variation on the rate and extent of penetration of bilirubin into cholesterol as a function of the pH.

It is possible to examine the reactivity of various substances in respect to penetration of monolayers. I have referred to the penetration of monolayers of cholesterol, and we note that some substances such as digitonin or cetyl sulphate or amine possess this property to a remarkable extent. Of the other important cell wall constituents we include phospholipins and the proteins. Little information as yet is available on phospholipins, but our knowledge of the reactions of this type in the case of the proteins, especially the alcohol-soluble and thus readily dispersible protein gliadin, has been greatly extended in recent years.

The stability of the protein monolayers is, as we have seen, due partly to their mutual association; if these are broken down by stronger associating reactants we might anticipate a dispersion of the monolayer resulting in a solution of the protein in the form of a protein-reactant complex. This phenomenon is readily observed on injection of even minute quantities of such substances as sodium oleate, cetyl sulphate, or psychosin beneath a protein monolayer.

Other substances may react by penetration into the protein layer but not effect dispersion. By spreading monolayers with various head groups and examining the reactions caused on injection, it is possible to identify the reacting group in the protein monolayer. A characteristic group of protein complexes formed in monolayers is the lipo proteins; thus gliadin forms a remarkable complex with cholesterol in the ratio 4 : 1 by weight. Here the cholesterol is anchored to specific groups in the gliadin, in particular the amino and carboxylic groups. At high pressures (20 dynes) the cholesterol is forced up above the protein monolayer and the surface becomes one essentially of cholesterol. Nevertheless the cholesterol is still anchored to specific portions of the protein, for on release of the pressure the lipoprotein film is re-formed. This extrusion and re-forming process can be repeated several times before the complex structure breaks down. It is interesting to note that saponin, which penetrates cholesterol with extreme ease, but proteins only slightly, will penetrate these lipo-protein films except at those pressures where the cholesterol is separated from the substrate by the protein monolayer to which the cholesterol is anchored.

It thus appears not unlikely that the materials such as cytoplasm, and especially in the more stratified chloroplasts, must be regarded as a protein gel framework to which is attached the enzymes, the phosphatides and lipoids, and the means of attachment is as we have seen due to the interaction both of the non-polar as well as of the polar portions of the molecules concerned. Another important conclusion to be drawn from monolayer experiments is that these penetrative reactions involve not only a new head group interaction, but in many cases also the breaking of such a head group interaction already existing in the monolayer prior to penetration. Several biological analogies may be mentioned. Thus, since lysis of blood cells can be brought about both by protein and cholesterol penetrants, we must conclude that it has lipo-protein surface. Several micro-organisms can be sensitized for lysis by cholesterol penetrants by a prior treatment with cholesterol. Again, cilia of Mytilus appear to be mainly lipoidal, those of Paramecia chiefly protein, as judged by the criterion of penetration.

The carrier action of desoxycholic acid on fatty acids can readily be demonstrated in monolayers, as desoxycholic acid does not interact with other lipoids, nor to any great extent with proteins. We find also that the hæmolytic activity of a long-chain alcohol is negligibly small owing to the fact that it is practically insoluble in water; but it readily forms a soluble complex with a long-chain sulphate and can be transported to the cell wall in this form. There both the sulphate and the alcohol can penetrate separately, the former acting both on the protein and on the lipoid, the latter only on the protein, and produce lysis.

Yet another reaction of this type has been described by Peters and Wakelin, who found that the complex ovoverdin containing protein and astacin could be split to form a lipo-protein containing soap by the addition of small amounts of saturated long-chain fatty acids setting free the astacin. On the addition of calcium ions the process is reversed. They likewise direct attention to the fact that it seems probable that the co-enzyme in an oxidase system may be separated from the enzyme by the formation of such a lipo-protein complex.

Somewhat more complex in behaviour are the blood coagulants, heparin and the synthetic sulphate celluloses. It is found that their biological activities run parallel to the ease with which they penetrate films of cholesterol. It is not unlikely that they operate by breaking down a cholesterol cephalin complex, setting the latter free.

We have referred to the fact that, for the penetration of a monolayer by a substance injected into the substrate, primary interaction between the reactive head groups occurs, followed by solution, that is, penetration and adlineation, of the tail. In the case of reactants containing two or more reactive head groups, it is found that these can associate with head groups in the monolayer and thus form a series of links. Here another important factor is found operative. If the injected bipolar molecule possess a hydrophobic portion of such a structure that it can pack or adlineate with its neighbours beneath the monolayer, the resultant composite film is remarkably stable. Thus the long-chain dibasic acids are adsorbed on to, but do not penetrate, monolayers of amines, whilst the diamidines are adsorbed by, but do not penetrate, monolayers of cholesterol. Substances containing the phenolic group are of particular interest in this respect, as they include a number of biologically important substances. They react with amine groups quite readily, and to a less extent, with the imido group in a polypeptide chain. Gallic and tannic acids react with great ease with monolayers both of amines and with proteins. It is interesting to note that the reactivity of tannic acid with the spaced amine groups of the protein is high, and that subsequent injection of fatty acids beneath such treated monolayers results in the dispersion of the galloylamine or galloyl-protein complex film, but not in the tanned one—an indication of the effectiveness of the interlinkage produced in the non-dispersible network by the multiple point contact of the large tannic acid molecules.

Another significant biological similarity has been noted when we measure the extent of penetration of a series of substances containing identical hydrophobic 'tails,' for example a C_{12} chain, but with different head groups, into a monolayer of a typical lipoid such as cholesterol. In all cases the extent of interaction as measured by the increase in surface pressure caused by the injection of 0·33 mgm./100 c.c. under a film of cholesterol originally extended to 40 A.^{2} per molecule is found to be closely parallel to the hæmolytic activities and lethal activities on Paramecia of these substances.

These latter can be placed in order both of monolayer penetration and biological activity:

$$RNH_3^+ > RSO_4' > RSO_3' > RCOO' > RN(\overset{+}{C}H_3)_3 > RNH(\overset{+}{C}H_3)_2 > \text{bile acids.}$$

We may conclude that the most reactive group in the protein macromolecule is the amino group, since the —NH—CO— group is poorly reactive, a point of some interest when we examine the reactions of lecithin and of cephalin. This order of head group reactivity receives confirmation when penetration into monolayers containing these head groups is examined, that is, on inverting the system. When we compare the reactivities of a series of long-chain compounds with identical head groups, it is found that biological activity and film penetration commences with C_8 when attached to a very reactive head group, with C_{12} when attached to a poorly reactive group, and reaches a maximum value at *c.* C_{16}. It is interesting to note that it is not necessary for all the carbon atoms to be in the form of a chain but that they may be enclosed in rings; thus activity commences with diphenyl derivatives and increases with addition of carbon atoms to an optimum, as in the bile acids, stearic acid, diethyl stilbene and benzpyrene. By examining the reactivity of substances containing two reactive groups at various spacings underneath protein monolayers, it is possible to obtain some idea as to the statistical distribution of the reactive groups in the monolayer. It would appear that some 12·5 A. is the mean distribution of the amine groups beneath a gliadin film. In the native protein such spacings are naturally different, and thus reactions involving two-point contact will not take place in bulk phase unless the spacing is unaffected by two-dimensional unrolling of the protein.

We have referred to the modification which must be introduced into either the Overton Meyer or Traube concepts of biological activity, that is, lipoid solubility or capillary activity necessitated by the concept of specific head group interaction. We see that a definite limit is also set to the hydrophobic portion of the molecule, not only on account of the decreasing solubility in the aqueous phase causing difficulty in transport, and on account of the ease of adlineation or packing having an optimum of C_{16} for association with sterols or fats, but also because a new phenomenon sets in with long chains, namely, dispersion of the monolayer. It is possible that this phenomenon of film collapse and dispersion may be a generally important factor in setting the upper limit to the chain length, or more generally the capillary activity of homogeneous series of biologically important substances, for example, anæsthetics. This dispersion of protein films may have biological counterparts in adsorption on specific portions of the cell surface similar to the hæmolytic activity of long-chain compounds such as oleic acid, which readily disperses protein films.

This method of attack permits us to investigate the nature of the coatings of cells or unicellular animals and plants by examining the effects of lipoid or protein penetrating substances on them.

Thus both red cells and Paramecia are affected by both lipoid and protein monolayer penetrating (cytolysing) or adsorbing (agglutinating) agents, and we deduce that their surface structures must contain lipoproteins or consist of a lipoid protein mosaic; whereas certain other unicellular animals frequently found associated with Paramecia and in addition the cilia of Mytilus are not affected by protein dispersants but are readily influenced by lipoid penetrating agents, and their coatings in consequence must be chiefly lipoidal in nature.

Examination of the carcinogenic hydrocarbons by the monolayer technique reveals the interesting fact that, whilst they themselves are unreactive, they are readily converted into extremely reactive water-soluble photo-oxides. These substances are not only reactive to protein monolayers like the water-soluble dibenzanthracene endosuccinate, but also are paramecicidal, the parallelism between the biological activity and monolayer reaction being maintained.

It has been the purpose of this address to re-emphasize the importance of the fundamental concepts introduced by Sir William Hardy and Dr. I. Langmuir as to the structure of matter in the boundary state. I have attempted to show that there is implicitly contained in the concept of molecular orientation a whole series of properties and events for which there are no analogies in homogeneous bulk phase systems. We note that many of the modes and types of the reactions which can be effected in monolayers, and which can be defined with precision and their mechanism established with a considerable degree of assurance, are unique for such interphases, but are again observed in living and organized material. It is with this object of ultimate correlation with biological behaviour that we have taken up the detailed study of interfacial reactions at Cambridge, and I should like to express my indebtedness to Dr. J. Schulman, who has been associated with me in this object.

Many 'vitalistic' models have been proposed in the past, and whilst it might be correct, although unscientific, to suggest that the ultimate level of integration in living matter is incapable of examination and definition, yet I believe that one is justified in asserting that at least one of the important levels to which due attention must be given for a proper understanding of biological activities is that of the ordered interface.

CULTURAL SIGNIFICANCE OF ANTHROPOLOGICAL STUDIES*

By Prof. H. J. Fleure, F.R.S.,

University of Manchester

THE vision of a universe in evolution has shown men that what had been accepted as absolutes are in several cases by-products of evolution. Old beliefs are increasingly relegated to the domain of folklore survivals, and the effects of this upon motive power in personal and social conduct are major factors of the present crisis in world affairs. Having been so long accustomed to accept an absolute basis which has now been undermined, men have hastily sought a new absolute, and some think they have found it in the State, which is being made an object of worship. This growth of State worship has come earlier on the Continent than in Britain, for we have pursued our traditional policy of finding a compromise that postpones the crises due to insoluble problems. Evangelical and tractarian movements have had influences of this kind on British life; they have counted for much less on the Continent. Again, State worship has grown with the acceleration of production and communications, a process that has given rise to an uncomfortable feeling of jostling and trade-pressure. We have attained to an anarchy of sovereign States and understand one another too little.

---

* Prepared for a discussion on "Anthropology in Education" arranged by Section H (Anthropology) for the Dundee Meeting of the British Association.

To study the peoples of the world in process of evolution in their varied environments is thus one of the greatest needs of our time. Men and women, their physical characteristics and functions, their social organization and material equipment, their reproductive rates and all that is linked with this, interrelations of groups, including production and exchange of commodities and ideas, their systems of control and the clashes thence arising, all need deeper interpretation for all peoples of the world, from the pigmies of the equatorial forest to the citizens of the United States of North America.

Specialists have taken up studies in physical anthropology, in social organization especially of the illiterate peoples, in archæology, in human geography and so on. But the difficulty has arisen that these subjects are too separate to allow a sufficient number of those who follow some of them to find opportunities to teach them in such a way as to make them a feature of a general education. So long as they remain pure specialisms, they must have small followings. We need a co-operative scheme that will bring them together, not as one 'subject', but rather as a linked group.

The human geographer, seeking to elucidate relations between men and environment, will study situation, climate in its relation with vegetation, and the annual cycle of cultivation, and this should lead on to the discussion of the round of festivals and ceremonies that marks the agricultural year. Here the social anthropologist dovetails with his appreciation of those rites and ceremonies his understanding of the fact that both these and the agricultural processes they accompany are not results of direct planning but rather the product of ages of 'trial and error'. This undeliberate method has been man's chief tool through the ages; the reason has come in to correct misapprehensions and wrong sequences of argument. The human geographer, again, will try to understand land-tenure and will appreciate the fact that better watered patches in an arid area are likely to have a scheme of tenure different from that used in areas of equatorial forest.

The anthropologist will then come in and study schemes of inheritance and control of land, and so one might go on and show how human geography and anthropology combine. The more they are studied together the better will it be for both subjects, for both their research and their educational aspects. They may co-operate with special advantage in studying the changes of land tenure, agriculture, organization and government among African peoples who have come into contact with Europeans. Intertropical Africa produced very little for export sixty years ago; recently its export trade approached one hundred million pounds sterling per annum. This change has had many repercussions on every part of a social structure that had been built up on subsistence agriculture and the almost completely self-supplying village. An analogous change from local self-sufficiency to complex interdependence has been going on among the peasantry of Europe in the last hundred years, and this is part of the problem of clashing national sovereignties that is threatening ruin to us all.

During the last twenty years, archæologists have realized, to a greater extent perhaps than social anthropologists, the need for studying environment. Concurrent studies of climate change, recently assisted by work on pollen analysis, and of soils, have shown increasingly that environments have undergone extensive changes within the period of human history and that reconstructions of environments of the past should be reconstructions for the climatic and vegetative conditions of a specified period. It has also been increasingly realized that prehistoric archæology tells us about our own ancestors, not about exterminated and forgotten peoples, and this has been an important factor in making archæology a study of the evolution of the future from the past.

At the same time, there is increased objection to accepting old parallels between peoples of antiquity and peoples of to-day. It is now considered less than a half-truth to say that the Australian blackfellows are surviving Mousterians, or the Bushmen of South West Africa surviving Aurignacians. Some of the Aurignacians were the leading peoples of their day and were on the upgrade; the Bushmen are rather a lingering remnant. Bushmen and Australians have picked up fragments of more advanced cultures even if, in some cases, these fragments are barely half-digested.

Physical anthropology, greatly helped by modern views of heredity, is learning to treat mass statistics with reserve and to criticize schemes of classification. Head form and pigmentation, for example, have very different kinds of histories. Depigmentation has affected a number of elements of differing bony structure in north-west Europe, and the idea of a unified Nordic race belonging basically to the Baltic is almost as fantastic as the twin-fancy that this Nordic race developed the essentials of European civilization and spread them from this assumed early home.

My plea is that a group of linked humane studies based on direct observation and measurement is needed not only for specialist work but also at all stages of education, and that the group should include human geography, social anthropology, physical anthropology and archæology, though it is obvious that one can scarcely expect any one person to cover all these specialisms. All that is needed is that they should have some common ground.

OBITUARIES

Prof. R. S. Troup, C.M.G., C.I.E., F.R.S.

THE death of Prof. R. S. Troup on October 1, at the age of sixty-four years, removes one of the outstanding figures in the development of forestry in the Empire. He passed the competitive examination into the Royal Indian Engineering College at Coopers Hill in 1894, and ever since then his profession had been his predominant interest. Endowed with more than the usual amount of Scottish common sense and with a good deal of Aberdonian caution, his mentality was peculiarly adapted to the orderly collection and presentation of facts.

After a brilliant career at Coopers Hill, where he took a number of prizes, not only among the few forest students, but also in competition with the far more numerous students of the engineering side, in such subjects as geology and surveying, Troup went to Burma with the other four men of his year. There he started with practical experience in some of the finest and best managed forests of the Empire. His reputation had preceded him and after a few years he was called to Dehra Dun, then beginning to assume its position as the headquarters of the Indian Forest Service. From about 1904 until 1920, when he left India, he was engaged in research and administrative and scholastic work, as a teacher at the Forest College, as forest economist, as sylviculturist, and finally as assistant inspector general of forests to the Government of India. These posts gave him unique opportunities not only of seeing all the finest forests in the quarter of a million square mile forest estate of the Indian Empire, but also of gaining an accurate knowledge of how this magnificent property could and should benefit the population.

Troup's own interests lay more in scientific sylviculture than in the utilization side, but his early training ensured that he should fully recognize that first-class sylviculture is not an end in itself but, to put it briefly, a means of obtaining the largest volume of the finest timber on a given area. Apart from a number of publications on the uses of woods and allied subjects, the principal works which he produced during his service in India were "The Silviculture of Indian Trees" in three fine volumes and "A Note on some European Sylvicultural Systems with Suggestions for Improvements in Indian Forest Management". This latter work, "the outcome of a tour made in 1913 in certain selected forests of France and Germany", appeared in 1916, and has always seemed to the writer to be of outstanding interest. Illustrated by excellent and well-chosen photographs, a clear and vivid description is given of all the important sylvicultural systems employed on the continent of Europe, and the possibility of their adaptation to the very different conditions of India and Burma is fully discussed. "Silvicultural Systems", which was published by the Clarendon Press in 1928, is an up-to-date and more generalized study of the same kind. It has been praised by Continental experts as being better than anything they have. In the work of 1916, Troup gave evidence of a very broad and catholic outlook on the main problems of Indian forestry, and established the principles on which the most important measures of progress have been based during the last twenty-five years.

Troup's greatest work, "The Silviculture of Indian Trees", appeared in 1921 and is, in his own words, "the outcome of several years of research into silvicultural problems at the Forest Research Institute, Dehra Dun, and at outlying experimental stations, combined with observations recorded in many parts of India and Burma for a period extending over twenty years". The writer, having accompanied Troup on many occasions in the field, can confirm the care with which these observations were made and recorded, and can testify to the technical interest of the scholarly descriptions of the very varied types of forests in India and Burma and to the great value of the estimates of the sylvicultural needs of the more important species. Constant use has been made by Indian forest officers of the information stored in these volumes, which have become standard works of reference, and contain much that was not available before.

After leaving India to succeed Sir William Schlich as professor of forestry at Oxford, Troup's interests gradually changed, and, as the result of a number of tours to various parts of the Empire, particularly Africa, he became recognized as an authority on forestry in the Colonies, and was, at the time of his death, engaged on a work on Colonial forest administration. His last publication, in 1938, was a small volume on "Forestry and State Control", which reviews the position in all the more important forest countries of Europe, with particular reference to the urgent need for improving the private forests of Great Britain.

His devotion to his profession and his remarkable ability in summarizing clearly and fully the salient points of any forestry problem earned for Troup a unique position, and made him a worthy successor to the great men of the earlier years of Indian forestry. He was also a good 'jungle man' with a proper appreciation of life in wild places, with a keen interest in the forest flora and fauna, and, in his younger days, a great love of sport. He was a successful 'shikari' and a very good shot.

ALEXANDER RODGER.

Prof. Ricardo Jorge

PROF. RICARDO JORGE, an eminent Portuguese hygienist and medical historian, was born on May 22, 1858, at Oporto, where he received his medical education and carried out some important work on plague in conjunction with Dr. Camara Pestana. He afterwards went to Lisbon, where he was appointed director-general of public health and professor of hygiene.

In 1912 Prof. Jorge was made the delegate for Portugal in the International Office of Public Health in Paris, where he was a regular attendant at its meetings and contributed important papers to its proceedings until shortly before his death. His published work comprised a large number of subjects, such as undulant fever, tuberculosis, pellagra, lethargic encephalitis and its mental sequels, alastrim, post-vaccinial encephalitis, epidemics on ships, especially the typhoid form of malaria and dengue, spirochætal jaundice, influenza and epidemic pleurodynia. As medical historian, he took an active part in the proceedings of the International Society of the History of Medicine, to which he contributed scholarly articles on the epidemics of the sixteenth century, the Renaissance in anatomy and medicine in Portugal, medical and scientific relations between England and Portugal and plague epidemics in Europe.

In addition to his medical activities, Prof. Jorge took a keen interest in literature, art, history, philosophy and philology, so that he has often been compared to the humanists of the Renaissance. He counted many friends in Great Britain, where he was elected an honorary fellow of the Royal Society of Medicine in 1938, twelve years after he had been made an honorary member of the Section of Epidemiology. One of his last writings was a sympathetic obituary notice of Sir George Buchanan, his colleague at the International Office of Public Health. His death took place on July 31 at the age of eighty-one years.

J. D. ROLLESTON.

WE regret to announce the following deaths:

Sir William Pope, K.B.E., F.R.S., professor of chemistry in the University of Cambridge, on October 17, aged sixty-nine years.

Dr. W. B. Wright, late of the Geological Survey of Great Britain, author of "The Quaternary Ice Age", on October 11, aged sixty-three years.

NEWS AND VIEWS

Ministry of Information

THE debate in the House of Commons last week on the Ministry of Information was announced too late for account to be taken of it in the leading article on the suggested Directorate of Scientific Information in NATURE of October 14, but there appears to have been nothing said which invalidates the comments in that article; indeed, the debate rather served to emphasize the importance of the principal points. Replying on behalf of the Government, Sir Samuel Hoare admitted that the public had lost confidence in the Ministry, and outlined the steps taken for its reorganization. Two factors have no doubt contributed largely to the difficulties of the Ministry, namely, confusion between the task of collecting information and of disseminating it, and the failure to utilize effectively organizations already in existence. The first has involved the Ministry in the difficult question of censorship and authority in relation to other Departments of State; the second has been responsible for excesses of expenditure and lapses of judgment for which the Ministry has been rightly criticized. It is not always realized that the collection of information in itself is a specialized activity. In the technical and scientific sense it is the task of the numerous information bureaux or departments, such as various Imperial Agricultural Bureaux, those associated with different research and other associations or with individual industrial firms. Activities of this kind are to be found over the whole range of industry and science, including the social sciences. To some extent the Association of Special Libraries and Information Bureaux serves as a clearing house in this field, and its services have already been offered to the Government. Official recognition of the vital necessity of information services and their co-ordination does not as yet appear to have been forthcoming, nor has their utilization by Government Departments and other organizations concerned with national service been encouraged, a situation which would scarcely have arisen had the Ministry been provided with adequate scientific guidance.

The collection of more general information in the sense of news is the essential task of the journalist, and some of the severest criticism of the Ministry of Information has been based on its neglect of the unrivalled experience and organization of the daily Press, both in the collection of news and in the problems involved in handling it. The statement hat news and censorship will now, generally speak-ng, be separated from the Ministry of Information, nay make such criticism irrelevant so far as the inistry is concerned, but the Government would lo well to take the lesson to heart, for other departnents also have tended to make the mistake of ormulating complete plans of their own instead of naking the utmost use from the start of existing rganizations and facilities. The collection of informaion is one activity demanding a particular technique nd type of mind; the dissemination of information s another activity and may require entirely different gifts. Incidentally, most information departments re concerned with both these activities in that they ollect information for use. The first essentials in andling information are sound judgment and a clear nderstanding of the extent to which the use of a articular piece of information is to be limited, either n the general interests of the industry or organization hich an information department is serving or, as ith the Ministry of Information, of the national inerests in the widest sense. The work of the ablest inormation bureaux, however, can be seriously injured y departmentalism which is lacking in vision or a ense of proportion. Sir Edward Grigg, Parliamentary ecretary to the Ministry, was able to give a welcome ssurance that no effort would be spared by the inistry to see that the country preserved its right o know the truth about the war in which we are ngaged and its right to comment with absolute reedom on that truth.

eace Aims

The correspondence columns of the leading lay ournals have given ample evidence of the lively oncern felt by thoughtful men everywhere as to he ultimate goal towards which Great Britain and rance are striving through the present conflict. A oteworthy pronouncement in the form of a manifesto igned by no fewer than fifty-seven men of science, all f whom are fellows of the Royal Society, appears in he *Manchester Guardian* of October 13. The names f the signatories represent many branches of scientific vestigation, but in the covering letter sent with the anifesto and signed by the Bishop of Birmingham, ir Richard Gregory, Prof. Lancelot Hogben, Sir John rr, Prof. A. J. Clark and Sir Peter Chalmers Mitchell, is pointed out that they "do not claim to speak for eir scientific colleagues as a body". The manifesto oints out that the "progress of science and its pplication to human well-being are threatened by e prevailing anarchy of international relations", nd states that a new international order, going far eyond the provisions of the Covenant of the League f Nations in its claims on individual States, should e set up when the war ends. All nations prepared renounce war between themselves should be vited to unite under a federal Government, which ould have power to use armed force against aggreson, would control the raw materials of undeveloped rritories in the possession of member States, and ould undertake the education of backward comunities without racial discrimination. Although perience of the League of Nations shows that these provisions are bristling with practical difficulties, there will be general agreement that a new world order based upon them would command the support of a considerable body of informed opinion.

T. K. Penniman

The curatorship of the Pitt-Rivers Museum in the University of Oxford, which has been vacant since the death of Dr. Henry Balfour earlier in the year, has been filled by the appointment of Thomas Kenneth Penniman, the appointment being for a period of seven years dating from October 1, 1939. Mr. Penniman is a member of Trinity College, Oxford, and holds the diploma in anthropology of the University of Oxford. He is the secretary of the Board of Anthropological Studies in the University, and is the author of a history of the progress in anthropological studies in the last hundred years, which in its introductory chapters traces the beginnings of anthropological observation, the work thus being a complete survey of the development of the science. Mr. Penniman was also joint editor with Dr. R. R. Marett of the correspondence of the late Sir Baldwin Spencer, the distinguished authority on the primitive tribes of central and northern Australia.

Robert Henry Thurston (1839-1903)

On October 25, Cornell University will celebrate the centenary of the birth of Robert Henry Thurston, the distinguished American professor of engineering, who by his work at the Stevens Institute of Technology, Hoboken, and the Sibley College of Engineering, Cornell University, contributed more than any other man of his time to the advancement of engineering education in the United States. Thurston was a man of great force of character, but sympathetic, the friend of all his students, and he was possessed of a wide and generous outlook. With a remarkable memory, great powers of concentration and unceasing industry, he was not only a teacher and engineer, but also an original investigator, an expert, and a public servant. He published some 300 scientific and technical papers and twenty separate works. When engineering education was in its infancy he founded the first engineering laboratory in the United States, and he was the first to serve as president of the American Society of Mechanical Engineers.

Thurston was born at Providence, R.I., the son of Robert L. Thurston, one of the pioneers of steam engineering in America. At the age of sixteen he entered Brown University, and after graduating, went into his father's workshops. The Civil War saw him an assistant engineer in the U.S. Navy, and at its close, in 1865, he was made an assistant professor of natural philosophy at the Naval Academy, Annapolis. This, however, was but a stepping stone. On the inauguration in 1870 of the Stevens Institute of Technology, Hoboken, the president, Henry Morton, invited him to become professor of mechanical engineering. For fifteen years he laboured at Hoboken and then, in 1885, the trustees of the Cornell University asked him to undertake the organization and development of the Sibley College of Engineering. When he took charge the total attendances in all classes was about 60; at his death in 1903 the attendances were about 960. The teaching staff had grown from 7 to 43. Besides his work as a teacher, writer and experimentalist, Thurston served on various committees and was a member of numerous societies both at home and abroad. The gathering at Ithaca on October 25 will pay tribute to his memory, and will also discuss ways in which engineering may meet the crucial challenge of our rapidly changing world.

A National Atlas of Great Britain

THE report of the committee appointed by the British Association in 1938 to prepare a scheme for a projected National Atlas of Great Britain and Northern Ireland was presented to the Association at the Dundee meeting and contains provisional details of the format and contents of such an atlas. "The proposed atlas," the report runs, "aims at a strictly objective and scientific presentation of the natural conditions, natural resources and economic development of the land (and adjacent seas), of the history and pre-history of the country, and of the distributions, occupations, movement and social conditions of the population." To this very comprehensive programme the proviso must be added "in so far as they provide suitable material for cartographic exposition", since it is not intended that there shall be any accompanying text to the maps. Such a work necessarily involves the collaboration of scientific workers in very different fields, and six sections of the Association were represented on the reporting committee, which sat under the chairmanship of Prof. E. G. R. Taylor (Section E).

THE complete Atlas will be in two large folio volumes, each volume containing 60–70 plates. The number of maps will, of course, be many times greater than the number of plates, but the sheet size has been selected so as to show the whole of England and Wales at a single opening on the scale of one to a million, a scale which experience has shown to be appropriate for many types of general map. The maps are grouped under four general headings: physical geography, bio-geography, industry and commerce, and human geography. Under physical geography are included cartography, orography, geology (with geomorphology), climatology and hydrography. Under bio-geography the sub-headings are soil, vegetation, distribution of species, pre-history (of plants), land utilization, forestry and agriculture. Many of the maps will be of types not hitherto constructed, or at least not hitherto published for Great Britain. Such, for example, are maps dealing with health and disease, recreation and amenities, which fall within the human geography section, and maps of accessibility from and to the leading cities, in the section devoted to industry and commerce. For certain sections and sub-sections, the contents of individual maps are indicated in the report, the object being to ensure constructive criticism and co-operation from workers engaged in particular fields of research. As the report states, the success o the enterprise "must depend on scientific workers an scientific bodies willing to undertake responsibilit for the accuracy of maps within particular fields"

Contemporaries of the Mammoth

IN an article contributed to "Russia To-day Pres Service" (Sept. 12, 1939) Prof. P. Kapterev gives a account of his experiments with organisms containe in frozen soil from Siberia. A paper by Prof. Kaptere on his discoveries was read before the Academy o Sciences of the U.S.S.R. during 1936 (see NATURE 138, 714; 1936). The flora associated with th mammoth has been known for years from the content of the food canal of frozen individuals, but it i astounding to learn that plants and animals contemporary with the mammoth have been brought t life after remaining in a state of suspended animatio which at a low computation must have extended ove twenty thousand years. The soil from which th organisms were obtained consisted of silt strat obtained in the galleries of mines in the taiga c Siberia at a depth of 131¼ feet, far within the limi of the permanently frozen soil, for even in th hottest summer the thaw never penetrates deepe than seven to ten feet. In contemporary strata th explorers found the bones of mammoths, the wooll rhinoceros, bison, and musk-ox, indicating a perio contemporary with the interglacial period whic came between the last two Ice Ages (Riss-Würm period) or with the last Ice Age (Würm period). Th soil samples were placed in sterilized containers in sterilized atmosphere, and they eventually yielde living organisms which included several kinds of soi bacteria, including a distinctive nitrogen bacterium fungi and water plants, the majority being closel related to present-day forms. From another sampl of later geological date, taken at a depth of 14 feet twenty different kinds of water-plants, mosses, filaments of fungi and a crustacean (entomostracean were obtained, and placed in favourable laborator conditions these organisms began to multiply rapidly But this stratum is reckoned to have been only from one to three thousand years old!

Archæological Excavations in Northern Syria

MR. M. E. L. MALLOWAN's account of his furthe excavations in Northern Syria in the report of th British School of Archæology in Iraq (Gertrude Bel Memorial) for the year ended June 30, 1939, agai records a striking frequency in the occurrence o amulets of various kinds among the finds—a featur to which attention was directed in earlier report The report on Mr. Mallowan's work covers the fift expedition to Northern Syria and the third consecutive season's excavations at Brak, one of th largest of the mounds in this part of Syria. Th great mud-brick temple, which Mr. Mallowan ha named "The Temple of a Thousand Eyes" on accoun of the enormous number of alabaster "eye idols" found in the foundations of the platform on whic the temple is built, has so far produced the mo important discoveries of the expedition. Its dimensions are approximately 30 yards by 25 yards; and its walls are exceptionally heavy, the outer walls being more than eight feet thick. They are buttressed with rough blocks of limestone and basalt. The temple dates from about 3000 B.C. and is thus the oldest shrine yet discovered in eastern Syria. Its architectural relationship to archaic temples at Warka, about eight hundred miles down the Euphrates from Brak, points to cultural contacts between north-east Syria and Sumer at this early date. A striking feature of the plan of the temple is a central shrine, three times as long as it is wide, with a pedestal for the presiding god against the end wall.

The adornment of the temple would appear to have been remarkable. A magnificent frieze consisted of three separate panels on the three faces of the pedestal in the sanctuary. Each of these was three feet in length and eight inches in breadth, and was composed of outer bands of heavy gold foil encasing blue limestone, white marble, and green corrugated shale. The panels were fastened to a wooden background with copper holdfasts, while the gold borders were held down by gold-headed nails with silver stems. No panels of this kind have previously been discovered. One of them has been allocated to the British Museum. Fragments of fluted copper panelling, which had adorned the walls, have been discovered; while on the south side the wall was embellished with a mosaic of clay cones painted in bright colours, and surmounted by large stone rosettes with alternate petals of white marble and dark green shale and a central corolla of red limestone. In the material of the mud-brick platform on which the temple stood, many thousands of objects were found. These include many beautifully carved amulets—models of lions, rams, bears, monkeys and vultures in serpentine and bone. A number of human heads in alabaster are said to be landmarks in the history of sculpture. A summary of the report appeared in *The Times* of October 14.

Juvenile Delinquency

In a discussion on juvenile delinquency before the Royal Statistical Society on April 18 which has now appeared (*J. Roy. Statist. Soc.*, **102**, 384; 1939), Dr. Rhodes concludes that juvenile crime appears to be part of a major problem, including adult crime, which involves social and economic considerations. More exact information regarding the age-constitution of local populations is required to gauge properly the differences between the incidence of juvenile crime in different parts of the country. In considering changes with time, we must take account of changing environment if we are to deduce anything from the facts of recorded crime regarding changes in the naughtiness of the juvenile population. Mr. C. P. Hill agreed that juvenile delinquency was linked both with density of population and with unemployment, but considered there were so many other unknown variables to be taken into account that no accurate forecast was possible as to the probable future course of juvenile delinquency from the data available. Mr. J. H. Bagot, from Liverpool experience, stressed the wastage in probation and education offices and police departments through the non-use of statistics, and concluded that the vast proportion of the delinquents were drawn from one section of the population, and, within that section, from a defective group, either from the point of view of family or overcrowding.

Alcohol and Crime

In an important paper on the problem of alcohol and drug addiction in relation to crime, published in the October issue of the *British Journal of Inebriety*, Dr. W. Norwood East, formerly H.M. Commissioner of Prisons, discusses the relation of parental alcoholism and drug addiction to crime, alcoholism in the individual as a cause of crime, the medical and legal aspects of alcoholic crime, and the treatment of criminal alcoholics and drug addicts. He illustrates the insignificant part played by drug addiction as a cause of crime, at least in Great Britain, by the fact that in 1937, when the number of drug addicts known to the central authority was only 620, not more than 31 persons were dealt with under the Probation of Offenders Act, or fined or imprisoned for offences against the Dangerous Drugs Act. Dr. East further points out that while every practical criminologist will attach some importance to the association of alcoholism and crime, it is easy to over-emphasize the connexion, and in support of this contention brings forward statistics from various prisons showing that familial or individual alcoholism is a much less frequent cause of crime than was formerly supposed. While allowing that the general medical treatment of alcoholism and drug addiction may be supplemented by psychotherapy in suitable cases, Dr. East asserts that this method is apt to be disappointing, and that he does not know of any impressive series of figures illustrating the success of such treatment.

Future of Welding

It is now known that the substitution of fabrication for casting is very advantageous to heavy-machine makers in a number of ways, mainly because it obviates the necessity of pattern-making. The time that would otherwise be lost in the foundry is considerable, especially when new patterns have to be evolved. In a leader on welding in the *Electrical Review* of September 29, it is stated that many electrical and allied manufacturers are now using welding on a fairly large scale. Some of them go so far as to design and make their own welding equipment. There are on a conservative estimate about forty manufacturers of electric welding machines in Great Britain and there are nearly as many suppliers of rectifiers for welding and thermionic valve control devices. Besides, there are one or two factories which make holding frames for rotating or otherwise manipulating the welding work being done. It is probable that not more than about a quarter of the known applications of welding are utilized in industry. The large amount of research being done is shown in the second progress report of the Institute of Welding. Further evidence is given of the increased applications by the issue of official regulations and specifications for welded steelwork by national bodies in many countries. Some manufacturers think that the welding industry may ultimately employ as much capital and labour as the steel industry now does. Such considerations apply equally to shipyards, and remembering the inherent water, oil and gas tightness of welded vessels, the rate of advance in the use of welding in shipyards will doubtless advance more rapidly in the future. The progressive widening of applications is producing fresh problems. Large-scale operations indicate the desirability of carrying out as much as possible of the actual welding in specially devised workshops rather than at the shipbuilding berth. This requirement will sometimes entail the re-design of component sections to render them more transportable and also the provision of suitable and adequate manipulative and adequate lifting equipment.

Johannesburg Municipal Bus and Tram Sheds

The all-welded structure of the new municipal bus and tram sheds at Johannesburg is claimed to cover an area greater than that of any other welded structure in South Africa. In *Electric Welding* of August, it is stated that, excluding an office block of reinforced concrete, the building has a frontage of 465 feet and an area of approximately 186,000 square feet. The outer walls are of concrete but all the interior walls are steel-framed. The floor is of concrete throughout. To give unobstructed floor space, the number of columns was cut down to a minimum. The largest of the girders span 90 feet and are 12 feet deep. They were dispatched by road from the company's workshops at Benoni, where all the steelwork was fabricated. To allow of transportation through Johannesburg, they were split into halves, the halves being welded together at the site and the girders lifted in one piece. A striking feature of the design is the absence of gusset plates and the lightness of all the sections employed. The entire framework is welded, including even the site connexions. The saw-toothed type of roof employed produces excellent internal lighting. The percentage of windows to floor space is about thirty. The lamps provided are of the mercury vapour type. Between 500 and 600 tons of steel were used in the erection of the sheds, the greater portion of this steelwork being produced in South Africa.

Electric Lighting in a Modern Store

In Welwyn Garden City, Herts, an entirely new building now houses the Welwyn Stores; a description of the building is given in the *Electrical Review* of October 13. The Welwyn Electricity Supply Co. built and equipped a new sub-station near the site to meet the required demand. The G.E.C. Co., Ltd., installed the whole of the lighting and fittings for 336 combined tungsten and Osira lamps, The outside illumination consists of four large neon signs. The shop fronts have artificial stone piers, marble risers and a painted wooden facia and cornice in which is set a line of fluorescent tubing running round three sides of the building. About 900 feet of 'Clora' coated tubing has been used for this purpose. The store itself comprises ground floor and part of the first floor. Under an artificial daylight effect achieved by 'T.O.T.' units, the natural wax-polished oak counters, stock fittings and panelling show up well. During the daytime, the daylight entering the ground floor through 'glass-crete' rooflights from the staircase blends with the artificial illumination, all strong contrasts being eliminated. Each lighting unit consists of one 80-watt 'Osira' fluorescent type discharge lamp and three 150-watt tungsten lamps enclosed in opal sphere pendants 18-in. in diameter. All the main selling floors have this type of lighting. The food hall is a separate section on the ground floor. There are 1,400 feet of fluorescent tubing, arranged round the ceiling in three parallel rows—one red tube and two blue—and the effect of this diffused brilliance is enhanced by the green and white chequered flooring, the tiled walls and counter fronts, and other modern fittings. Light signalling by pre-arranged combinations of four different colours is used throughout the store for attracting the attention of managers or other persons.

Soil Science at Adelaide

The Winter School in Soil Science held during August 14–23 at the Waite Agricultural Research Institute, Adelaide, was a signal success. It was sponsored by the Council for Scientific and Industrial Research and the University of Adelaide and met under the chairmanship of Prof. J. A. Prescott. Sixty members attended, all directly engaged in work on soils, and representative of universities, State departments of agriculture and of forestry, water supply commissions, Government chemical laboratories and other interests. Papers were presented on classification, physical composition, colour, water relations, acidity and lime requirement of soils; methods of soil surveying and utilization of soil maps and data; spectrochemical and polarographic methods of analysis; methods for determination of soil carbon, soil reaction and soluble salts; the erosion problem in pastoral areas; and other topics. Numerous demonstrations were arranged. As a result of the School, soil investigators throughout the Commonwealth will in future be working in more intimate association and along more uniform lines.

Rare Medical Books

On the occasion of the seventieth birthday earlier this year of the late Prof. Harvey Cushing, Schuman's of New York brought out, under the title of "Seventy Noteworthy Medical Rarities", an illustrated and annotated catalogue to which are prefixed a portrait of Dr. Cushing, taken about forty years ago, and an appreciation of the eminent surgeon and bibliophile by Dr. Lawrence Reynolds. Among the notable works listed in the catalogue may be mentioned a thirteenth century medical manuscript on vellum containing some of the works of Constantinus Africanus, Giles of Corbeil and others, the work of Bartholomaeus Anglicus entitled "De Proprietatibus Rerum" (1535), Ambroise Paré's "Dix Livres de la Chirurgie" (1564), Gasparo Aselli's book on the lacteals (1627), Robert Boyle's "Sceptical Chymist" (1661) and modern works by Oliver Wendell Holmes, Sir William Osler and S. Weir Mitchell.

The Science Library

The Science Library, Science Museum, South Kensington, is remaining open. Books and periodicals are available for consultation in the reading room and for external loan to institutions engaged on research work. A relatively small number of the older books and periodicals have been removed and are not at present available. Although difficulty is anticipated, every endeavour will be made to maintain the collection of important current foreign scientific and technical literature up to the pre-war degree of completeness. The bibliographical and information service of the Library will be maintained so far as the reduced resources permit.

Royal Astronomical Society

The meetings of the Royal Astronomical Society will continue to be held at Burlington House, London, but at an earlier hour. The *Monthly Notices* and also *Occasional Notes* will be published so far as possible, but the former will not necessarily appear each month. The library will be closed except on meeting days, as the assistant secretary and office have been transferred to Oxford. The Christmas lecture, soirées, etc., have been postponed indefinitely. Prof. H. H. Plaskett, the senior secretary, is serving in the Royal Artillery, and Prof. W. M. H. Greaves has been appointed acting secretary for the present.

British Astronomical Association

The annual general meeting of the British Astronomical Association will be held as usual on October 25, in accordance with the articles of the Association, and no arrangement has been made at present to alter procedure in the matter of ordinary meetings. The president, two secretaries and treasurer have been empowered to conduct the business of the Association if war-time emergency should cause a discontinuance of the meetings. If this contingency arises, the *Journal* will still be published monthly, and it is hoped that papers will be contributed as usual by members. The library will be open only on the second and fourth Wednesdays of each month, but the librarian has power to refrain from opening in case of emergency.

Institute of Physics

The offices of the Institute of Physics have been transferred to the University of Reading, where accommodation had been reserved for them, by the kindness of the Council of the University. It is hoped to carry on so far as possible the normal work of the Institute, with such further activities as may be necessitated by emergency conditions. The Institute is in touch with Government departments and other employers, and has been collecting and collating such information as is available regarding the employment of physicists during war conditions. A considerable number of inquiries for advice on this and other emergency matters have received attention. It has been decided, unless unpredictable circumstances intervene, to continue the publication and distribution of the *Journal of Scientific Instruments* on the same terms as in the past, though it may be necessary to reduce to some extent the number of pages in each issue.

Announcements

Dr. Ian Galloway has been appointed scientific superintendent of research at the Pirbright Research Station of the Foot-and-Mouth Disease Research Committee.

Dr. S. C. Harland has been appointed director of the Institute of Cotton Technology of the National Agricultural Society of Peru.

Sir Frederick Menzies has resigned his position as medical officer of health and school medical officer of the London County Council, and has been succeeded by Dr. William Allen Daley.

In the hope of giving assistance to students in London who have been unable to follow their university colleges into the provinces in the present emergency, the managers of the Royal Institution have arranged for additional short courses of lectures to be given dealing in an introductory manner with certain subjects of modern physics and chemistry. Applications should be made to the Royal Institution, 21 Albemarle Street, London, W.1.

It is hoped to arrange day and/or evening courses in electrical methods of chemical analysis, microchemical analysis, spectroscopy and bacteriology at the Sir John Cass Technical Institute. Those wishing to take classes in these subjects should write, stating possible days and hours of attendance, to Dr. E. de Barry Barnett, Sir John Cass Technical Institute, Jewry Street, London, E.C.3.

The governing body of the British Medical Postgraduate School has decided to carry on postgraduate instruction for the present.

Owing to the war, the International League against Rheumatism will no longer be able to carry out its activities, and its bureau at Keizergracht 489, Amsterdam, will be closed.

Eighteen cases of smallpox were notified in England in 1938, of which nine were variola major and nine variola minor, and there were three deaths. These are the first deaths from smallpox which have occurred in England since 1934.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 713.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Kinematical Relativity and the Geological Time-Scale

IN a recent paper, a detailed analytical theory of time-keeping has been developed on an axiomatic basis[1]. Starting from the existence of a temporal sequence for events at any given observer and the existence of a 'substratum of equivalent observers', it has been found that amongst all possible graduations of the clocks of a substratum two families stand out with special properties, namely, the family τ, according to which the substratum is described by each of its members as static, and the family t, according to which it is described as uniformally expanding from a point origin. By deriving the equation of motion of a free particle, it has been found that if we identify the smoothed-out universe of extra-galactic nebulæ with a substratum, then the uniform time of dynamics is to be identified with τ-time[2], which gives an infinite 'age' to the universe, whereas the uniform time of optics and atomic vibrators is to be identified with a t-time[3], which gives 2×10^9 years as the 'age of the universe'.

It is well known that this 'age of the universe', as derived from Hubble's law, is of the same order as the 'age' assigned to the oldest rocks on the earth's surface by analysis of their uranium-lead ratio. This result, by itself, cannot be taken as conclusive evidence that this is the earth's 'age' because, as Holmes remarks[4], "Hutton's oft-quoted dictum that he could find 'no vestige of a beginning' remains true of geology to this day. Geological time dates from the deposition of the oldest known sediments, and whatever their age may be that of the earth must be still greater". However, strong corroborative evidence for the significance of this figure comes from recent investigations of the helium ratio of iron meteorites, about 70 per cent of which are now believed to reach our planet from outside the solar system[5]. These again lead to a greatest 'age' of the order 2×10^9 years.

These investigations of rocks and meteorites are based on the Rutherford-Soddy law of radioactive decay, which states that if N is the number of atoms of a particular radioactive element present in a specimen at a given epoch, and if δN is the number of these atoms which disintegrate in the subsequent interval δt, then

$$-\delta N = \lambda N \delta t,$$

where λ has been found to be independent of temperature, pressure, etc. 'Ages' are then assigned by this law on the 'assumption' that λ is invariant for change of epoch. This, of course, is simply a *definition* of the particular uniform time of radioactive decay of a given element. Since different elements and methods lead to consistent results, we have good reason for believing that there is a unique uniform time of radioactive decay, and the agreement between the 'ages' assigned to the oldest rocks and meteorites with the 'age' assigned to the universe by Hubble's law makes it extremely plausible to identify this time with the uniform t-time of optics.

If, therefore, we regard the dates assigned to geological epochs as t-scale dates, it becomes of interest to compare them with the corresponding dates on the τ-scale, given by[6]

$$\tau = t_0 \log (t/t_0) + t_0,$$

where t_0 is the present t-epoch, since this is the scale which has been identified with the uniform time of dynamics. It is readily seen that if t_1 is any past t-epoch and τ_1 is the corresponding τ-epoch (the two scales agree on the value of the present epoch, t_0) then

$$t_0 - \tau_1 = t_0 \log (t_0/t_1).$$

We can, therefore, immediately compile the following table to illustrate the difference between the t- and τ-periods assigned to geological eras, all figures being in millions of years.

Geological period	t_1	$t_0 - t_1$	$t_0 - \tau_1$
Present	2,000	0	0
Base of Eocence Rocks	1,930	70	71
Base of Cretaceous Rocks	1,900	100	102
Base of Triassic Rocks	1,800	200	210
Base of Devonian rocks	1,700	300	325
Base of Ordovician rocks	1,600	400	445
Base of Cambrian rocks	1,500	500	575
Laurentian rocks	1,000	1,000	1,400
Oldest European rocks	500	1,500	2,800
Oldest rocks (Manitoba)	250	1,750	4,200
'Creation'	0	2,000	∞

We observe that the t- and τ-measures of the whole fossil period (Cambrian age to present) differ by about 15 per cent of the t-measure, which is not much greater than the probable error in assigning epochs by the present radioactive methods. Moreover, when we go back a thousand million years on the t-scale, that is half way back to 'creation', we find that the τ-measure of this period is not more than fourteen-hundred million years.

G. J. WHITROW.

Christ Church, Oxford.
Sept. 21.

---

[1] Milne, E. A., and Whitrow, G. J., *Z. Astrophys.*, 15, 263 (1938).

[2] Milne, E. A., *Proc. Roy. Soc.*, A, 154, 69 (1936); 157, 324 (1937).

[3] Whitrow, G. J., *Quart. J. Math. (Oxford)*, 7, 271 (1936).

[4] Holmes, A., "The Age of the Earth", 30 (1937).

[5] Holmes, A., "The Age of the Earth", 230.

[6] Milne, E. A., *Proc. Roy. Soc.*, A, 158, 337 (1937).

Fission of Uranium under Deuteron Bombardment

Since the phenomenon of neutron-induced fission of the uranium and thorium nuclei is now indisputably established, attention may be turned to the possible efficacy of other bombarding particles in this respect. An outline is here presented of evidence suggesting that high-energy deuterons are, in fact, capable of producing fission in uranium.

The following experimental arrangement has been used. One inside surface of a copper box is covered with a 20 mgm./cm.^{2} layer of uranium metal, and is bombarded by deuterons passing through an aperture in the opposite side of the box. An inside pocket on one of the other walls contains metal foils for the purpose of collecting particles projected from the target through an aperture in the pocket. A thickness of 2 mm. S.P. aluminium is always present to protect the collecting foil from the low-energy products due to mechanical disintegration of the target. Bombardments of about 1 μamp. for ten minutes are convenient, and are found to produce on the collector activities of intensity suitable for measuring with a Geiger counter.

It is necessary to estimate what part of the activity on the collector is due to general neutron radiation and to deuterons scattered from the target. In the pocket are placed three foils of 3·3 mgm./cm.^{2} aluminium, F, D and N in order of proximity to the target, and a single thickness of half-millimetre copper sheet between the foils D and N. Five minutes after a 4 μamp./min. bombardment with 9 Mv. deuterons, it is found that the neutron effect of the irradiation has produced in N a small activity of 40 counts per minute; the neutron effect is eliminated from D and F simply by subtraction of this N effect. D's activity measures the scattered-deuteron effect and is initially about 100 counts per minute, decaying with a half-life of 2·3 min. to reach a negligibly small value after 20 min. F's activity, however, is about 1,500 counts per min., and is much longer-lived, although with a target entirely of lead, F as well as D shows only a D effect.

The decay curve for F's activity has been followed for about 7 hours and has been compared with that calculated from Frisch's formula[1] for the decay of multiplex activity. The measure of agreement is so substantial as to preclude the possibility of a merely accidental coincidence.

A stack of six 0·66 mgm./cm.^{2} aluminium foils has been placed in the pocket and after the lapse of 30 minutes (when the D effect has decayed) the activities are found to decrease regularly through the stack, reaching inappreciably small values in the fifth and sixth foils. Regarding another aspect, the fact that replacement of aluminium as the collector material by silver causes no significant difference in the decay curve, suggests that the activity has been implanted rather than induced. The evidence thus indicates that radioactive nuclei are projected from the uranium target with a range of the order of 2 cm.; this occurrence is evidently to be ascribed to a fission of the uranium nucleus.

It is important to assess the magnitude of the fission effect caused by background neutron radiation, and for this purpose there has been enclosed in the pocket itself a layer of uranium, separated from F by 2 mm. S.P. of aluminium, and from the target by the copper sheet, this arrangement necessarily reproducing fairly closely that activity in F which is due to neutron-induced fission. The intensity in this case is less than one twentieth of that observed in the positive experiment.

Approximate measurements have been made on the excitation function for deuteron-induced fission, using aluminium absorbers to modify the energy of the beam and a suitable disposition of diaphragms to protect the collector against deuterons scattered from the absorbers. The threshold for the process appears to lie at about 8 Mv., and the cross-section increases rapidly in the range 8–9 Mv.

The conclusions drawn from these preliminary experiments would receive unequivocal confirmation from a chemical identification of the fragment nuclei or a detection of their large ionization impulses in an ionization chamber. It might also prove profitable to examine the effects given by others of the heaviest elements (especially thorium).

Dr. R. S. Krishnan and other colleagues of the Cavendish cyclotron group have rendered me indispensable assistance, and I am indebted also to Prof. J. D. Cockcroft for pertinent suggestions.

D. H. T. Gant.

Cavendish Laboratory,
Cambridge. Aug. 26.

---

[1] Nature, 143, 852 (1939).

Absorption of Polymolecular Films in the Infra-Red

The use of infra-red absorption spectra as a means of investigating molecular structure has still to be extended to surface films. Until very recently, the possibilities of this extension seemed remote, since a monomolecular layer does not contain enough molecules per square centimetre to produce measurable absorption. Thus it is found experimentally that approximately 10^{19} molecules are required to produce appreciable absorption in a beam of 1 sq. cm. cross-section, whereas the number of molecules per square centimetre in a monomolecular layer is about 5×10^{14}. With the production of polymolecular films close to 1,000 molecules thick, the possibility of detecting absorption still seemed slight, but technically feasible, if a method employing several reflections through such a film were employed.

As a matter of interest, it was decided to try whether any absorption could be detected using a single reflection through a film of methyl stearate 700 molecules thick, deposited on a chromium-plated strip of metal. We were surprised to find that the well-known absorption at 3·3 μ due to CH groups was easily detectable, showing about 30 per cent absorption, while other weaker bands were noticeable between 6 μ and 10 μ. Next, a film only 200 molecules thick was tried. This still gave the 3·3 μ band with appreciable intensity. These results mean that absorption spectra were being obtained from approximately 10^{17} molecules, instead of the customary 10^{19}. In other words, the absorption coefficient of a molecule in the infra-red seems to be considerably increased when it is in a surface film.

The possible causes of this will not be discussed here. The purpose of this note is merely to record this fact, which opens up a new and potentially interesting field of research in infra-red spectroscopy and its application to problems of molecular structure. In particular, this may prove to be a very suitable method of studying protein molecules.

We wish to express our thanks to Dr. Stenhagen, who prepared the films.

G. B. B. M. Sutherland.
W. T. Tutte.

Laboratory of Physical Chemistry,
Cambridge. Sept. 1.

Analysis of Varying Sound

The only reasonable method of frequency analysis applicable to the case of varying sound as yet published is that of Germansky[1] and Brown[2], using diffraction of light by varying-density sound-film. But the technical difficulties owing to low dispersion seem to prevent further development in practical applications of that method. I have recently used a very simple photographic method of frequency analysis which can be designed so as to satisfy all the requirements met with in the analysis of any sounds or other vibrations.

The essential part of this method is a photographic plate (analysing plate), illustrated in Fig. 1, in which the transmitted light intensity varies as $A + B\sin\frac{2\pi}{d}x$, $(0 < B < A)$, along the x direction in the figure, and the wave-length d varies continuously in the y direction. The incident light intensity is varied according to the sound to be analysed, and a photographic film is moved at constant velocity along the x direction at the back of the analysing plate.

Let the incident light intensity be expressed as $P + Qf(t)$, $(0 < Q|f(t)| < P)$, and the velocity of the film be V; then a point on the moving film receives an amount of light which can be expressed as

$$\int_{-Nd}^{Nd} \left[P + Qf\left(\frac{x-\xi}{V}\right)\right]\left[A + B\sin\frac{2\pi}{d}x\right]dx,$$

where ξ is the co-ordinate of the point at $t = 0$, and $2N$ is the number of waves in the analysing plate. If N is sufficiently large, the above integral reduces to a constant term added to the expression

$$QB\int_{-Nd}^{Nd} f\left(\frac{x-\xi}{V}\right)\sin\frac{2\pi}{d}x\,dx = QB\int_{t_1}^{t_2} f(t)\sin\frac{2\pi}{d}(Vt+\xi)\,dt,$$

which is practically the Fourier component of $f(t)$. On a uniform background, sharp lines, the blackness of which varies sinusoidally, are obtained stroboscopically, one corresponding to each component.

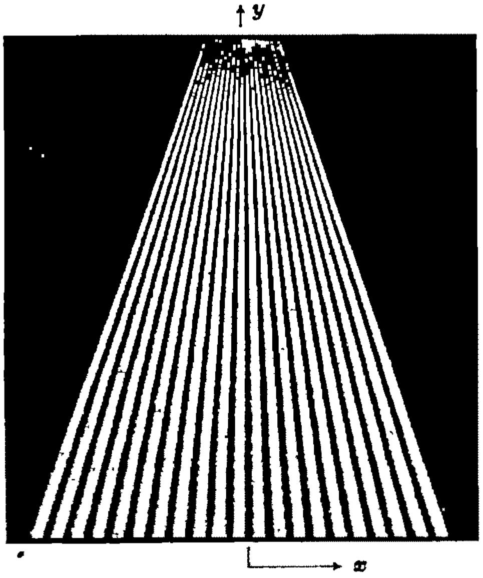


Fig. 1
Analysing Plate

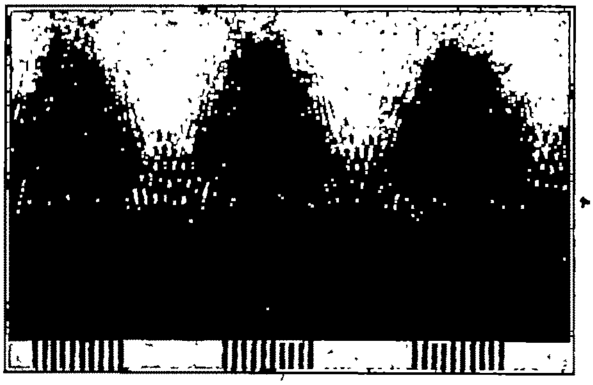


Fig. 2

If the number N is not very large, these lines are broadened to bands, and this broadness limits the resolving power. In the case of varying sound, the variation of the spectrum can be followed by making N sufficiently small, so that the resolving power of frequency and that of time counteract each other. But this is not a defect in the method. The lack of resolving power in frequency is complementary to precise knowledge of time variation, and vice versa.

A simple example is given in Fig. 2, which shows the analysis obtained for the 'square waves' (10 pulses followed by an intermission of 10 periods) shown at the bottom of the figure, n_0 being the fundamental frequency. A preliminary test of the application of this method to the analysis of speech was also undertaken. The variation of word pitch and the crossing of different successive overtones over the formant region of the vowels were clearly observed.

The analysing plate can be modified in various ways for different purposes, Fig. 1 being merely an example. Further, the sinusoidal transmission character of the analysing plate may be generalized to any orthogonal sets of functions, and thus a method is obtained of expanding given functions in series or integrals of some suitable orthogonal functions.

Another application of the analysing plate is found in the artificial composition of sound. By throwing on the plate suitably formed moving rays of light, and receiving the transmitted light on a photo-cell, any desired sound can be produced.

The construction of this analysing apparatus and investigations of some of its applications are now in progress in Prof. Takeo Hori's laboratory. I wish to express my gratitude to Prof. Hori, and also to the Hattori Hokokai for financial support.

Katumi Imahori.

Hokkaido Imperial University,
Sapporo.
July 2.

---

[1] Germansky, B., *Ann. Phys.*, 7, 453 (1930).

[2] Brown, D., Nature, 140, 1099 (1937); *Proc. Phys. Soc.*, 51, 244 (1939).

Atomic Parameters of γ-Silver - Cadmium

Readjusting atomic parameters of γ-brass, we have calculated three successive sets of atomic parameters for γ-silver - cadmium. These sets we tested by comparing the intensities calculated with them with the observed intensities of the reflections of γ-silver - cadmium. For our thrice readjusted atomic parameters, namely, $a = 0{\cdot}105$, $b = 0{\cdot}175$, $c = 0{\cdot}358$, $d = 0{\cdot}310$, and $e = 0{\cdot}038$, the agreement between the observed and the calculated intensities was sufficiently good to afford confirmation of the correctness of these values. Interatomic distances calculated from these adopted atomic parameters suggests a regular distribution of the silver and the cadmium atoms, silver atoms occupying positions of B atoms and C atoms, cadmium atoms those of A atoms and D atoms.

Our calculations were based on powder photographs and the data of reflections made available to us by Prof. A. Westgren of the University of Stockholm. A detailed account of them will be published in the *Acta et Commentationes Universitatis Tartuensis*.

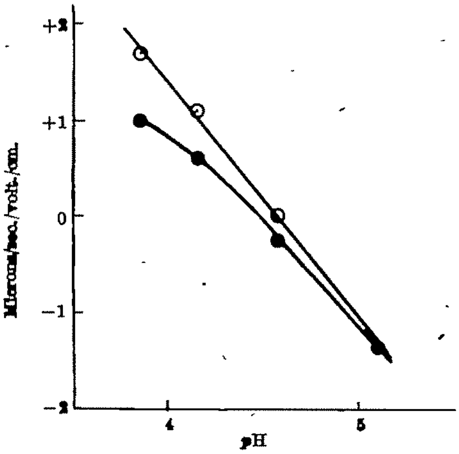
HARALD PERLITZ.
ROLF AAVAKIVI.

Laboratory of Theoretical Physics,
University, Tartu.
Sept. 20.

Cataphoretic Measurements on Solutions of Visual Purple and Indicator Yellow

LIGHT transforms visual purple, the substance responsible for scotopic vision, into a yellow compound, the colour of which depends on pH ('indicator yellow'[1]). Visual purple behaves as a coloured protein, that is, it is a 'chromoprotein'. Experiments have been carried out to see if a shift of the isoelectric point occurs on bleaching.

The visual purple was obtained from Hungarian frogs by means of extraction with digitonin, and the solution dialysed for long enough to remove the bulk of the salts, but not to precipitate the protein. Measurements were made with a micro-cataphoretic cell which will be described elsewhere. Quartz particles of the size 2–5 μ were suspended in the solution and $N/100$ acetate buffer added. The particles adsorb the chromoprotein and their movement is governed by the ionization of the latter[2]. The measurements on visual purple were carried out in ruby light to prevent bleaching. After each determination, white light was switched on without removing the cell, so transforming the visual purple into indicator yellow. During the bleaching the cataphoretic velocity of the particles increased in solutions more acid than about pH 4·5, and decreased in solutions more alkaline than pH 4·5. After a few minutes a steady velocity was reached, which was independent of whether observation was made with ruby or white light.



THE VARIATION OF THE CATAPHORETIC VELOCITIES IN SOLUTIONS OF VISUAL PURPLE AND INDICATOR YELLOW WITH pH VALUE

The cataphoretic velocities before and after bleaching for one preparation are plotted against pH in the accompanying graph. It appears that the isoelectric point of the particles in the visual purple solution is 4·47, and in the indicator yellow solution 4·57 pH units. Other preparations gave the same type of curves and the same shift on bleaching, but sometimes the positions of the isoelectric points were slightly different (±0·1). The isoelectric points are, therefore, in a comparatively strongly acid range. This explains the observation that solutions of visual purple become acid on prolonged dialysis against distilled water[3].

No other case appears to be recorded in literature where moderate illumination produces a change in the isoelectric point of a protein or chromoprotein. The bleaching process of visual purple is apparently associated with an increase in the number of alkaline groups, such as NH_2, available for ionization.

Our thanks are due to the Rockefeller Foundation for financial help.

E. E. BRODA.
C. F. GOODEVE.
R. J. LYTHGOE.
E. VICTOR.

University College,
London.
September 6.

---

[1] Lythgoe, R. J., *J. Physiol.*, 89, 331 (1937).

[2] Abramson, H. A., *J. Amer. Chem. Soc.*, 50, 390 (1928).

[3] Lythgoe, R. J., and Quilliam, J. P., *J. Physiol*, 93, 24 (1938).

A Mechanism for the Concentrating of Potassium by Cells, with Experimental Verification for Muscle

THE membrane considered is one of special type, with cation and anion pores, permeable to potassium but not to larger sodium ions, and permeable at the same time to small anions of the type of chloride, bicarbonate, phosphate, etc., but not to larger anions such as hexose esters, phosphocreatine, etc. The concentrations inside (or within the cell) and outside the membrane are represented as follows: B/V and b, impermeable cations; k_1 and k, potassium; d_1 and d, permeable anions; A/V, impermeable non-colloidal anions; C/V, colloidal anions inside; x, external impermeable non-electrolyte such as glucose.

The permeable anions, which will be almost entirely chloride and bicarbonate, are considered as monovalent, and the valencies of B, A and C are written as m, n and p. V is the volume of the solvent inside, which is considered to be initially one litre. The quantities A, B and C are regarded as independent of V. The total external concentration is written as 'c'.

From the requirements of the osmotic, electrical and Donnan equilibria we may deduce the following equations:

$$V^2(c^2-4kd)-2VKc+(K^2-K_1^2)=0 \quad . \quad (1)$$

$$2k_1 = c-(K-K_1)/V \quad . \quad . \quad . \quad . \quad (2)$$

$$kd = k_1d_1, \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$\text{where } K = B+A, \quad . \quad . \quad . \quad . \quad (4)$$

$$\text{and } K_1 = nA+pC-mB. \quad . \quad . \quad . \quad (5)$$

Reckoning the value of $(K-K_1)$ from the available data, it is found to be sufficiently small to be neglected in approximate calculations, so that we may write for (1) and (2) :

$$V = \frac{2Kc}{c^2 - 4kd} \quad . \quad . \quad . \quad . \quad . \quad (6)$$

$$\text{and} \quad k_1 = c/2, \quad . \quad . \quad . \quad . \quad . \quad (7)$$

From equations 6 and 7 it appears that as potassium is substituted for sodium in the external solution, the potassium concentration in the cell will remain unchanged, but potassium will enter and the cell volume increase. As the external concentration is increased, the potassium concentration inside will increase ; but if the external potassium is also raised, the volume will stand higher than otherwise and potassium will have entered the cell.

When excised muscle is immersed in Ringer or Barkan fluid, potassium is lost until the external potassium is 29 milliequiv./litre. The raised equilibrium value appears associated with widening of the cation and anion pores, and it is from this raised value we shall consider the effect of potassium changes. The interspace fluid is taken as 9 ml./100 gm. tissue (from magnesium and inulin methods), though small differences with total volume changes will not materially affect the calculations.

The following table illustrates the kind of results obtained ; each figure being the mean of four or five experiments. Concentrations are expressed as milliequiv./litre of external fluid or 'fibre' water (which latter is normally 71 ml./100 gm. muscle).

Potassium conc. in ext. fluid	Total conc. of ext. fluid	Potassium conc. of 'fibre' water Exper.	Theor.	Potassium entry. Milliequiv./litre of 'fibre' water
2·5	240 (plasma)	119	120	
33·5	248	115	124	12·5
103	256	121	128	83·8
103	384	196	192	33·2
103	534	263	267	8·8

For equation 3 we have the following data, taking chloride as an example of the permeable anion.

External conc.		Inside conc		Products	
K	Cl	K	Cl	K × Cl	K × Cl
29	106	119	26·6	3074	3165
80·4	132	145	73·0	10613	10585

Original entrance of potassium and relation of potassium interchanges to carbohydrate metabolism. Here we shall consider briefly an apparently easy and effective means of increasing the potassium in cells without change in external potassium or in total concentration outside. If, in the above scheme, impermeable anions are formed from permeable, V the volume of the cell will increase from equation 6, and potassium and more diffusible anion will enter the cell in accordance with equations 3, 2 or 7. No intermediation of hydrogen ion with its excessively low gradients will be necessary. A permeable anion that could play this part pre-eminently is phosphate, and when we examine the nature of the impermeable non-colloidal anions within the fibre we find that they are mostly if not quite formed of phosphorylated compounds important for the carbohydrate cycle. If such compounds decrease in concentration during rapid carbohydrate oxidation, potassium should leave the cell, and when reformed the reverse should occur. A relation between carbohydrate metabolism and potassium interchanges has, in fact, been already noted (for example, by Verzar) and is here rationally interpreted.

With the above membrane the potential changes with varying external solutions can also be readily understood, previous explanations assuming chloride impermeability being demonstrably incorrect.

The above research was supported by a grant from the Irish Medical Research Council.

E. J. Conway.
P. J. Boyle.

University College,
Dublin.
Sept. 1.

Action Potentials Recorded from Inside a Nerve Fibre

Nervous messages are invariably associated with an electrical change known as the action potential. This potential is generally believed to arise at a membrane which is situated between the axoplasm and the external medium. If this theory is correct, it should be possible to record the action potential between an electrode inside a nerve fibre and the conducting fluid outside it. Most nerve fibres are too small for this to be tested directly, but we have recently succeeded in inserting micro-electrodes into the giant axons of squids (*Loligo forbesi*)[1].

The following method was used. A 500 μ axon was partially dissected from the first stellar nerve and cut half through with sharp scissors. A fine cannula was pushed through the cut and tied into the axon with a thread of silk. The cannula was mounted with the axon hanging from it in sea water. The upper part of the axon was illuminated from behind and could be observed from the front and side by means of a system of mirrors and a microscope ; the lower part was insulated by oil and could be stimulated electrically. Action potentials were recorded by connecting one amplifier lead to the sea water outside the axon and the other to a micro-electrode which

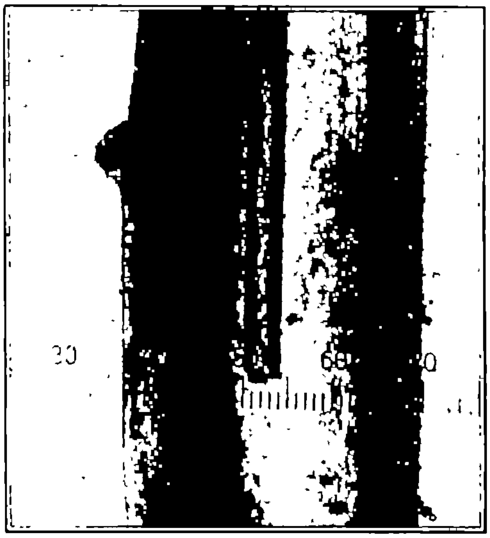


Fig. 1.

Photomicrograph of electrode inside giant axon. 1 scale division = 33 μ.

was lowered through the cannula into the intact nerve beneath it. The micro-electrode consisted of a glass tube about 100 μ in diameter and 10–20 mm. in length; the end of the tube was filled with sea water, and electrical contact with this was made by a 20 μ silver wire which was coated with silver chloride at the tip. Fig. 1 is a photograph of an electrode inside the living axon. The giant axon shows as a clear space and is surrounded by the small fibres and connective tissue which make up the rest of the nerve trunk. The silver wire can be seen inside the electrode and about 1 mm. from its tip. A small action potential was recorded from the upper end of the axon and this gradually increased as the electrode was lowered, until it reached a constant amplitude of 80–95 mv. at a distance of about 10 mm. from the cannula. In this region the axon appeared to be in a completely normal condition, for it survived and transmitted impulses for several hours. Experiments with external electrodes showed that the action potential was conducted for at least a centimetre past the tip of the micro-electrode.

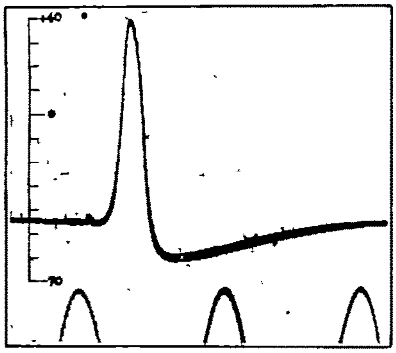


Fig. 2.

Action potential recorded between inside and outside of axon. Time marker, 500 cycles/sec. The vertical scale indicates the potential of the internal electrode in millivolts, the sea water outside being taken at zero potential.

These results are important for two reasons. In the first place they prove that the action potential arises at the surface, and in the second, they give the absolute magnitude of the action potential as about 90 mv. at 20° C. Previous measurements have always been made with external electrodes and give values which are reduced by the short-circuiting effect of the fluid outside the nerve fibre.

The potential difference recorded between the interior and exterior of the resting fibre is about 50 mv. The potential difference across the membrane may be greater than this, because there may be a junction potential between the axoplasm and the sea water in the tip of the electrode. This potential cannot be estimated, because the anions inside the nerve fibre have not been identified.

We wish to express our indebtedness to Mr. J. Z. Young, whose discovery of the giant axon in *Loligo* made this work possible.

A. L. Hodgkin.
A. F. Huxley.

Laboratory of the
Marine Biological Association,
Plymouth.
August 26.

---

[1] Young, J. Z., *Proc. Roy. Soc.*, B, 121, 319 (1936).

Legume Nodule Metabolism and Nitrogen Fixation

The extent of nitrogen fixation in legume nodules is governed primarily by the carbohydrate supply[1,2]. Quantitative information concerning the carbohydrate and nitrogen metabolism of nodules is, however, somewhat limited. Investigations of this subject, conducted during the past four years, are here reported upon briefly.

The experimental procedure involved the use of standard manometric techniques supplemented by chemical analyses. Nodules from twelve species of legumes were compared with normal root tissues of these legumes and of twelve species of non-legumes. These tissues were detached from young field-grown plants, washed, and used as quickly as feasible in Warburg respiration experiments, or otherwise as desired. The outstanding results of these studies are given below.

Variations in behaviour between samples of nodules of different species were not much greater than between samples of the same species, hence the selection of a species for an experiment was relatively unimportant. The same generalization applies also to root tissues.

The inner tissues of most nodules kept in air were under partially anaerobic conditions; this was likewise true for large nodules even in oxygen. This conclusion is based upon the relative rates of respiration and respiratory quotients of nodules and roots in different partial pressures of oxygen. In air, the average Q_{O_2} of whole legume nodules and small roots of legumes and non-legumes was about 2·2; the values for nodules immediately after crushing usually varied between 3 and 7. The use of pure oxygen increased the average Q_{O_2} of whole nodules to about 5·3, but changed that of small roots only slightly. Small root tissues are evidently well aerated, even in air. The *R. Q.* values of nodules increased with nodule size and with decrease in oxygen concentration. In air most nodules, even though small, showed *R. Q.* values considerably above 1·0, whereas in pure oxygen the values were usually near 1·0. Small legume and non-legume roots usually gave values appreciably below 1·0 even in air.

Small roots apparently contain less available carbohydrates than do nodules, since glucose additions increased the Q_{O_2} of the former about 40 per cent and of the latter 12 per cent. The smaller diameter of the roots, however, favoured sugar penetration, and this fact may account for a portion of the greater increase. Under anaerobic or partially anaerobic conditions both nodule and root tissues formed ethyl alcohol[3]; under aerobic conditions alcohol was oxidized completely to carbon dioxide and water.

The rates of respiration per unit of tissue nitrogen of legume and non-legume roots was 3–4 times as great as for nodules in air, and twice as great as for nodules in oxygen. This indicates that a considerable portion of the nitrogen in nodules is either in storage, translocatory or other biologically inactive compounds.

Repeated attempts to obtain nitrogen fixation by detached nodules of different species and ages and maintained under various conditions were, with one possible exception, unsuccessful. Nitrogen analyses were made either by the Kjeldahl method or by gas analysis.

These experimental results are in harmony with the generally accepted idea that the bacteria in nodules are mostly in a dormant condition. Under ordinary atmospheric conditions the Q_{O_2} of nodule tissue was not greatly different from that of young root tissues, and the average respiration rate of the bacteria corresponded to or was even lower than that of resting rhizobia (Q_{O_2} usually about 6–8) in culture. Considering, furthermore, that nodules usually represent only 1–5 per cent of the total dry weight of the plant, it is obvious that the bacteria in the nodules oxidize only a small portion (see earlier discussion[1]) of the carbohydrate synthesized by the host plant. The bulk of the carbohydrate supply that largely determines the magnitude of nitrogen fixation is actually used by the host in its growth processes.

A detailed account of these investigations will be published shortly in a series of papers.

Franklin E. Allison.
C. A. Ludwig.
Sam R. Hoover.
Francis W. Minor.

Bureau of Agricultural Chemistry and Engineering,
U.S. Department of Agriculture,
Washington, D.C.
Aug. 28.

---

[1] Allison, *Soil Sci.*, 39, 123–143 (1935).

[2] Allison and Ludwig, *J. Amer. Soc. Agron.*, 31, 149–158 (1939).

[3] Ludwig, Allison, Hoover and Minor, "Incidental Observations Regarding the Production and Utilization of Alcohol by Plant Tissues". *Science*. In the press.

Correlation between Seed Weight and 'Adult' Weight in Tomatoes

In a recent contribution to the study of heterosis, Luckwill[1] adduces evidence that in different crosses of tomatoes hybrid vigour may appear at different stages in the life-cycle. He states that in certain crosses "there was found to be very little correspondence between the presence of heterosis in the seed and in the mature hybrid". A possible reason for this, as Luckwill mentions, is that seed size is influenced by other than genetic causes, but there is another explanation which has been overlooked, and which is important in all such studies of plant growth.

In Luckwill's experiments seeds of known weight were planted in pots, and were afterwards transplanted "with the greatest possible care" into garden plots. Luckwill assumes that the disturbance in growth due to transplanting does not interfere with any correlation between seed weight and adult weight, and that if seed weight is important in determining size, larger seeds should give rise to larger plants, notwithstanding this treatment. The following data show that this assumption is incorrect.

Covariance of seed weight and adult weight for ten strains of tomatoes, between means of strains.

Treatment	Degrees of freedom	Sums of products	r
Transplanted	9	18·8193	0·503, not significant
Control	9	28·7683	0·949, significant

Weighed seed of ten strains of tomatoes (five inbred lines and five F_1 crosses) were planted in uniform conditions in a greenhouse. After an interval of 31 days half the seedlings were transplanted with great care into ten-inch pots. The other half remained in the ten-inch pots in which they had germinated. The transplanted and control seedlings were arranged in blocks in a greenhouse, to facilitate statistical analysis. On the 78th day after germination, as the first flowering truss appeared, the plants were harvested, dried in a stream of air at 95°, and weighed. The accompanying table shows the result of an analysis of covariance between seed weight and adult weight for the transplanted and control plants.

It is clear that there is a highly significant correlation between seed weight and dry weight at the onset of flowering, and that this correlation is destroyed if the plants are transplanted between sowing and harvesting, however carefully the transplanting is carried out. It seems obvious that Luckwill's method of comparing the significance of differences of means of seed weight on one hand, and of means of fresh weight 145 days after planting, and after transplanting, on the other hand, can give no reliable information as to the relation between seed size (whether in hybrids or inbred lines) and adult size.

A full account of these experiments will shortly be published.

Eric Ashby.

Botany School,
University of Sydney.
Aug. 28.

---

[1] Luckwill, L. C., *J. Gen.*, 37, 421 (1939).

Loaded Dice

Dice have been used as a game of chance from time immemorial and have in all ages been associated with gambling for high stakes. Loaded dice or dice adjusted to increase the probability of a particular face or one of a group of faces turning up have been used by swindlers from very early times, and such methods of destroying symmetry as unsymmetrical weighting and slight alteration of form are well known. Even in the case of normal dice, the method of numbering the sides may cause a slight departure from perfect symmetry, and there may be justification for the alleged belief of professional gamblers that there is a slight tendency for the higher numbers 4, 5 and 6 to turn up more often than 1, 2 and 3.

Dice are numbered in such a way that the sum of the numbers on opposite sides is always 7. There are two possible arrangements which are mirror images of each other, but I do not know whether both are used. The numbers 1, 2 and 3 are grouped around one corner of the cube and the opposite numbers 6, 5 and 4 around the diametrically opposite corner. It follows that if conical or hemispherical holes are used for numbers, since more material is removed the higher the number, the centre of gravity will be displaced towards the corner adjoining the three low numbers, and there should in consequence be a slight bias in favour of the higher numbers turning up, the magnitude of the bias being increased with the size of the holes. There should also be a bias, though very much smaller, in favour of even numbers against odd numbers.

Attempts to detect such a bias by a very large number of throws have, I believe, been recorded but I am unable to trace such records. Experimental detection of a bias would not show, however, that the bias was due to displacement of the centre of gravity, since another and very important factor is involved, namely, lack of uniformity in the frictional resistance of the surfaces of the die.

In professional gambling, dice are thrown along a plane surface of correct texture such as a billiard table. A die near the end of its course with just sufficient momentum to overturn it, if arrested by the surface will, if its frictional resistance is low, slip forward without overturning, but if sufficiently retarded by friction will turn over on to the next face. The result of this can be more easily seen by considering dice marked, as they frequently are, black and white on opposite faces. If the black faces have low and the white higher frictional resistance, a die on its black face will slip forward and stay on that face when one with the same momentum but on its white face will turn on to one of the four adjoining faces, two of which are white and two black. Assuming that there is equal probability of a die being on any one of its six faces before frictional resistance is operative, friction can thus cause a large bias, of limiting probability 3 to 1 in favour of the die coming to rest with one of the faces of higher resistance on top.

In order to test this effect of frictional resistance, I marked plain, transparent coloured dice of the modern type with a small black dot on three adjoining faces and a small white dot on the three opposite faces, and treated the faces having black dots in various ways with the view of increasing resistance to slip without leaving visible signs of treatment. Excellent results were obtained with a specially prepared slow-drying colourless varnish, undetectable by appearance on the treated dice. When the varnish had hardened sufficiently, a slight difference of touch was detectable though not obvious. Numerous trials with treated dice thrown on a suitable surface, best on a billiard table, showed a most pronounced bias in favour of the treated sides with black dots turning up. The bias decreased as the varnish became harder, and was much smaller twenty-four hours later. The following throws made with a single die and grouped into hundreds are typical:

$$\frac{\text{black}}{\text{white}} = \frac{65}{35} + \frac{74}{26} + \frac{69}{31} + \frac{62}{38} + \frac{67}{33} + \frac{69}{31} + \frac{65}{35} + \frac{61}{39} = \frac{1\cdot 9}{1}$$

If two such dice are thrown, as in a common form of gambling, the probability of a pair of black against a pair of white is $1\cdot 9^2 = 3\cdot 6$ to 1.

With ordinary numbered dice with conical or hemispherical holes, it is possible that the frictional resistance may be increased or diminished with the number of holes according as the edges of the holes are sharp or rounded. Consequently, any observed bias cannot be attributed to displacement of centre of gravity unless the possibility of such bias being due to difference of frictional resistance has been eliminated.

F. P. WORLEY.

Auckland University College,
Auckland, New Zealand.
July 25.

Points from Foregoing Letters

The uniform time of radioactive decay is identified by G. J. Whitrow with the *t*-time of kinematical relativity, according to which the 'age of the universe' is of the order 2×10^9 years. Since this is not the uniform time of dynamics, according to which the 'age of the universe' is infinite, a comparison is made between the dates assigned to various geological epochs by radioactive methods and the corresponding dates in dynamical time. It is found that the two measures of the whole fossil period differ by an amount not much greater than the probable error in estimating its duration by the present methods.

D. H. T. Gant has bombarded uranium with high energy deuterons, and by studying the decay curve of the recoiling fragments he has obtained evidence suggesting that radioactive nuclei are projected from the uranium target with a range of the order of 2 cm., due to a fission of the uranium nucleus. The threshold for the fission process appears to lie at about 8 Mv. and the cross-section increases rapidly in the range 8–9 Mv.

G. B. B. M. Sutherland and W. T. Tutte report that appreciable absorption in the infra-red region of the spectrum between 3 μ and 10 μ is exhibited by polymolecular films only a few hundred molecules thick. This rather surprising result opens up a new field of research in the application of infra-red spectroscopy to the structure of surface films, and may be of importance in studying protein molecules.

K. Imahori describes a photographic method of frequency analysis which can be applied to sound.

From powder photographs by A. Westgren and H. Ålstrand, H. Perlitz and R. Aavakivi have calculated the atomic parameters of γ-silver - cadmium, finding by the method of successive approximations values which gave calculated intensities in good agreement with those observed experimentally.

E. E. Broda, C. F. Goodeve, R. J. Lythgoe and E. Victor find that the iso-electric point of visual purple is 4·47 *p*H units, and that it undergoes a shift by 0·1 *p*H units to the alkaline side on bleaching to indicator yellow. This is taken to suggest that bleaching results in an increase to the number of alkaline groups available for ionization.

A special type of cell membrane is dealt with by E. J. Conway and P. J. Boyle which is both anion- and cation-permeable up to certain size limits of the ions. Potassium, for example, is considered permeable and sodium impermeable. In contact with ionic media like blood plasma, such a membrane will result in a high internal potassium concentration being in equilibrium with a low value outside, and certain relationships can be deduced which are shown to apply to excised muscle. A relation with carbohydrate metabolism, and the manner of the original entrance of potassium into cells, are suggested.

A. L. Hodgkin and A. F. Huxley describe a method for inserting an electrode into a living nerve fibre. They have recorded action potentials of 90 mv. across the surface of the fibre.

Respiration studies made by F. E. Allison *et al.* show that the inner tissues of legume root nodules are usually partially anaerobic. Both nodule and root tissues may produce or oxidize ethyl alcohol, depending upon the oxygen supply. The rates of carbohydrate consumption under ordinary atmospheric conditions by nodule and young root tissues are usually about the same. Attempts to obtain nitrogen fixation by detached nodules were unsuccessful.

RESEARCH ITEMS

Blood Groups among Primitive Peoples

The British Association Research Committee on Blood Groups among Primitive Peoples, of which Prof. H. J. Fleure is chairman, reported at the Dundee meeting on its work during the year 1938–39. Results obtained by Dr. F. W. Vint in Nairobi, Kenya, in 1936, which it has not been possible to carry further, are recorded as follows: Individuals tested, 121 (Bantu, 73; half-Hamites, 5; Nilote, 33; mixed, 10); percentages: *O*, 42·1; *A*, 22·3; *B*, 30·6; *AB*, 5. In the Naga Hills, Assam, from observations in 1936–37, 407 tests were made in all. Of these 140 were of Angamis, Lhotas, Rengmas, and Semas, known historically to be of similar stock. They gave the percentages, Angamis, *O*, 35·4, *A*, 34·4; *B*, 25·0; *AB*, 5·2; while all four tribes together gave, *O*, 40; *A*, 33·6; *B*, 22·1; *AB*, 4·3. The percentages for the four tribes together do not differ appreciably from those for the Angami alone. Larger numbers are required to determine whether Semas, Lhotas and Rengmas show significant differences. Three other tribes were tested as follows: Konyaks (127): *O*, 45·7; *A*, 40·2; *B*, 10·2; *AB*, 3·9; Aos (57): *O*, 47·4; *A*, 22·8; *B*, 22·8; *AB*, 7·0; Thado Kuki (83): *O*, 19·3; *A*, 30·1; *B*, 32·5; *AB*, 18·1. These results accord with the view of Mr. J. P. Mills that the Konyaks are more primitive than the Angami-Rengma, that the Konyak and Aos have much more in common, and that the Thado Kuki are an entirely different race. The Konyak and Aos may be regarded as the most primitive in blood grouping. In Travancore 171 Kannikars, as well as Pulayas and other tribes, have been tested with results markedly different from the general population of Trivandrum. Anthropometric measurements and blood group tests have been carried out on 1,000 Egyptians of the Sharqiya Province, Upper Egypt; and 300 tests have been made in Co. Antrim, Northern Ireland, on individuals with a residential history in the district of three generations, to show whether local differences can arise in a small isolated population.

Alsea Ethnography

The Alsea, like other coast Oregon groups, have suffered both a decline of their numbers and a shattering of their culture under the impact of white civilization. At the time Philip Drucker collected data of their culture in 1933 (*Univ. California Pub. Amer. Ethnol. and Archæol.*, 35, 7; 1939) three persons only remained cognizant of their languages and customs; and from them these particulars were obtained. The Alsea territory comprised the two short river valleys of the Alsea and the Yaquina, and the ocean frontage between them. Adjoining to the north were the Salishan Tillamook; to the south the linguistically related Siuslaw and Lower Umpqua. They were never numerous. Their culture was definitely peripheral, possessing the broader outlines of Northwest Coast culture, but lacking the refinements of the focal civilization. They were off the main lines of communications, along which many complexes were diffused. They were a fisher folk, their choice of dwelling-sites, their seasonal migrations, and their technological interests reflecting the importance of this pursuit in their lives. Salmon ranked first of the several kinds of fish taken. Dried, it was the mainstay, which provided a winter of leisure to a people lacking a plentiful and easily preserved food source. Other fish and game only supplemented this diet. Of a full list of fishing devices, traps and harpoons were regarded as the most effective. Traps were used in conjunction with weirs. Dip-nets—conical sacks—were used. The salmon club was indispensable. Hunting was considered an adventurous way of supplementing the fish diet. Probably there were many who rarely hunted. Elk were hunted in the fall. Dogs were used to hold the elk at bay until the hunter came up. The paucity of hunting devices emphasizes the lack of interest in any pursuit other than fishing.

Behaviour of Tsetse Flies

Under the title of "Studies in the Physiology and Behaviour of *Glossina morsitans*", R. W. Jack, chief entomologist for Southern Rhodesia, gives a detailed account of observations made upon this species of tsetse fly (Mem. Depart. Agric., Southern Rhodesia, No. 1, 1–203; 1939). It embodies, in the main, the results of laboratory research, but certain field data are also included. It is evident, according to the author, that *Glossina morsitana* can thrive under a relatively wide range of conditions, given an adequate food supply. The only extremes of climatic conditions which might exclude *G. morsitans* from extensive tracts of country appear to be too low a mean temperature, which retards reproduction below the survival limit, and too high a maximum temperature especially if it is associated with an inferior cover of vegetation. Interference with the food supply is undoubtedly the best general method of eradicating this insect. It is possible, and economically feasible, in Southern Rhodesia to clear any kind of country of *G. morsitans*, but only at present at the expense of the wild game. With the object of finding alternative measures which can be used over wide areas, it is necessary to continue both laboratory and field research. Not enough is known to combat the fly in its habitat and at the same time to spare the game. A large proportion of the country in Southern Rhodesia infested with *G. morsitans* is relatively sterile, largely waterless, mostly unfit for Europeans and only capable of supporting a very scattered native population. Such areas constitute the major problem because, unless they can be cleared of the tsetse fly or shut off by an effective barrier, they will remain a constant danger to more valuable land where it may otherwise be possible to control the situation.

Replacement of Fangs in Rattlesnakes

The functional fangs of rattlesnakes are changed or replaced periodically, such replacement occurring whether the discarded fang has been damaged or is still intact. Laurence M. Klauber describes the method of replacement (*Occasional Papers*, No. 5, *San Diego Soc. Nat. Hist.*, Aug. 1939). There are two maxillary fang sockets on each side of the head, and these are used alternately as the site of the functional fang on that side. The next replacement fang always lies behind the vacant socket, in which it becomes anchored by the solidification of a bony pedestal when the time for replacement arrives. Replacement on the two sides of the head is not synchronous, but at the time of replacement there is a short period when the new fang and the one which will shortly drop out are both functional. Fang change is so frequent that only during the period of most rapid growth in the largest species can a difference in length be detected between a fang and its next replacement. The author also describes and illustrates the method by which the maxillary is rotated so that a fang can be translated from a resting position against the roof of the mouth to a striking or biting position perpendicular thereto. He notes that the fangs are particularly well adapted for biting rather than merely for striking.

Larval Trematodes in Molluscs

AN exhaustive memoir by Dr. Annie Porter on the larval Trematoda found in certain South African Mollusca, with special reference to schistosomiasis, was published in 1938 by the South African Institute for Medical Research (No. 42, 8, Johannesburg). The memoir is zoological, and describes very fully the life-history of *Schistosoma hæmatobium* and *S. mansoni*, their intermediate molluscan hosts, experiments on transmission, and methods of control—an invaluable survey for the medical man and the parasitologist. In South Africa the vectors of *S. hæmatobium* are the snails *Physopsis africana* and *P. globosa*, while *S. mansoni* is carried by *Planorbis* (? *Biomphalaria*) *pfeifferi*, *Physopsis africana* and *Bulinus tropicus* (Cf. Mozley's paper on the fresh-water molluscs conveying schistosomiasis in Tanganyika, NATURE, 143, 951; 1939). Dr. Porter was able to obtain all stages of the parasites from egg to adult, and successfully carried out artificial infection of the snails by miracidia, and of rats and puppies by cercariæ obtained from the snails. She also investigated the penetration of the skin by the cercariæ in native children bathing in infested pools. She concluded that persistent education, treatment of sufferers and mollusc control are the most effective methods of reducing the incidence of both urinary and intestinal forms of this terrible disease. Shorter accounts of other species of Schistosoma follow. The greater part of the book is taken up with descriptions of cercariæ, mostly of unknown parentage, collected by the author from South African snails and studied alive. The eighty-one plates drawn from living material are to be commended for their excellence.

Caridea of the John Murray Expedition

SEVEN new species of Caridea have been described by W. T. Calman and eighteen recorded for the first time from the area traversed by the *Mabahiss* (British Museum (Natural History). The John Murray Expedition 1933–34. Scientific Reports, 6, No. 4. Crustacea : Caridea. 1939). Most of the sixty-seven species identified were from deep water and include some particularly interesting forms. One new species of Plesionika, *P. minor*, has epipods on the first two pairs of legs only, thus being intermediate between Plesionika and Parapandalus. *Parapandalus filipes* n.sp. is peculiar in having the fourth and fifth legs very long and of "thread-like tenuity", the propodus being excessively attenuated and the dactylus microscopic. Two new Pontoniids, both found in association with sponges and referred to the genus Periclimenes and to the sub-genus Periclimenœus and Ancylocaris respectively, are very much alike, and the second resembles *Periclimenes* (*Periclimenœus*) *robustus* of Borradaile in its massive claws, the armature of the fingers and the short thick claws of the walking legs. It is possible that Borradaile's species may also be associated with sponges. *Periclimenes* (*Ancylocaris*) *crassipes* is the only one of these three with simple claws on the walking legs, but otherwise resembles the others very closely : this supports the suggestion of Kemp (1923) that Periclimenœus may not deserve to be even a sub-genus. None of the three has a hepatic spine, which seems to be a further reason for placing them together.

Vegetation of a South Westmorland Fell

THE district described by Alwyn Bennett (N. W. Nat. Union Year Book 1936–37, 19–48) lies between Burton-in-Kendal and Hutton Roof, and its chief ecological interest lies in the close proximity of limestone and acid gravel drift. The glacial drifts, formerly covered by oakwoods, are now, as a result of deafforestation and subsequent grazing, largely covered with bracken, which is actively spreading on land gone out of cultivation. Changes in the ground flora consequent upon the eradication of bracken by cutting and burning are outlined. The limestone area shows stages in development of closed communities from bare scree slopes to grassland or gorse scrub. A flora rich in species is present in the deeper crevices of the limestone pavements, which afford protection from grazing and conserve moisture. The filling of the crevices with humus leads finally to the development of grass heath corresponding to that of the scree slopes, which may later be invaded by bracken or juniper. Grazing pressure prevents the final succession to ash wood. Some statements referring to the wider distribution of certain species require correction. *Asplenium viride* is said not to be recorded in Ireland. It occurs in 30 per cent of the Irish vice-counties. *Dryas octopetala* is wrongly stated to occur on Ingleborough, whilst *Actæa spicata* is not, as stated, absent in Westmorland, but is recorded from the same limestone formation within six miles of the area studied.

Principles of Plant Geography

THE wide scope of plant geography and the varied methods of phytogeographical research are summarised by W. B. Turrill in a paper based on a series of lectures delivered at Westfield College (*Kew Bull.*, No. 5; 1939). The distribution of the main types of world vegetation is determined by climatic factors, principally temperature and precipitation, similar climates giving rise to plant communities with similar physiognomy, for example, the Mediterranean macchie and Californian chaparral. The distributional area of cultivated crops is also a valuable indication of natural conditions, and the areas in which they show maximum diversity have been used to determine their centres of origin. Distribution of the taxonomic units is discussed under physiographic, climatic, edaphic, biotic and historical headings. Other "inherent and miscellaneous" factors which influence distribution are cytogenetics (the distribution of polyploids, for example, often differs from that of diploids), plasticity of species, structural adaptations permitting survival of plants during unfavourable seasons, seed and fruit dispersal and seed setting. The last includes internal and external factors such as carbohydrate-nitrogen ratios, photoperiodism, pollination mechanisms, environmental control of seed ripening and cytogenetic factors for fertility and sterility. Brief reference is made to the determination of past and present migration routes and the theories of continental drift, age and area, and tolerance.

Hot Water Treatment of Iris Bulbs

IT is now a standard practice to heat most kinds of bulbs for three hours in water at 110° F. to combat attacks of eelworm. Iris bulbs have not usually been subject to the pest, but W. Buddin recently described a considerable attack of this plant by the stem eelworm *Anguillulina dipsaci* (*J. Roy. Hort. Soc.*, **64**, Pt. 9; September 1939). He applied the usual heat treatment for the comparatively short period of 50 min.; but even this slight operation had the unfortunate result of diminishing the flowering capacity of the bulbs. Exposure to the hot water for 25 min. had little effect upon the bloom, but was of doubtful value for control of the pest. It remains to find a critical length of treatment between 25 and 50 min., where the pest will be controlled, and the flowering not markedly reduced. Lowering of the floral vigour appears to be a direct lethal effect of the hot water, for increased exposure killed the vegetative parts also.

Spiral Structure in *Osmunda regalis*

I. MANTON (*Phil. Trans. Roy. Soc.*, B, **230**, 179–215; 1939) shows that the chromosomes of *Osmunda regalis* provide excellent material for the analysis of chromosome behaviour. The haploid number of chromosomes is 22 and all have terminal or subterminal centromeres and are similar in size. The number of coils at the first meiotic division is 4, at the second meiotic division is 8 and during mitosis is between 12 and 16. The coils are in equilibrium and exhibit no signs of torsional strain during meiosis. The author is of the view that the chromosomes exhibit high elasticity. Measurements indicate that the chromosome length remains constant throughout mitosis, but that at leptotene the thread is about 50 per cent longer, and at first meiotic metaphase 33–50 per cent shorter, than at mitosis. A hypothesis utilizing the apparent similarity to a proteinaceous elastic fibre in the α, β and supercontracted state suggests that the straightening of the molecular contractions at leptotene is a causal factor in chromosome-pairing.

Genetic Construction in Triticum

L. SMITH (Univ. Miss. Research Bull., 298; 1939) describes 56 mutants resulting from the X-raying of *Triticum monococcum* var. *vulgare* and var. *flavescens*. Only 9 of these 56 viable mutants had been found in untreated material. Among the genes were some which controlled the development of chlorophyll, of anthers and sporogenesis, while others influenced colour, hairs, stiffness of leaf and other characters. Ninety-seven combinations of genes have shown that there was no linkage between them, while nine pairs are closely linked, four (involving six genes) being very closely linked.

Thermal Properties of Water and Steam

Two papers by N. S. Osborne, H. F. Stimson and D. C. Ginnings (*J. Res. Nat. Bureau of Standards*, **23**, 197, 261; 1939) describe measurements of the heat capacity and heat of evaporation of water in the range 0°–100° C., and the calculation of the thermal properties of saturated water and steam. The papers include a careful critical examination of previous work. The second paper contains extensive tables. It may be mentioned that the value for the latent heat of evaporation at 100° found is 2256·30 internat. joules per gm., and that the specific heat values accord better with the results of Rowland, Laby and Hercus, and Jaeger and von Steinwehr, than with those of Callendar and Barnes. The new data affect the accepted values of the saturation properties of water and steam in the whole range up to the critical region.

Vapour Pressures of Sulphuric Acid Solutions

SOLUTIONS of sulphuric acid should be suitable as standards in the isopiestic method of investigating the thermodynamic properties of aqueous solutions in the higher concentration range, and S. Shankman and A. R. Gordon (*J. Amer. Chem. Soc.*, **61**, 2370; 1939) describe some measurements of the vapour pressure of sulphuric acid solutions at 25° for concentrations of 2–23 molal by the static method. The results are in good agreement with previous vapour pressure measurements up to 8 molal, and with electromotive force measurements up to 3 molal. At higher concentrations the vapour pressure and electromotive force measurements are in definite disagreement. A possible explanation is that the cell reaction in the case of the electromotive force measurements is not that postulated. The authors have calculated the activity of the water and the activity coefficient of the acid at various round values of the concentrations.

Reinforced Concrete Research

THE eighth of the studies in reinforced concrete made at the Building Research Station (Dept. of Scientific and Industrial Research, Building Research Technical Paper No. 25. H.M. Stationery Office. 1*s*. 3*d*. net) deals with the strength and deformation of reinforced concrete slabs subjected to concentrated loading. Various tests were made on slabs, 6 ft. × 6 ft. × 4 in., 12 ft. × 6 ft. × 4 in. and 6 ft. × 9 in. × 4 in., the concrete mixture in each case being 1 : 2 : 4 by weight, water-cement ratio 0·62 by weight, giving a slump of 1 in. to 1¼ in. At low loads, before the incidence of cracking, the slabs deformed in accordance with the theory of the elastic homogeneous plate. After the incidence of cracking under higher loads, considerable redistribution of moments was apparent and the ultimate loads were about twice as great as the values calculated by the elastic theory for square slabs and 1¼ times in the case of rectangular slabs. Hence the design of reinforced concrete bridge deck slabs on the usual basis of the elastic theory is conservative for the case of point loading under static conditions, since the high theoretical stresses in the neighbourhood of the load are considerably reduced as a result of plastic deformation at high loads. While this conclusion bears the satisfactory inference that the theory is a safe basis of design, it has been pointed out that the mechanics of slab action after the incidence of cracking are so complex that no alternative method of design is at present suggested. It is also mentioned that in this investigation the deflections of the supporting beams were so small that they were considered as not seriously affecting the moment distributions. In practice, however, the yielding of the supporting beams may be of considerable importance in this respect.

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

THE seventh General Assembly of the International Union of Geodesy and Geophysics was held at Washington, D.C., during the period September 4–15, 1939, after the declaration of war upon Germany by Great Britain and France, consequent upon the German invasion of Poland. It was therefore probably the last of the series of great international scientific conferences of the period following upon the War of 1914–18. The choice of Washington as the place of the seventh assembly was made at the sixth assembly, in Edinburgh, in 1936. At Washington the invitation of Norway to the Union, to hold its eighth assembly in that country, was formally accepted, for 1942 or as soon thereafter as conditions in Europe permit. The first five assemblies of the Union were held at Rome, Madrid, Prague, Stockholm and Lisbon.

On August 30, when the political crisis was already nearing its height, the president and secretary of the Union, Dr. D. la Cour (Denmark) and Brigadier H. St. J. L. Winterbotham (Great Britain), after consulting the American Organizing Committee and other colleagues then in Washington, cabled to all adhering organizations intimating that the assembly would be held, but that its activities would be confined to scientific matters only. This last decision was subject to the approval of the executive committee of the Union, and was later agreed to; it was made because many of the expected delegates would be absent from the assembly, either because, having crossed to America, they had been recalled (as was the case with the whole French delegation and many of the British delegates, including most of those in the service of the Government), or, having started, did not proceed to their destination (as happened to the delegation from Germany, with the exception of one member who had travelled earlier to Washington), or had cancelled their journey before leaving. The business thus excluded from the original agenda included the discussion of administrative matters and of the proposed amendments of statutes, and also the election of new officers and executive committees for the Union and its seven associations. The existing officers were continued, as an emergency measure, until such time as a postal ballot seems desirable and feasible. Hence, for the present, the above-mentioned officers of the Union continue in office, as also those of the associations, as follows (*P* = president, *S* = secretary): Geodesy: (*P.*) Meinesz (Holland); (*S.*) Perrier* (France). Seismology: (*P.*) Heck (U.S.A.); (*S.*) Rothé* (France). Meteorology: (*P.*) Chapman (Britain); (*S.*) Bjerknes (Norway). Magnetism: (*P.*) Fleming (U.S.A.); (*S.*) Goldie* (Britain). Oceanography: (*P.*) Helland-Hansen (Norway); (*S.*) Proudman (Britain). Volcanology: (*P.*) Michel-Lévy* (France); (*S.*) Signore* (Italy). Hydrology: (*P.*) Lütschy* (Switzerland); (*S.*) Diénert* (France).

The vice-president of the Association of Hydrology, Prof. Slettenmark (Sweden), was present and presided over its meetings; the Association of Volcanology was entirely without officers present, and Dr. L. H. Adams (U.S.A.) was chosen as acting president.

Brigadier Winterbotham returned to England before the assembly opened, and Dr. W. Bowie (president of the Union at the Edinburgh Assembly) was chosen as acting general secretary of the Union; the work of the five absent secretaries of Associations was also undertaken by American delegates.

At present, about thirty-two countries adhere to the Union, and twenty of these were represented at Washington (Argentine, Belgium, Canada, Chile, Columbia, Denmark, Eire, Finland, Germany, Great Britain, Greece, Holland, Japan, Mexico, Norway, Poland, Rumania, Sweden, Switzerland and the U.S.A.). Visitors were present also from Bulgaria, Dominica, Hungary, India, the Philippines and Venezuela (non-member States). The United States naturally provided the largest section of members present, numbering approximately three hundred (with a hundred non-members); the number of other members present was about ninety-five (with about twenty-five non-members); thus the Assembly was one of the largest yet held. The absence of French and Italian delegates (and Russian visitors, as at Edinburgh) was much regretted.

In accordance with the decision not to discuss new administrative questions, the associations adopted no schemes involving new expenditure, and agreed to continue their financial management and programmes along the lines heretofore followed, so far as the available funds allow. Fortunately, the Union (and some of the associations in addition) has accumulated a certain reserve of unexpended money, and with its aid it is hoped that, despite the probable reduction of subscriptions accruing during the next year or two, the work of the Union and its associations can to some extent be continued until peace is restored.

The interest of the United States Government in the Assembly was shown not only by the financial provision which (with other assistance) enabled the American organizing committee (president, Dr. R. M. Field, secretary, Dr. J. A. Fleming) to make the excellent arrangements that helped so much towards the efficient conduct of the meetings. The Government, which during the development of the crisis clearly indicated its wish that the Assembly should be held, showed its good will also by an address of welcome from Mr. Cordell Hull, Secretary of State, at the opening meeting of the Union; moreover, the President, Mr. F. D. Roosevelt, received the Union officers and the presidents of the associations, together with Dr. Field, at the close of the Assembly. The closing words of Mr. Cordell Hull may be quoted here:

"If is my fervent hope, which the people of this country share, that the day may soon come when the statesmen of the world will take a leaf from the book of the scientists and solve international political problems in the same dignified and friendly spirit."

The scientific meetings of the Associations, and of the Union's Inter-Association Commission on Continental and Oceanic Structure (president Dr. Field), were held at the George Washington University, the new and older premises of which, generously placed at the Union's disposal, proved very satisfactory and convenient. The absence of administrative business enabled the full time of the Assembly to be devoted to scientific discussion, including several joint meetings between two or more associations, such as are rendered desirable by the ever more closely interwoven problems in the different departments of geophysics. At the end of the Assembly, when reports on the work of the seven associations and the Commission were presented, it was on all sides agreed that the scientific discussions had been most useful and successful, and that the Assembly had been as valuable as it was harmonious. Apart from the exchange and clarification of knowledge by the reading and discussion of scientific reports and papers (many of which had been circulated in full or in abstract beforehand), the associations were able to perform useful business in arranging for the continuance, in some cases with useful modifications or extensions, of international enterprises of geophysical importance, which they organize or support. Valuable and instructive scientific excursions, and visits to American scientific institutions, also took place during or before the Assembly.

---

* These officers were not present.

Personal meetings and discussions between fellow-workers in geophysics, from different countries, form another important contribution which such international assemblies afford to scientific progress. These were facilitated not only by the formal meetings, but also by the public and private hospitality which were dispensed to delegates, with the proverbial American warmth and generosity. Recollection of the kindness thus received from our American hosts will long be treasured in our memories.

The president and general secretary of the Union were honoured during the Assembly by the conferment of the doctorate of the George Washington University.

The Pan American Institute of Geography and History (director, Dr. P. C. Sánchey, Mexico) co-operated with the Union and held three meetings of its executive committee during the Assembly, at which many matters of interest to geodesists and geophysicists were discussed. S. Chapman.

WORK OF THE WATER POLLUTION RESEARCH BOARD

A PART of the programme arranged for the Conference of Delegates of Corresponding Societies during the Dundee meeting of the British Association was a discussion on river pollution. Sir Robert Robertson, chairman of the Water Pollution Board of the Department of Scientific and Industrial Research, had prepared a statement of the work of the Board for presentation to the discussion, from which the following account has been prepared. Details will be found in the reports of the Board published by H.M. Stationery Office.

Trade Effluents

Beet-sugar factory effluents. The evil due to these effluents can be avoided by passing the effluents through a biological filter, similar to that used on sewage disposal works. It is also practicable, however, to avoid the discharge of effluent by simple treatment by sedimentation, and addition of small quantities of lime so that the waters can be re-used in the factory.

Milk-factory effluent. This effluent, which is highly polluting and may be inimical to fish-life, since it removes dissolved oxygen from the water, has been demonstrated to be capable of complete purification by two methods: that of biological filtration, in which two percolating filters in series are employed, and the sequence of the two filters is periodically changed, and by the activated sludge process. The former method has been adopted in a number of factories. Fish can live in the treated effluents.

Studies of River Pollution

The River Tees. A river was chosen which is substantially unpolluted in its upper reaches, then polluted by sewage from a large town, and finally contaminated by sewage and trade effluents in its estuary. The Tees was formerly an important salmon river; it was found that in their progress down the Tees to the sea the smolts were poisoned in thousands. There has been no study made of a river's life-history so intensive, from the different aspects, chemical, biological, and hydrographical. In the non-tidal reaches the effects of sewage were studied on the chemical composition, and animal and vegetable life of the river, and on the seasonal changes with respect to the self-purification of the river. Similarly, in the estuary, these effects were observed on the composition of the water and estuarine life. An interesting conclusion was reached that the hitherto unsuspected cause of the death of smolts was due to cyanide from the coke-ovens; and methods of avoiding this were suggested, and to some extent have been adopted. This intensive study of a river from source to sea may be taken as an authoritative model for future investigations of other rivers.

The Mersey Estuary. Possibly as a result of its successful investigation of the River Tees, the Board was asked to carry out an investigation on the effect of the discharge of crude sewage from Liverpool and other towns in the district on the presumed silting-up of the estuary of the Mersey. This work, on which a comprehensive report has been made, involved nearly four years investigations by hydrographers, chemists, and biologists, and its findings, which are unequivocal, have been accepted by the interested bodies. It was found that the volume of the estuary is subject to periodical changes, but that the alleged shrinkage in the volume and hardening of the bed could not be attributed to the discharge of sewage into the estuary.

Water Supply

Two aspects of water supply have engaged the attention of the Board: the base-exchange process for softening water, and the question of prevention of contamination of drinking water by lead.

Base-exchange process. The effect of the various substances used for this process has been examined, and quantitative determinations have been made of the efficiency of the substances on the market, as well as of others, including treated natural clays. A remarkable discovery has been made whereby suitably prepared artificial resins can be used to remove both acidic and basic radicals from water.

Prevention of contamination by lead. A study of plumbo-solvency is being made with the object of improving large-scale methods of treatment of water. In the meantime, an apparatus has been evolved which on being introduced into a water circuit enables a quantitative measure of the lead present in the water to be obtained.

Sewage Purification

As fundamental knowledge was wanting as to the mechanism of methods of treating sewage, such as the activated sludge process, two groups of workers have been engaged on the chemistry and biology of this problem.

The effect of the air-bubbles, which are an essential part of this process, has been examined by chemical and physico-chemical methods, and the changes which occur in the nitrogen and carbon compounds found in sewage and sewage-sludge have been studied in conjunction with the enzymic activity of bacterial cells.

ROAD DEVELOPMENT IN THE UNITED STATES

Mr. E. L. Leeming, an expert on road construction, has given a description in *Roads and Road Construction*, of October 2, of a motor journey he made recently across the United States from Washington to San Francisco, along the Lincoln Highway. This road is now practically completed.

The first thing which strikes the eye of a road engineer, or a road user, when 'docking' at New York, is the sight of the motor traffic speeding along the overhead 'express highway' parallel with the Hudson River and linking the busiest parts of 'downtown' with Riverside Drive, Bronx and other suburbs. For the rapid movement of people, this artery is just as important to the city as the underground railways are. In Washington, since the economic blizzard of 1929, considerable transformation has taken place. Where streets are wide, many things are possible in the way of accommodating traffic. There is room for parking at the side or in the centre, and it is possible to construct an underpass of one road relative to another. Mr. Leeming saw a scheme of this kind in progress; one road is being carried beneath the other, while the surface of the junction is being arranged as a circle to link the connecting roads.

The Lincoln Highway connects the east coast at New York, where it passes beneath the Hudson River by the new Lincoln tunnel, with the Pacific coast near Portland. The road touches Philadelphia, Pittsburgh, Fort Wayne, south of Chicago, Cedar Rapids (Iowa), thence crossing Nebraska, Wyoming, Idaho and Oregon. At Wyoming the road crosses the 'continental divide' at a height of about 7,000 feet. At Salt Lake City he left the Lincoln Highway (U.S.30) and travelled by U.S.40 to San Francisco. Between Nebraska and Wyoming his average speed was 55 m.p.h. in his Studebaker car and his longest day's run was 610 miles. With daily mileages of 500–600, the number of restrictions or hazards are few. Cyclists and pedestrians are entirely absent, while horse vehicles are very rare.

Some curious notices were observed: "Danger, slippery, beware crickets" (meaning dead grasshoppers). In some of the villages, signs were noticed, such as, "Stop when pedestrians are on the crosswalk", "No overtaking for 700 feet", and so on. Good work is being done in the States in regard to 'safety first' measures by organizing schoolchildren. Selected children are trained as leaders to act as traffic police for the purpose of conducting schoolchildren across the roads to and from school. They carry signs indicating "Stop", and every motorist obeys them. Besides preventing children from being run down on the road, it teaches them to observe habits of 'safety first'. In Salt Lake City, where wide streets occur, parking is arranged with the aid of a special meter mounted on a pedestal opposite each vehicle parked on the slant. This meter is operated by placing a nickel (2½*d.*) for half an hour's parking, two nickels or one dime for an hour, and two dimes for two hours. Within these periods an indicator finger is visible at the top of the meter. The meters are only employed between the hours of 9 a.m. and 6 p.m.

Mr. Leeming's journey back from the Pacific coast to New York was made by air over a route covering the Boulder Dam, Grand Canyon, Texas, Kansas City, St. Louis and Pittsburg. This trip takes about 18 hours flying time, but compared with the journey by road, one does not acquire any intimate knowledge of the continent. The author strongly recommends a road journey across from east to west, by one of the arterial routes, U.S.30, U.S.40 or U.S.50. If it is not practical to hire or share a car, the Greyhound, a motor-bus service, is always running. These buses travel over the whole of the States, day and night, and one can sleep on them in very comfortable reclining chairs, if time has to be saved. The cost appears to be much less than that of the rail services. While the latter cost 90 dollars return from New York to San Francisco (without extras), the bus services cost about 65 dollars (about £14) for some 6,000 miles. These buses travel along the highways at about 50–60 m.p.h. and make very good progress.

Some indication of the programme of road development which is likely to be followed in the future is given in the General Motors Exhibition at the New York World Fair. Before making the tour, on the moving chairs of the panorama depicting the highways of America in 1940 gradually changing into the highways of 1960, you are shown a large map of the United States on the ceiling. By an arrangement of the lighting the existing roads are replaced by the new system of modern highroads which will cover the whole continent. Mr. Leeming was informed in Washington that there is enough road development work progressing in the States to keep them busy for the next two generations. Taking into account the remarkable progress which America has already made in road planning, bridge construction and the provision of flyover junctions, he has no doubt that the scheme outlined at the World Fair will be brought to fruition within the period contemplated.

SCIENCE NEWS A CENTURY AGO

Artesian Well in Paris

In the *Athenæum* of October 26, 1839, it is stated that: "At a late sitting of the Academy of Sciences M. Arago stated that he had that morning been making some thermometrical experiments at the artesian well at Grenelle, in order to ascertain the temperature at the depth which had already been attained, viz., 483 metres or 1584 feet. When the workmen had reached 466 metres the chalk was of a green colour, indicating the proximity of water. Since then the chalk had become mixed with clay, and of a dark colour, a still stronger indication that the sheet of water which it intended to meet is near. M. Arago used the thermometer of M. Walferdin, and after having taken all the precautions in order that the pressure which at such a height is equal to 50 atmospheres would not injure the bulb, six thermometers of the same kind were successively let down to a depth of 481 metres, care having been taken not to lower them until 36 hours had elapsed since the boring, in order that the heat which this work might have communicated should have subsided. The thermometers were left in the well for thirty-six hours. The heat at this depth was 27° of Réaumur, or 92¾° of Fahrenheit, being about 23 metres for each degree of temperature. M. Arago expressed a hope that no water might be found for a hundred metres more, as in that case there would be a permanent hot spring at the very gates of Paris."

The well was ultimately driven to a depth of 547 metres. A monument which existed at this spot was demolished in 1904 and a statue of Pasteur erected in its place.

Dye-Wood

This issue of the *Athenæum* of October 26, 1839, contains the following note: "A method of extracting the colouring matter from wood has been lately employed by a M. Besseyre with much success. He first reduces the woods to very small divisions, and then immediately places them in a closed vessel exposed to a current of steam. When the whole has attained 80 degrees of heat, it is uncovered and watered with several pints of cold water. By means of a tap below the condensed liquid is drawn off, and thrown back upon the chips, and the operation is repeated until the dye has acquired sufficient strength."

Edward Cowper at King's College, London

"On Monday last," said the *Mechanics' Magazine* of October 26, 1839, "a new and very important class of manufacturing art and machinery was opened to the students of this institution by Mr. Edward Cowper." The objects of the lectures and instruction were to familiarize students with machinery in actual use, and students were to make experiments themselves and also visit factories and works accompanied by the lecturer.

Edward Cowper, who was born in 1790 and died in 1852, was well known for his important inventions in connexion with printing machinery. With Augustus Applegarth (1790–1871) in 1827 he invented the four-cylinder machine which superseded the Koenig machine for printing *The Times*. His son, Edward Alfred Cowper (1820–93), the inventor of the hot-blast stove, was in 1880–81 president of the Institution of Mechanical Engineers.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Assistant I in the Directorate of Communications Development—The Under-Secretary of State, Air Ministry, Dept. ZA. (B.127), Harrogate, Yorks (quoting B.403) (October 27).

Borough Engineer and Surveyor of the Metropolitan Borough of Stepney—The Town Clerk, Municipal Offices, Raine Street, E.1. (October 30).

Lecturer in Pharmacy in the Department of Chemistry of the Witwatersrand Technical College, Johannesburg—Frank Ross and Co., 9 Fenchurch Avenue, E.C.3 (November 1).

Professor of Chemistry and a Professor of Biochemistry—The Registrar, Indian Institute of Science, Bangalore, India (December 15).

Lecturer (Woman) in Mathematics—The Principal, Training College, Lincoln.

Assistants Grade I (Ref. A.001), Assistants Grade II (Ref. A.002), and Assistants Grade III (Ref. A.003)—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1938. Vol. 73, Part 1. Acreage and Production of Crops, Number of Live Stock and of Agricultural Workers, and Output and Prices of Agricultural Produce in England and Wales. Pp 118. (London: H.M. Stationery Office.) 1*s.* 6*d.* net. [310

City of Birmingham. Annual Report of the Mental Hospitals Committee, April 1st, 1938, to March 31st, 1939. Pp. ii+32. (Birmingham. Mental Hospital.) [310

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 1: The Scottish Carboniferous Crinoidea. By James Wright. Pp. 78+12 plates (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 14*s.* 6*d.* [410

Ollscoil na h'Eireann (The National University of Ireland). Calendar for the Year 1938. Pp. ix+336+648+426. (Dublin: National University of Ireland.) [410

Other Countries

Smithsonian Institution: Bureau of American Ethnology. Bulletin 124: Nootka and Quileute Music. By Frances Densmore. Pp. xxvi+358+24 plates. (Washington, D.C.: Government Printing Office.) 60 cents. [210

U.S. Department of the Interior: Office of Education. Bulletin 1938, No. 10: Local School Unit Organization in Ten States. By Henry F. Alves, Archibald W. Anderson and John Guy Fowlkes (Local School Units Project.) Pp. xi+334. (Washington, D.C.: Government Printing Office.) 40 cents. [210

University of Illinois: Engineering Experiment Station. Bulletin No. 312: An Investigation of Wrought Steel Railway Car Wheels. Part 1: Tests of Strength Properties of Wrought Steel Car Wheels. By Prof. Thomas J. Dolan and Rex L. Brown. Pp. 68. 70 cents. Bulletin No. 313: Tests of Plaster-Model Slabs subjected to Concentrated Loads. By Nathan M. Newmark and Henry A. Lepper, Jr. Pp. 54. 60 cents. Bulletin No. 314: Tests of Reinforced Concrete Slabs subjected to Concentrated Loads. By Prof. Frank E. Richart and Ralph W. Kluge. Pp. 76. 80 cents. Bulletin No. 315: Moments in Simple Span Bridge Slabs with Stiffened Edges. By Prof. Vernon P. Jensen. Pp. 106. 1 dollar. Reprint No. 13: First Progress Report of the Joint Investigation of Continuous Welded Rail. By Herbert F. Moore. Pp. 30. 15 cents. Reprint No. 14: Fifth Progress Report of the Joint Investigation of Fissures in Railroad Rails. By Herbert F. Moore. Pp. 34. 15 cents. (Urbana, Ill.: University of Illinois.) [210

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 26, No. 3 (Mathematics No. 40): Beiträge zur Geometrie der Kreise und Kugeln (32). Von Sôzi Matumura. Pp. 89–134. Vol. 26, No. 4 (Mathematics No. 41): Beitrage zur Geometrie der Kreise und Kugeln (33). Von Sôzi Matumura. Pp. 135–178. (Taihoku: Taihoku Imperial University.) [210

U.S. Department of Agriculture. Miscellaneous Publication No. 344: Taxonomy of some Scale Insects of the Genus *Parlatoria* encountered in Plant Quarantine Inspection Work. By Harold Morrison. Pp. 34+11 plates. 10 cents. Technical Bulletin No. 680. Status and Relative Importance of the Parasites of the Hessian Fly in the Atlantic States. By C. C. Hill, J. S. Pinckney and H. J. Udine. Pp. 16. 5 cents. (Washington, D.C.: Government Printing Office.) [410

Annals of the Royal Botanic Garden, Calcutta. Vol. 14, Part 2: An Account of the Genus *Dioscorea* in the East. Part 2: The Species which twine to the Right; with Addenda to Part 1, and a Summary. By D. Prain and I. H. Burkill. Pp. 425–528. (Alipore: Bengal Government Press.) [410

Catalogues

A Catalogue of English and Foreign Books and Periodicals on Pure and Applied Mathematics, Physics, etc. (No. 492.) Pp. 28. (Cambridge: Bowes and Bowes.)

Abridged List of Microscopical Preparations: Botany, Zoology, Histology, Bacteria, Diatoms, Textile Fibres, Rock Sections. Pp. 19. (Manchester: Flatters and Garnett, Ltd.)

Editorial & Publishing Offices :
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

Telegraphic Address :
Phusis, Lesquare, London

Telephone Number :
Whitehall 8831

Vol. 144 SATURDAY, OCTOBER 28, 1939 No. 3652

ANTHROPOLOGICAL STUDIES IN INDIA

ALTHOUGH India offers in its aboriginal tribes and its diversity of peoples, languages, nd cultures a field exceptionally favourable for he development of anthropological studies, it annot be said that either Government authorities r those responsible for the direction of higher ducation have given them the encouragement hich such opportunities deserve. The valuable ork initiated by Sir Herbert Risley, and more articularly the Ethnographic Census, has been llowed to lapse, while until recently the universities have shown little inclination to include this nportant department of investigation within the ange of subjects in which they have provided acilities for research. It was, therefore, doubly nfortunate that for some considerable time nterest in Indian racial and cultural history was ostered by argument of a strongly tendentious haracter. The 'dry light' of pure science and isinterested research was, however, kept aflame y a small band of devoted enthusiasts, among hom the veteran anthropologist, Sarat Chandra Roy, will ever be held in honour. The establishment of a department of anthropology in the University of Calcutta, under the guidance of the ate Sir Asutosh Mookerjee, heralded the dawn of etter things, of which the work now carried on in the Universities of Bombay and Lucknow is an arnest.

Although the period which has elapsed since the nitiation of these facilities for anthropological tudy has been comparatively brief, it has sufficed o bring out certain difficulties which arise from he extent of the territory to be covered and the cattered distribution of the workers. Notable mong these shortcomings was a serious lack of o-ordination and co-operation in both research and instruction. It was felt that if research was to go forward with any measure of success, some centre at which workers from different parts of the country might meet for discussion and interchange of views was an imperative need. Only from full and free discussion, it was evident, would it be possible to formulate and give concrete shape to the problems which urgently call for investigation. The leading anthropologists of India thereupon decided to form an Indian Anthropological Institute, at which such meetings and discussions might take place. This was inaugurated in 1936, with Dr. J. H. Hutton as its first president, and a number of prominent anthropologists from different parts of India as the first members of its Council.

It is obvious that an institute of this character, founded and maintained on broad and catholic lines, should be in a position to exert a dominant influence in determining the future development of anthropological studies in India. It promises well that certain fields which are in urgent need of research, certain departments of investigation in which there are defects of organization urgently calling for reform, have already been indicated as demanding the consideration of the Institute's members, and it may be hoped that this will also arouse the interest of a wider public.

It was unfortunate that the foundation of the Institute took place only a short time before Dr. Hutton's retirement from the Civil Service and his departure from India. His many years' experience of ethnographical survey work among primitive peoples under the Government of Assam, as well as his organization and superintendence of the Census of India, 1931, gave him a knowledge of the problems of Indian ethnology which is unrivalled among anthropologists of to-day. This knowledge would have been of inestimable value in shaping and carrying out a policy of development in anthropological research in India. Dr. Hutton himself has not been without recognition of his responsibilities; and in his presidential address to the Institute, written towards the close of 1938 after his return to England, and in the nature of both an inaugural message and a valediction, he has wisely taken advantage of the opportunity thus offered him to suggest briefly the lines upon which the future work of the Institute might be carried on in relation to the organization of scientific study of the problems of anthropology in India.

No one is more fully aware than Dr. Hutton of the difficulties which lie in the way—the vast distances, and the differences of language, of temperament and even of script, which hinder co-operation among anthropological workers in India; but he suggests that these very difficulties make it all the more imperative that anthropologists should co-operate in a science "which can do more than any other branch of study to resolve into a homogeneous unit the racial, cultural, and temperamental diversities inevitable in the inhabitants of so great an area and such varying environments". Indeed, when he goes on to enumerate the subjects which urgently demand investigation, he points out how this very diversity in the peculiar social conditions of India provides a field more favourable to investigation than any other extant.

Nor is the question one of purely domestic concern to India alone, for, as Dr. Hutton justly adds, it may provide the solution of problems of world-wide application. Caste, for example, affords an unrivalled field for research, in that it preserves better than any other institution the pure genetic line and hence, owing to the wide and varied field of distribution, provides exceptional material for the study of the effect of different geographical and climatic environments on physical characters, on successive generations, and, in relation to the study of heredity, on individual aptitudes, on the inheritance of acquired characters, and a number of other cognate problems—in short, it opens up an opportunity for the full investigation of the effects of isolation on human groups, physically, psychologically and culturally. A further matter which is stressed, and is of more than local interest, is the need for detailed monographs on the aboriginal tribes and other groups, of which the lack severely circumscribe the study of Indian ethnology in the English universities.

Passing over other problems of research, upon which Dr. Hutton touches, as matters of technica rather than general interest, there is one question commended to the care and attention of th Institute which is vital for the future successfu pursuit of these studies. This is the supply o trained men, though in this connexion Dr. Hutton speaks more especially with reference to the need of museum work. If the efforts of the Institut in this direction are to be of any avail, it is scarcely necessary to point out that the closest co-operation with the universities must be secured, as well a an increased recognition among academic bodie that additional facilities for these studies wi have to be provided.

On one aspect of anthropological studies and research Dr. Hutton, in addressing a body o scientific men, did not dwell. In speaking of th need for a linguistic survey of languages south o the Godavery—a need upon which all anthropologists in India are agreed, and of which th lack is a serious bar to successful research—th need for ethnographical monographs on th aboriginal tribes, for the study of caste in it various aspects, and the like, the plea for study o all these problems might well be reinforced by stressing their practical bearing on the work o administration, and their value, if not indeed their vital necessity, for successful government under the new constitution, of peoples in whom racial, social and traditional differences run deep.

However much it may be felt that the study o the modern peoples of India falls short of th merits of its intrinsic interest, there are those wh think that the investigation of its past civilizations is in an even more parlous state. In communication, which appears in the first issu of the Institute's journal, Lieut.-Colonel D. H Gordon puts forward a grave indictment of thos who are responsible for the study of the pre- an proto-historic archæology of India, whether in India itself or outside, more especially since th retirement of Sir John Marshall from the archæological service.

It is evident that Colonel Gordon feels strongl that the position of archæological studies relatin to India calls for plain speaking. Nor does h stand alone. It is unnecessary here to enter int a detailed examination of Colonel Gordon' contentions in view of the report prepare y Sir Leonard Woolley on the results of his ecent inspection of the field organization and ccomplishment of archæological studies in India, digest of which is printed on page 758 of this ssue of NATURE. Colonel Gordon's views, indeed, nd further emphasis to Sir Leonard's criticisms. tringent though Sir Leonard's comment may be, specially in dealing with the work of the Archæoogical Department since the retirement of Sir ohn Marshall, and drastic as may be the changes dvocated, his recommendations are measures of eform, and not revolution. He admits the xcellence of the material in the members of the taff, and the learning and enthusiasm which net him everywhere; although the Department as been starved financially, the need of the noment is not the immediate expenditure of more noney, but training and experience in both fieldvork and the museum, combined with differentiation in function of the members of the staff. Hence follows the need for more complete co-operation between the universities and the Archæological Department inside India, and the participation in excavation and research of cientific and learned bodies from without.

Sir Leonard Woolley, as one of the foremost f practical archæologists who have worked n modern lines, has stressed fully the principle hat research on the grand scale, such as the importance of the cultural history of man in India demands, is an affair of the close adjustment of preliminary planning, field-work exactly carried out and precisely recorded, and the further analysis and study of the immediate results in the archæologist's laboratory—the museum—followed by early and widespread dissemination through prompt publication in appropriate form.

Opinion in India no doubt will be divided on Sir Leonard's recommendation that skilled assistance should be brought in from outside for a period to organize archæological studies. Yet in view of recent advances in technique and the wide field to be covered, especially in the earlier stages of prehistory, it would be difficult to ensure speedily a sound foundation for an Indian school of archæology by any other means at present.

For the moment, reforms must stand in abeyance; but even so it is not too soon to plan for the future. India is entering upon a new phase of its history. Could a more fitting memorial of that event be found than the institution of an organization for research which, in course of time, would build up worthily a comprehensive panorama of the development of the civilizations of India from the very earliest times down to the present day?

YOUTH AND NATIONAL SERVICE

The Needs of Youth

A Report made to King George's Jubilee Trust Fund. By Dr. A. E. Morgan. Pp. xi + 434 + 8 plates. (London: Oxford University Press, 1939.) 10s. net.

THE raising of the school-leaving age is only one of the factors which in recent years have directed special attention to the welfare of the adolescent. Reports from the Commissioners for the Special Areas have evinced concern at the effect of prolonged unemployment on the juvenile worker. and the situation has prompted attempts at amelioration such as the juvenile transference scheme and the junior instruction centres. Social surveys, such as the work of the Social Science Department of the University of Liverpool on population problems of new estates, have directed attention to educational and labour problems nvolved in the decline of the juvenile population, and to the need for industry to concern itself more closely with questions of recruitment. The annual reports of the Chief Inspector of Factories continue to emphasize the alarming proportion of preventable accidents among young workers, and the need for greater training and care for the young recruit to industry. The question has also been examined from the point of view of nutrition. as in the University of Bristol social survey of the standard of living in Bristol, or of general physical fitness from the point of view of the National Fitness Council, or the demands of national service. The present concern with the question of juvenile delinquency is yet a further factor, possibly less serious than some are inclined to fear.

In all such approaches, however, the welfare of the adolescent has been considered primarily from the point of view of the needs of the community if not rather of some special section of it. Even if we concede that the Education Act, 1936, was prompted mainly by a desire to safeguard the interests of the adolescent, it must be admitted that few, if any, authorities on education are satisfied with a measure which stops short of raising the school-leaving age to sixteen years, with provision for part-time training up to eighteen years. Moreover, however conscientiously the Act is administered, there has been evidence, in the applications for exemption, of failure once again to realize that the adolescents of the nation are ultimately more important than any industry.

The report which Dr. A. E. Morgan has recently prepared for the King George's Jubilee Trust Fund is thus opportune. Dr. Morgan reviews social, educational, industrial and recreational conditions in so far as they touch the adolescent, and his impartial and scientific survey, if it makes no claim to be a piece of sociological research, permits in any event an attempt at a coherent and comprehensive statement of the needs of youth in Great Britain to-day. Moreover, he contrives in his survey to give a picture of the life of youth in great industrial cities which is as welcome for its human appeal as for its challenge to constructive planning and resolute action.

One of the great merits of this survey is that it views the problem and the needs of youth as a part of the general problem of national welfare. Only on the bedrock of youth, Dr. Morgan asserts, can we lay the foundations of real national fitness. If under the specious plea of the needs of any particular industry, through the opposition of any vested interest, or even the demands of national defence, we allow the physique or morale of youth to be damaged, we are in danger of finding that not merely industry but also the nation as a whole is impoverished. There is a point beyond which the enforcement of economy at the expense of youth, even at the behest of national defence, may vitiate or nullify that last colossal effort.

The favourable comments on the first militiamen have often failed to direct attention to the debt owed to the extension of education to cover every kind of social service to the child. The schools are not only training the mind and body of the child, they are eradicating the results of the hectic industrialization of the nineteenth century. Extension of education to cover recreation, medical inspection and treatment, physical training and introduction to the use of leisure is only rectifying some of the great social injustices of the past.

If, for example, we see in the quality of mind and body revealed by recruits of the former militia some of the fruits of educational policy and expenditure, Dr. Morgan's book indicates how great the need still is, and the grave danger that in the years of unguided or unhelped adolescence, serious damage may be done alike to the physical, mental or moral development of youth which will prevent the full benefits of educational advance being reaped. Even on the educational side, the Education Act of 1936, however conscientiously administered, does not take us far enough. The nation cannot be said to be taking the care of its children seriously until the school-leaving age is raised to sixteen years. Even at sixteen we cannot afford to let the boy or girl step out of our care. The imminent decline in the adolescent population might well impel us now to take steps to prevent further invaluable human capital running to waste by insisting on a system of part-time continued education during the working day up to the age of eighteen years.

Next to this insistence on the need for providing for further education, at least part-time education, up to the age of eighteen, and for resisting any financial or industrial pressure that might endanger the interests of youth, Dr. Morgan stresses the need for much more careful provision for training and selection for a job and for dealing with the blind alley difficulty as well as with the serious problem of juvenile unemployment, so as to prevent both physical and moral deterioration. Similarly, juvenile delinquency is to be regarded as essentially an educational problem, the successful handling of which is an educational process.

Moreover, it is not merely in the actual training for a particular occupation and the selection of individuals for a job for which they are suited that closer attention to the needs of youth is required. Definite exclusion of youth from occupations which from their nature are unsuited requires extension. Much more could be done to reduce or prevent the alarming incidence of accidents among young persons entering industry. This involves not merely more careful training and instruction of the entrant to industry, and the placing of the accident-prone in jobs which are free from hazards; it involves also education of management and employers to a fuller sense of responsibility Nutrition, hygiene, medical care—these are all matters where extension of provisions or services for the school child to the young worker in his or her first trying and formative years in industry might be as sound an investment from the national point of view as it is socially desirable.

These are fields in which many scientific workers, by virtue of their managerial responsibilities or professional knowledge, may well be able to assist. When, however, Dr. Morgan proceeds to the discussion of the needs of youth in leisure and recreation and the means of meeting those needs, he raises a number of questions which are of the widest interest and significance. For all but a small minority who find expression in their vocation, workers as a whole look outside their labour for the expression of their lives. In our modern civilization, work has largely ceased to be an absorbing means of expression and is sought merely as the device by which we get the money wherewith to buy the things we desire. The hours of work are suffered for the sake of the reward which is to be reaped thereafter.

This salient factor, which the scientific worker is liable to overlook, gives special significance to the right use of leisure, above all when the tendency is to decrease the hours of work. Even adult education, for a quarter of a century claiming to be designed not for livelihood but for life, has emphasized this gulf which separates work and living. Moreover, with this search for real life outside work, leisure has largely become commercialized with debasement of artistic and other standards, while the functions of leisure have been widened and the need for its proper use enhanced.

The difficulties are increased by the confusion introduced by the false emphasis placed on freedom, particularly at a time when a democracy is especially nervous of anything which threatens the sacred principle of liberty. Ultimately, leisure must be a voluntary pastime. It is the means of expressing the vital aspect of human capacity, and as such must be free. Like any other human faculty, however, the capacity for recreation needs education, and the process of training involves compulsion. Again, while work may narrow with increasing specialization, the scope of leisure occupation is as wide as life itself, and even within the compulsory stage training must give the widest options.

These considerations lead Dr. Morgan to place his main emphasis on the need for leadership. This is a dominant factor in guiding and training youth so that its dormant faculties find normal and healthy expression, whether in physical recreation, in hobbies and pastimes, or whether, as in the 'Young Farmers' Clubs' in the union of vocational education with recreation, thus contributing to the solution of that major social problem of our time, the divorce of work and leisure. The value of the great majority of juvenile organizations, such as boys' and girls' clubs, depends on the right quality of leadership being available, and even in various community centres, facilities are being neglected and wasted for lack of leaders to manage and lead them. Moreover, when local authorities are actively assisting juvenile organizations and providing facilities, they are often unacquainted with the practice of other authorities. No one appears to have made a survey of the situation, and the Board of Education itself is without comprehensive information.

This matter of co-ordination and further survey of actual practice calls for further investigation, either by a group such as Political and Economic Planning or by the social science departments of the universities.

The general question of leadership, however, touches scientific workers generally even more clearly. It is not merely that the training which they have received carries with it certain social responsibilities, and that by virtue of their training the proportion of leaders should naturally be higher than in classes which have not been so highly trained or educated. The traditional source of supply for club leaders has been the young men and women of the better-to-do classes, whose sense of social responsibility urged them to devote time, and often money as well, to the welfare of the less privileged. The universal difficulty of recruiting enough help is an indication of a lack of social sense and responsibility to-day, and our educational system might well do more to impart such a sense of social responsibility. Leaders are in fact being recruited from every walk of life, but the significant fact to which Dr. Morgan directs attention is that leaders can now no longer be secured in sufficient numbers on a voluntary basis.

At present, the number of paid leaders is small, but boys' clubs must face the fact they will depend more and more on professional service, and the practical problem is to ensure that it is of the right kind. The basic difficulty is that imposed by the limited financial resources of such clubs. A club leader should have had a good education and some professional training. Much is expected of such leaders, but rarely is a boys' club in a position to offer a salary of more than £200 a year.

Dr. Morgan insists that we must recognize that club leadership is a profession and must be remunerated properly if the right men are to be forthcoming. He suggests it is essentially educational, and that local education authorities might well be persuaded to make far more grants to the voluntary movements for this purpose. Recognizing that even with this help there are limitations to the remuneration which could be expected, he suggests that more could be done to make such work a stepping-stone or stage to other careers whether in teaching, in industrial welfare work, probation service and the like, where the experience gained should be an asset.

Certain obstacles would have to be overcome. Such work must receive full recognition in regard to security and pension rights. Closer attention must be given to the training of entrants for such positions, and in this the social science departments of the universities might well co-operate.

As this tendency develops, it might open up careers for those taking a diploma in social science or pursuing a short course of social research, provided they possessed the essential qualities of leadership.

Here are suggestions which should be welcome to many scientific workers who are turning their attention to social problems. For some of them the voluntary work which will long be required may offer an opportunity for the expression of their sense of social responsibility, and for maintaining or even raising the standard of leadership. Others may find a like opportunity in the social surveys and investigations which are still necessary to render further information available as a basis for the national action required. For all, however, there is the opportunity to assist by pressing for adequate attention to the problem by local and national educational authorities, by supporting with their active interest such work as is already being carried out in this field by the universities, by bringing sympathy and insight and creative thought to bear on the problems which the needs of youth present to-day. Nor should scientific workers be unmindful of their responsibility as citizens to protest against any hesitation by public authorities to exercise their powers of compulsion to stop certain abuses which at present, as Dr Morgan so clearly shows, are detrimental to both the health and morale of youth, and, in effect squander capital which grows the more precious in a time of emergency. R. Brightman.

PLANETS AND SUNSPOTS

Tidal Forces in the Sun's Corona due to Planets
By K. G. Meldahl. Pp. 14+7 plates. (Copenhagen: Berlingske Forlag, 1938.) n.p.

THE author of this work believes that radiation pressure on certain small particles in the corona should balance gravitation so closely that a 'sensitive layer' exists. If this is disturbed, it will undergo violent motion and probably ejection. The force likely to produce the disturbances is the tidal action due to the planets, and though this is too weak to cause any noticeable motion in the heavier, luminous portion of the sun's gases, nevertheless, as the hydrogen prominences appear at a level comparable in height to the altitude of the 'sensitive layer', it is important to seek for some connexion between the disturbances and tidal forces. Only five planets need be considered to contribute anything of importance to the tidal force—Mercury, Venus, Earth, Jupiter and Saturn. Mercury, though very small, must be taken into account because the tidal force varies inversely as the cube of the distance of the planet from the sun; Mars is neglected as its tidal force is only about 3 per cent that of the earth. The five tidal forces are added vectorially, the resultant vector giving the height h of the force wave running round the equator, and the main investigation is carried out on these lines.

The period of Mercury is close to 88 days, and for this reason diagrams of vectorial additions for every eleventh day are drawn from 1663 to 1966 to test for periodicities. It does not appear that the period of Jupiter or the longer secular period of the three inner planets taken together is concerned, but a period of 243 years is partly noticeable, and a multiple of this seems to be indicated.

Discussing the connexion between the diagrams and the observations of disturbances, the author directs attention to two important matters. (1) Where radiation pressure is not constant, an increase in it would drive out the previously balanced particles and bring heavier ones into floating equilibrium, thus facilitating disturbances in the lower layers of the corona. (2) If existing spots increase radiation locally, this provides the possibility for relatively smaller tidal forces to generate disturbances. It will be misleading to compare the periodicity of *observed* spots and group sizes with tidal forces; the latter should be compared with the *genesis* of spots, and the existing spots should generally show a lag.

The mechanism of spot creation is considered to be as follows: Gases of the sensitive layer rotating with the sun at a speed of about 2 km./sec. run through the tidal field of force. At times they encounter forces greater than those that permit quiescent motion, and there ensues a break-up into vortices such as hydrogen prominences. A detailed description is given for the appearances of spots with regard to certain physical features, but it is open to some doubt whether all these are fully explained by the supposed mechanism of spot creation.

The author predicted a number of disturbances recently, which have since been observed, and it is possible that he has opened the door for further investigation into the genesis of sunspots, auroras, magnetic storms, etc. If it is true, as he states, that prominences are started in the corona by external forces and that spots are the consequence a fruitful field for research lies in this realm.

M. D.

AQUATIC PLANTS OF INDIA AND BURMA

Hand-Book of the Common Water and Marsh Plants of India and Burma, 1936
By K. Biswas and C. C. Calder. (Health Bulletin No. 24: Malaria Bureau No. 11.) Pp. xiii + 140 + 38 plates. (Delhi: Manager of Publications, 1937.) Rs. 2.12 or 5*s*.

THE purpose of this book is to facilitate the field work of those associated with anti-malarial investigations of the breeding places of mosquitoes. It is obvious that a sound knowledge of the plant life found in those localities, their reactions to each other and their relations with the animal life in their surroundings is an important stage in this research.

Brief accounts of the bionomics of freshwater vegetation, general features of aquatic vegetation, periodicity of water plants, methods of control, precede the systematic enumeration of the plants likely to be encountered. The work is not exhaustive, but is intended only to comprise the commoner plants. Short descriptions of the 61 families, 126 genera and 220 species (including Cryptogams) are set out, together with practical keys for the determination of genera and species where necessary. A key to the families would have been helpful to those inexpert in systematic botany.

Six reproductions from photographs of aquatic habitats and line drawings of 157 of the species or varieties listed are appended. Comparison would have been made easier had the plants of the same family, or at least genus, been juxtaposed. Only in the case of the Cryptogams have the magnifications of the enlargements been stated.

The nomenclature is not in all cases that accepted nowadays by systematists: for example, *Herpestes Monniera* has been retained in place of *Bacopa Monniera* (L.) Wettst., and *Panicum muticum* is given preference over *Brachiaria mutica* (Forsk.) Stapf

There are a number of errors and omissions; many of these have been corrected in an addendum not bound up with the publication, but others have escaped: for example, at the foot of p. 7, "Whether this . . ." should read "Where this . ." and *Leersia hexandra* Sw., described on p. 100 and figured on Plate III, is omitted from the index.

The work, however, is generally good and should amply fulfil its object. C. E. C. Fischer.

SOME ASPECTS OF CHEMICAL ENGINEERING

A Practical Manual of Chemical Engineering
By Harold Tongue. Pp. xvi + 560. (London: Chapman and Hall, Ltd., 1939.) 36*s*. net.

A BOOK on chemical engineering published in England is welcome, even if only to show the growing interest in this subject. Mr. Tongue's work does more: it fills, as he claims, a gap in the literature, by dealing with the materials which modern science has placed at our disposal, and methods of using them. It is admittedly a compilation and, as such, it is bound to exhibit a certain lack of balance; for example, under the heading "Wood", with the exception of a table of the mechanical properties of a few American woods, redwood is the only material discussed. Under "Rubber", six pages have been transcribed verbatim from a well-known pamphlet, apparently without acknowledgment—no doubt a slip on the part of the author—and there are other abstracts which, although good in themselves, are often somewhat disconnected.

The chapters dealing with metals and alloys are excellent, and the only criticism which need be made is again a certain lack of co-ordination, the mass of isolated facts tending to produce a sense of confusion. Perhaps in a future edition the author would consider the introduction of a few phase diagrams to explain the interrelations of some of the alloy systems. Since space is important, details of welding procedure might be curtailed, and extraneous matter, such as the uses of platinum as a catalyst, omitted.

The following sections on pressure vessels and piping are up to the high standard which is to be expected from the author of "The Design and Construction of High-Pressure Chemical Plant", and they are followed by a useful chapter on heat insulation and an even more valuable summary of recent data on the economic utilization of power in works. This difficult subject is one which should have more attention than it frequently receives.

At this point the author appears to have realized that the book was becoming too large, and to have attempted the impossible task of crowding heat transfer and a few selected unit processes into two hundred pages. The result is unfortunate, for the theory is inadequate and a great deal of the remaining matter, although by no means uninteresting, is strongly suggestive of a collection of manufacturers' catalogues. In the section on heat transfer, reading is not made easier by the use of different symbols for the same quantity and, in the chapter on distillation, modern work such as that of Kirschbaum is not mentioned. Under "Filtration", there are no fundamental principles at all. In short, in contrast to the earlier chapters, this part of the book contains little that is not to be found in standard textbooks. It would have been better omitted, or, alternatively, expanded into a second volume dealing not only with the plant itself, but also with recent research into fundamentals, which is becoming daily more important for the purpose of design

Any defects in the second half, and they are only defects of omission, are more than compensated by the earlier chapters, which presen in a handy form a summary of valuable information collected from sources which are not always readily accessible. As a volume of reference the work should find a place in the library of every chemical engineer. H. E. W.

APPLIED MECHANICS

Proceedings of the Fifth International Congress for Applied Mechanics

Held at Harvard University and the Massachusetts Institute of Technology, Cambridge, Mass., September 12–16, 1938. Edited by J. P. Den Hartog and H. Peters. Pp. xxxii+748. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

THIS account of the work of the Fifth International Congress for Applied Mechanics is contained in a volume of 748 pages preceded by preliminary matter including the list of the four hundred members of the Congress. The proceedings consist of general lectures and short papers of about six pages, divided among three groups.

The first group deals with Elasticity and the Properties of Materials. The general lectures by Hardy Cross, Joseph Pérès and F. Körber are reported in full and are followed by forty-four papers about equally divided between theory and experiment. Obviously no summary could do justice to the variety of topics here treated, so we select for special mention, on account of its historical interest, a paper by Hetenyi on photo-elastic studies of three-dimensional problems. In 1850 Clerk Maxwell observed that, if isinglass is loaded at an elevated temperature, after cooling and removal of the load it exhibits, in polarized light, permanent fringes which correspond to an elastic stress condition. Maxwell also concluded that there could not be actual stresses present in the annealed specimen, from which conclusion it would follow that slicing the piece should not change the fringe pattern. From an examination of the slices the stress distribution in a three-dimensional model could be inferred. This final step was not taken until 1935. The paper gives experimental evidence justifying the method of slicing together with some interesting photographs.

The second group, Fluid Mechanics, begins with general lectures by C. H. Chatfield, H. U. Sverdrup and G. I. Taylor, followed by sixty-two papers. The numerical comparison with the first group throws an interesting light on the relative trend of present day research. Not only so, but of the sixty-two papers, twenty-four deal with turbulence and related problems; indeed, a turbulence symposium was a feature of the Congress. In this group we select for special mention the paper by Norbert Wiener on "The Use of Statistical Theory in the Study of Turbulence". Behind the seeming innocence of this title there lies in this paper the beginning of a more general and systematic method of attacking the important problem of turbulence. The basic theorem is an extension by Wiener of the original ergodic theorem of Birkhoff to include the equi-measure transformation corresponding to the translation groups in space. The importance of this theorem is that it permits us to translate averages over all systems of an ensemble into averages over all points of space for a given system in the ensemble. This theorem, together with the definition of certain specific ensembles which can be described in detail, and for which every average can be computed, would appear to form a firmer foundation for the examination of turbulence than any which has hitherto been suggested. To complete the picture the abandonment of the hypothesis of the continuous medium will probably be found necessary.

The book concludes with seventeen papers on dynamics and an appendix. The whole volume has been reproduced from typescript. There may be some good reason for preferring this method to ordinary print, but there can be no question that the ragged margins inherent in typescript and the handwritten mathematical symbols are not things of beauty. Nevertheless the volume does give a cross-section of modern research in applied mechanics and is therefore worthy of serious attention. L. M. M-T.

METAMORPHISM AND IGNEOUS ACTION[*]

By Prof. H. H. Read, F.R.S.,
Imperial College of Science and Technology, London

THE consideration of the relation between metamorphism and igneous action, which forms the subject of Prof. H. H. Read's presidential address to Section C (Geology), falls into two parts. First, a brief historical summary of the peculiarly national contributions serves to display the wide divergences in opinion on this question. The views of the Rosenbusch school of pure thermal metamorphism are contrasted with the imbibition notions of the French, and the work of Becke of Vienna, the Swiss, Sederholm of Finland and the Americans is reviewed. The classic investigations of George Barrow on zones of progressive regional metamorphism in the Highlands north of Dundee and their causal relation to granitic injections are sympathetically summarized. In the second part of the address, a discussion is presented of the origin of regional metamorphism, that is, of the transformations which have affected large portions of the earth's crust.]

I first note the equivalence, according to Rosenbusch and others, of regional and dynamic metamorphism. The forerunner of the term dynamic metamorphism was Lossen's dislocation-metamorphism, a simple expression denoting a transormation genetically connected with dislocations of the crust. Lossen's old term would cover a arge class of phenomena, such as the dominantly mechanical breaking-down of rocks, cataclasis, mylonitization and the like, all connected with demonstrable dislocations. I propose to continue o use dislocation-metamorphism for this class of phenomena.

Rosenbusch, having replaced Lossen's excellent erm by his dynamic metamorphism, proceeded o make this the equivalent of regional metamorphism, and to regard orogenic pressure as its cause. Backed by the authority of Rosenbusch, dynamic metamorphism became fashionable, the dynamic aspect overshadowed all others and mountain-building movements could do all things requisite and necessary. It must be remembered, however, that many of the French were frankly sceptical; nevertheless, the notion of a metamorphism on a regional scale "induced in rocks because of their deformation" remains still a leading principle in many schools of metamorphic geology.

On the other hand, the emergence of ideas on a static or load metamorphism of regional extent, in which orogenic pressure is not a causal condition, indicates that all is not well with the supposed equivalence of dynamic and regional metamorphisms. Before discussing static metamorphism itself, I deal with some of the difficulties raised by this equivalence.

I mention certain facts commonly observed in regionally metamorphosed rocks but difficult to reconcile with the operation of pressures tangential to the earth's surface. One of the chief of these observations is the coincidence of schistosity and bedding. As metamorphic rocks showing this coincidence are often horizontal over great areas, the notion of static or load metamorphism has been put forward. But Daly has cited a score of regions where schistosity and bedding agree—in folded and horizontal rocks alike. These are the phenomena that Daly felt to be "truly inexplicable by pure dynamic metamorphism", an opinion with which I am in complete accord.

The preservation of original textures in rocks that have been completely recrystallized is a matter of common observation. There are innumerable examples of the preservation in regionally metamorphosed rocks of minute sedimentation-characters, such as graded bedding, current bedding, the interlamination of undisturbed, exceedingly thin, beds, and so forth—characters that should have been obliterated by the action of orogenic pressures. As an instance of how excellent this preservation may be, I may recall the successful use of current bedding and graded bedding in unravelling the stratigraphical sequence in the Grampian Highlands. An additional and telling example is the recognition of varved bedding in the metamorphic rocks of Finland and Canada. It seems to me that such details of original textures cannot possibly be preserved if the rocks in which they occur were metamorphosed "because of their deformation". I admit, of course, the operation of dynamic action in the production of various metamorphic rocks of low grade, but in these cases the original primary textures are completely obliterated. This obliteration in low-grade metamorphism and preservation in high-grade metamorphism of original textures shake my faith in the unity of the progressive series from the chlorite zone or epizone to zones of higher grade.

---

[*] From the presidential address prepared for Section C (Geology) of the British Association.

Whilst stress is admittedly the dominant factor in the production of low-grade metamorphic rocks, there is agreement that its effect is small in the higher grades, where the products of regional and thermal metamorphisms converge, high temperatures being in control. There is no correspondence between the degree of deformation and the metamorphic grade, unless it be one of the greater the deformation the lower the grade. In this connexion, I may cite the failure of experimental work, like that of Larsen and Bridgman, to produce minerals characteristic of rocks supposedly formed by dynamic metamorphism. Stress, by itself, is not enough.

No one can dispute the observed fact that regionally metamorphosed rocks are often more or less violently folded. The inference so often made that the metamorphism and the folding are coeval is not, however, always justified. It seems to me clear that most fold-structures in regionally metamorphosed rocks ante-date the crystallization, this being post-tectonic in the terminology of Sander.

It will be realized, I trust, that there are many features of regional metamorphism that are incompatible with dynamic action. The recognition of this has led to the invocation of static or load metamorphism, and I examine the validity of this notion.

One of the especial difficulties that has to be faced by advocates of a metamorphism due to the vertical pressure of the overlying beds is the existence of completely non-metamorphic rocks which have nevertheless been covered by an immense thickness of superincumbent strata.

This difficulty confronting static metamorphism has been tackled by Daly, who meets it by relaxing the rigidity of the doctrine of uniformitarianism. He admits that, compared with its proposed potency in Pre-Cambrian times, load-metamorphism must have been of relatively little importance in later geological eras. To account for this, he assumes that the earth's thermal gradient was steeper during the formation of the Pre-Cambrian so that regional metamorphism under a moderate cover was possible. I am not competent to discuss Daly's speculation, and I have only to state that I feel that the proposal does not strengthen the case for regional static metamorphism.

The idea of a metamorphism controlled by load, as such, fails to meet many other observations. I have space here only to cite the occurrence, in the eastern United States, of highly metamorphosed stratigraphically younger beds resting naturally on lowly metamorphosed stratigraphically older beds; of high-grade sillimanite-zone rocks overlying lower-grade rocks as in Sutherland and Norway; of the passage, in Banffshire, from slates to metamorphosed rocks containing andalusite garnet, cordierite, sillimanite and staurolite withi a half-mile of coast-section; of a similar narro restriction in the Barrovian zones as in Dutches County, New York. Load, by itself, is not enough.

The literature of regional metamorphism abound in references to the great depths within the crus at which such metamorphism takes place. Thes suggestions of great depths, however, carry n kind of conviction to my mind. On the contrary I consider that high-grade regionally metamorphosed rocks must have been formed in man areas under relatively little cover. Daly was o this opinion, too, and he was influenced thereb in his idea that thermal conditions were differen in Pre-Cambrian time from what they were i Palæozoic time. He pointed out that from Clarke' data it is possible to form a rough estimate of th total amount of rock eroded in geological time and that only a small portion of this amount can be assigned to Pre-Cambrian time. Of thi small portion, part is represented in the non metamorphic Pre-Cambrian sediments which li unconformably on the metamorphosed basement The several complexes of the basement were highl metamorphic before the denudations correspondin to the unconformities which separate them. Fron a consideration of these points, and of the grea volume of Pre-Cambrian rocks, Daly conclude that the average cover on the complexes at th time of their metamorphism was much less than 5,000 metres in thickness. Barrell came to similar conclusion by an argument based upon the amount of salt in the sea, and the erosion of the igneous rocks to give this. He decided tha Pre-Cambrian erosion had removed a cover of les than a mile in thickness.

Though these arguments may not appear altogether sound to some, still I suspect that th notion of the great depths of regional metamorphism flourishes because of the supposed necessit of carrying rocks *down* to be metamorphosed. suggest that as an alternative we should conside the possibility of bringing the metamorphosing agents *up*.

I next discuss certain aspects of the zona notion, especially in connexion with a depth control.

I note the development of ideas on depth-zone and, in connexion with static and load metamorphism, I direct attention to difficulties encountered in regarding grade of metamorphism a directly controlled by depth. Admittedly, metamorphism does often increase in grade with depth but, as I have said in another place, I personall find no difficulty in envisaging a metamorphism which increases laterally or vertically; I conside depth, as such, not to be a factor in metamorphism nd that if we are to retain a zonal notion, then he idea of depth-control must be completely disregarded.

The relation between the large-scale tectonics nd the metamorphic zones in the Highlands is a question which, in the present state of our knowedge, bristles with difficulties. The Cambridge School considers that the metamorphism is pre-ectonic, and that the metamorphic zones can be ecumbently folded. On the other hand, Bailey nd others regard the metamorphism as partly ontemporaneous with the folding. For my part, suggest that the metamorphism may be post-ectonic. Both in the Highlands and elsewhere it eems to me that the isograde lines are indeendent of both stratigraphical and tectonic arrangements, and I prefer to relate regional metamorphism not to load, nor to deformation, nor to tectonic or any other depth.

I have pointed out the destruction of sedimentary structures in low-grade metamorphism and their apparent perfect preservation in high-grade metamorphism. If these are valid observations, then it seems to me that the progressive series from slates to higher-grade rocks must break down, or, at least, that high-grade rocks were not necessarily at one stage of their career in the condition represented by the lowest-grade rocks of the zonal series. Low-grade rocks may once have been high-grade, but the reverse is not necessarily true.

(To be continued.)

REACTIONS OF ACCLIMATIZATION AND OF NON-ADAPTATION

By Prof. M. Piery and Prof. J. Enselme,
Faculty of Medicine, Lyons

UP to the present time, physiologists have been especially concerned with the cute effects of high altitudes or of acute mountain ickness. As a consequence of the work of Prof. Monge of Lima, who both discovered and studied hronic mountain sickness as manifested in human eings, we, in our turn, have investigated the xperimental effects of high altitudes on animals. We believe that in this way we may be able to discover more about the mechanism of adaptation f organisms to altitude, and thus explain the athogenesis of Carlos Monge's disease.

With this object in view, we studied the effects roduced in various animals by a sojourn of six months in the laboratory of the Jungfraujoch, at an altitude of 3457 metres. We have already described elsewhere the technical methods and detailed observations which we have made in his experiment. Here, our object is to give xpression to certain views which we hold relating o the adaptation of the animal organism to the ower atmospheric pressures of high altitudes.

The problem of the effects of altitude upon nimal organisms gains considerably in depth and nterest if, by exceeding certain limits which are usually accepted, we consider it from a more eneral point of view.

In order to do so, the following facts must first f all be taken into account:

(1) The problem constitutes a particular case f the much wider problem of adaptation in general; it is the case of adaptation to the lowering of atmospheric pressure.

(2) It consists of several biological stages which, like all adaptations, may be schematized as follows:

(*a*) A tissue forms the receptive element for the external influence. Sometimes this is the skin, sometimes the digestive organs and, in this particular case, the lungs.

(*b*) The effects there are carried by a transmission system into the innermost tissues and set up a connexion between the receptive tissue and the whole of the organism. This transmission system consists of two physiological pathways, a neuro-vegetative action, adrenergic or cholinergic, or alternatively in the form of an action of a chemical messenger.

(*c*) A system of tissue reception which affects the various organs and those elements of inter-tissue synthesis; namely, the glands of internal secretion.

(*d*) A mechanism of genetic transmission, the reaction of the genital elements.

(3) Furthermore, in the case of each one of these components, the following must be distinguished:

(*a*) The modifications which appear as direct effects of the climatic change: as, for example, the modification of the tissues by chemical or mechanical influences.

(*b*) A number of reactions which are not so easily explained and which are called defensive reactions because they permit of the survival of the tissues. These constitute the actual basis of the phenomena of adaptation.

(4) The adaptation thus effected constitutes a new form of state of the organism which, in order to return to its previous state, must pass once more through the same stages.

These principles set forth, we will now proceed to apply them to the problem with which we are concerned, namely, that of adaptation to the lower atmospheric pressure of high altitudes. And here, we propose to divide the subject as follows:

Effects of Reduced Pressure on an Organ Sensitive to Climatic Anomaly

Here, climatic anomaly is constituted by the drop in the partial tension both of the oxygen and of the carbon dioxide in the air inhaled; and consequently in the alveolar air. The sensitive organ here is the lung.

The effect of this lowering appears to be a congested state such as we have witnessed in rabbits and geese which have spent six months in the laboratory at the Jungfraujoch. This congested state is characterized by a decided vaso-dilatation of the inter-alveolar capillaries. A large number of alveoli contain red corpuscles, and some of them contain, in addition, alveolar cells in process of desquamation. These lesions have no characteristic localization. There is no indication either of inflammatory cells or of the presence of fibrin in the alveoli.

The importance of these lesions varies according to the subject. In order to estimate them to the best advantage we conducted, on one hand, a histological examination of the lungs; and, on the other, we administered doses of iron to the entire organism. The results given by the two methods appear to agree with one another.

These lesions appear to aggravate further the difficulties experienced by oxygen in passing through the walls of the pulmonary alveoli. Their action is of the same kind as that of the diminution of the partial tension of oxygen in the alveolar air. They thus appear to act in the same direction as the reduction of atmospheric pressure and to increase the disturbances which it evokes. In addition, we observed that these lesions actually lower the oxygen saturation of arterial blood.

On the other hand, a defence reaction which tends to correct the abnormal phenomena evoked by the lowering of pressure is observed. This defence reaction consists of an unfolding of those alveoli which have not, as yet, been utilized; and of a polypnœa which renews the alveolar air more rapidly and thus contributes to a slight rise in the partial tension of the oxygen in the alveoli.

Disturbances at the Level of the Systems o Transmission

We have already seen that it is convenient t distinguish two systems.

(1) The system of neuro-vegetative transmission responds to the excitation evoked by reductio of atmospheric pressure and to the lowering of th blood oxygen by tachycardia, which permits of more rapid circulation of arterial blood and consequently of transmission of oxygen. Furthermor a reflex produces a splenic reaction which throw a large number of red corpuscles, oxygen carrier into the circulation. These ensure the mos complete circulation of oxygen.

(2) The system of chemical messengers show two types of reaction:

(*a*) An inevitable chemical effect of the lowerin of the partial pressure of alveolar oxygen is th fall in the oxygen saturation of the blood. This in any event, represents a classical idea which w re-discovered in the case of the rabbits in th Jungfraujoch laboratory, among which the averag was 77, while that of the control animals was 91

Another result of the same type is the marke drop in the total quantity of carbon dioxide i the blood. Lowering of the partial pressure of th alveolar carbon dioxide has also been described and we found it again. Actually, our rabbit showed an average of 29·6 for total blood carbo dioxide, while the controls gave an average of 42·7

(*b*) The defensive reaction of the organism is shown by a hyperactivity of the hæmatopoietic centres, which throw a large number c corpuscles, usually of the smaller kind, into th circulation and thus increase the surface o absorption reserved for hæmoglobin. The averag number of red corpuscles in a rabbit is abou 4,300,000; in the experimental rabbits it increase to a total of 6,978,000. An important increase i the oxygen capacity of the blood ensues; an while among the animals experimented upon i Lyons this capacity was represented by an averag of 12, in those at the Jungfraujoch it increase to 19.

In another connexion, the lowering of th carbon dioxide of the blood effects a lowering c the alkaline reserves. Compensation for this i obtained by an increase of certain buffer system

Disturbances of the Tissues

Disturbances of the tissues are manifold. In general sense they correspond to the phenomen of anoxia and acapnia. The phenomena of anoxi are distinguished, in every part of the organism by chemical modifications, such as the lowerin of the basal metabolism and the increase c of lipides or of cholesterol. They become mor easily recognizable when they affect special organ

(1) We made a special study of muscle, and hile in rabbits generally we found equal amounts f muscle iron, in those animals which had been n the Jungfraujoch laboratory we observed a arked decrease in the quantity of the iron. We re of the opinion that during the first months of daptation, a diminution in exchanges, together ith a lowering of the iron content, takes place. his irregularity soon passes off Clinically peaking, muscular anoxia is expressed in the form f asthenia and disturbances of a painful nature.

(2) The liver also has occupied our attention o a large extent. In our rabbits, the iron increased. We are of the opinion that this constitutes a first efence reaction against anoxia, the iron playing e part of an active agent of oxidation. Hepatic noxia is expressed clinically by the characteristic gns of insufficiency of the organ.

(3) The heart very often gives rise to acute mptoms, and in our animals we observed, stologically, traces of sclerosis.

(4) Finally, a number of other organs are also fected, such as the nervous centres or the kidneys; ut histologically, in the case of our animals, no ions were visible.

Conclusions

In this preliminary study, we have considered e mechanisms of adaptation at an altitude of out 3,500 metres as observed during a sojourn six months' duration. We have observed the adual development of a certain number of these echanisms. The observations which we were le to make on the constitution of the blood have ly served to confirm data that had already come classical. On the other hand, the observaons which we were able to make on the tissues, ngs, muscle and liver, give rise to a number of w conceptions. For example, in the lung, phemena of congestion appear which seem to gravate the anoxæmia, while in the liver and muscles, variations in the iron content seem to be in accordance with adaptation to anoxia.

It remains now to distinguish among the facts which have been observed and described above; those which arise from a successful adaptation—that is to say, from successful acclimatization—and those which in the animal correspond to the chronic mountain sickness manifested in human beings.

In this connexion, non-adaptation to lowering of atmospheric pressure is accompanied by congestion and capillarization of the lungs, by a drop in the oxygen saturation of the blood, by a marked lowering of the total quantity of the carbon dioxide of the blood, by the diminution of the alkaline reserves, by the diminution in muscular iron, and finally, a light sclerosis of the myocardium. On the other hand, the phenomena of effective adaptation give rise to polypnœa, to the unfolding of the alveoli, to emphysema, to increased activity of the hæmatopoietic centres, to an increase in the oxygen capacity of the blood, to the growth of certain buffer systems and finally to an increase of iron in the liver.

Thus our analysis, both chemical and histological, results in arguments in favour of the idea of a complex response of the organism to anoxæmia and of the existence of manifold reactions of acclimatization. It now remains to apply to man the experimental observations which we have carried out on animals. This we hope to be able to do at some future date.

Bibliography

Piery, M., Enselme, J., Peschiera, O., et Donjou, P., "Étude expérimentale de l'influence biologique d'un séjour prolongé à l'altitude. (3): Modifications hépatiques et musculaires", *C.R. Acad. Sci.*, 208, 1442 (1939). Piery, M., Enselme, J., Enselme, Mme. J., et Peschiera, O., "Étude expérimentale de l'influence biologique d'un séjour prolongé à l'altitude. (1): Les modifications sanguines", *C.R. Acad. Sci.*, 208, 1254 (1939).

Piery, M., Martin, J. F., Enselme, J., et Peschiera, O., "Étude expérimentale de l'influence biologique d'un séjour prolongé à l'altitude. (2): Les modifications pulmonaires", *C.R. Acad. Sci.*, 208, 1367 (1939).

Piery, M., Enselme, J., et Peschiera, O., "L'adaptation chimique de l'homme à la dépression atmosphérique". *J. Med. Lyon*, 409–420 (1939).

NUTRITION DURING WAR-TIME

By Sir John Boyd Orr, F.R.S.

THE new science of nutrition has raised issues which profoundly affect the economic and cial structure of the State. During the last few ars, the agricultural, trade, health and social pects of these issues have been studied by rious groups of investigators, and arrangements re made by the Division for the Social and ternational Relations of Science for a discussion the subject at the British Association meeting at Dundee on September 8. Owing to the outbreak of war, the discussion did not take place. The results of the investigations promoted by Government committees, research institutes and other organizations in recent years will now prove invaluable to those adjusting the national food supply to war needs.

These studies of the food position have clarified ideas. It is now common knowledge that a great deal of disease, ill-health and physical disability, which in the past were regarded as normal and inevitable, are due to faulty diet and, therefore, preventable. We now know the kind of diet needed for health. The British Medical Association standard was calculated to be good enough to prevent obvious clinical signs of malnutrition. According to the results of Sir William Crawford's survey, which agrees closely with the results of other investigations, there are nearly nine million of the population of Great Britain whose diet is below that standard. But there is a great difference between the mere absence of disease and full vigorous health, which is provided for in the higher standard of the League of Nations Nutrition Committee. The diet of nearly half the population does not come up to this higher standard. Quality of diet is correlated with income. Dietary and health surveys have shown that as family income falls the diet becomes worse, and ill-health and poor physique become more prevalent. The infant mortality rate is three times as high among the very poor as among the wealthy. The incidence of disease attributable to faulty diet is several times as high, and the average adult stature is three to four inches less.

In addition to poor diet, there are, of course, other factors associated with poverty, especially bad housing and psychological factors which affect health. It is difficult to assess the relative importance of these, but there is no doubt about their combined effect on health. As the Right Hon. Mr. Bruce has put it: "Poverty is directly correlated with ill-health, disease and premature death."

It used to be assumed that the poor represented an inferior strain of the population and that the high infantile mortality among the poor was Nature's salutary method of eliminating the unfit. This view, which would absolve us from doing anything to abolish poverty, is not supported by facts. Where the infantile mortality rate is highest, the survivors are of poorest physique and vice versa. The factors which make for high infantile mortality seem to be the same factors which make for ill-health and poor physique among the survivors. There is no doubt about the importance of heredity, but we cannot dogmatize about inherited difference in health and physical fitness between the well-to-do and the poor until environmental conditions affecting health and physique are comparable in both classes.

Of these environmental factors, nutrition seems to be of prime importance, because the results of feeding tests show that when the diet of the children of the poorer classes is improved, making it more like that of the well-to-do, the rate of growth of children approaches that of children of the well-to-do classes, and there is a noteworthy improvement in health and physique. In the la twenty-five years, there has been a remarkable im provement in the national dietary. Consumption 'protective' foods has increased by nearly fifty p cent; there has been an accompanying improv ment in national health and physique; infa mortality rate has fallen by nearly fifty per cent the gross forms of deficiency diseases, such rickets, are rapidly disappearing; deaths fro tuberculosis, resistance to which has increased b good diet, has been reduced by nearly fifty p cent; children leaving school to-day are two three inches taller than their parents at the sa age. What has been done shows how easily li could be saved and life and happiness increase It affords complete justification for the publ health and social services which have made t 'protective' foods, especially milk, available, fr or at reduced prices, to necessitous mothers a children.

Although such a remarkable improvement h taken place, we are still far from our goal, whi is an adequate diet for every member of the co munity, however poor. In the United States, t British Dominions and other countries, whe investigations have been done, the position is n markedly dissimilar to what it is in Great Britai National health and physique, especially of t poorer classes, is far below what it would be the new knowledge of nutrition were fully applie This opens up a glorious vista for the futu Even in the most advanced countries, man h not yet attained his full capacity for health a physical fitness. We have the knowledge and can provide the means for a further great advan in human welfare. Rapid improvements have be made in Great Britain and elsewhere, and, in atmosphere of increasing good will, schemes we maturing for adjusting national food policies provide diets for the whole community on t standard now known to be necessary for healt

It would be disastrous if this work were push into the background as being of minor importan in war-time. As a matter of fact, the nutriti problem becomes even more urgent in war. T will continue to be a war of nerves, and the iss may well depend upon whether or not the peo are able to withstand the physical and men strain of war. Malnutrition, due to lack of 'p tective' foods, leads to lack of capacity for s tained physical and mental effort, apathy a despondency, all factors which make for fear and spirit of defeatism. For maintaining the will victory in this war for liberty, the quality of t national diet is as important as the quantity. O aim should be to accelerate the remarka improvement in diet and accompanying impro ment in health of the last few years.

Fortunately, the food policy for war is the same as the food policy needed for peace, namely, ncreased production and consumption of 'protective' foods. Food defence, in addition to providing stores of wheat, sugar, fats and other foods, and organizing distribution and rationing, must consider the question of what additional foodstuffs agriculture must produce to maintain and improve the national diet. Yield of protein, vitamins and minerals per acre must be considered as well as yield of calories.

This is one of the war measures for which we need not grudge expense. A war food policy, designed to increase the health and vigour of the population and to adjust agriculture and trade in foods to the needs of the population, will leave a national asset which will be invaluable in the reconstruction period after the war for world freedom is won. There is here a great opportunity for the Ministry of Food to co-operate with the Ministries of Health and Agriculture, involving a national policy which will help to win the war and have at the end of it a vigorous race ready to take a lead in post-war world reconstruction.

OBITUARIES

Prof. Sigmund Freud, For. Mem. R.S.

By the death of Sigmund Freud, the world of psychology has lost its best-known figure. Born in 1856 of Jewish parents in Moravia, he decided at an early age to take up the study of medicine. While still in the twenties he went to Paris to study psychiatry under Charcot; and at the age of thirty-one returned to Vienna, where he spent the greater part of his life.

To the scientific world, Freud's name first became known through researches on the nervous system. But while working in France he became strongly mpressed with a notion that had already been taking shape in his own mind, the notion, namely, that in the existing state of physiological knowledge nervous disorders are best investigated, not by looking for physical causes, but by studying mental causes, particularly emotional conflict and repression. In his early work as a neurologist he began by applying the methods of hypnosis which he had learnt in Paris. Gradually, however, he abandoned this approach for a more effective technique, to which he gave the name of psycho-analysis. The method, suggested it would seem by the work of Wundt and Galton on free association, threw an unexpected light on symptoms and processes which the patient's answers to the direct questioning of the consultant were apt to leave wholly obscure or even to misinterpret. To-day the term psycho-analysis is applied, not merely to the method, but also to the vast body of doctrine built up with its aid by Freud and his disciples: it might be loosely defined as the empirical study of unconscious mental processes.

The essential framework of Freud's views was laid down in his early writings on hysteria nearly forty years ago. He never hesitated to modify or expand his hypotheses; but in the main his later publications, running to something like two hundred books and articles, consist in suggestive and provocative applications of these leading ideas and principles to various branches of psychology. From the study of major nervous disorders, he proceeded to minor abnormalities that characterize mental life for every one of us—dreams, lapses of memory, slips of the tongue, and the like; and thus showed in concrete detail how the scientific study of the exaggerated reactions of pathological cases may explain the more puzzling or neglected phenomena of normal persons. From this he turned to other fields. Art, poetry, religion, crime, mythology, anthropology—nearly every sphere of life was illuminated by the inquiries he attempted and the principles that he applied.

Freud was, indeed, one of the boldest and most original of thinkers. Nevertheless, the isolated items in his theories were by no means so novel as is popularly supposed. Both in Great Britain and in America a strong reaction against the intellectualistic psychologies of the nineteenth century had already set in: James and Stout had emphasized the need for a more dynamic psychology; McDougall had urged the importance of unconscious motives, particularly in the instinctive and emotional life; Janet had emphasized the importance of dissociation in mental disorder and disease; Havelock Ellis had attempted a scientific study both of dreams and of sex. Freud's own great achievement was perhaps to incorporate what was most fruitful in these ideas in a single, striking, unifying system, and to collect a vast amount of empirical data from a wide variety of sources, all illustrating much the same fundamental mechanisms of the mind.

Though widely read in psychological literature—English and American as well as German and French—Freud never cared to bring his own views into line with academic tradition. This led at first to wide misunderstanding, but was equally a condition of his fresh and revolutionary outlook. In Great Britain, as elsewhere, his bold speculations and even bolder expression of them aroused initial opposition. But a wide experience of nervous disorders during the War of 1914–18 quickly convinced workers like Rivers, Myers and McDougall that there was a most important foundation of truth in the novel doctrines that Freud had advanced. It was perhaps the very antagonism aroused by his frank utterances that in the end gave a wide publicity to the new attitude towards mental disorder, and brought home to the medical man what the psychologist had long urged—the need for considering not merely the physical but also the mental, emotional, and social condition of his patients.

CYRIL BURT.

Prof. Harvey Cushing, C.B., For. Mem. R.S.

THE death of Prof. Harvey Cushing on October 7 at the age of seventy years removes from the world of medicine its greatest ornament since William Osler. Cushing and Osler had much in common. Each had tireless energy, unbounded enthusiasm, and that great gift of making friends and keeping them. The love of all that was good in literature and of the classics of medicine was as much a characteristic of Cushing as it was of Osler.

Born of a Massachusetts family which had migrated in the early part of the nineteenth century to the Western Reserve, now part of the State of Ohio, Harvey Cushing was the ninth child of a Cleveland doctor whose father and grandfather before him had practised the art of healing. If on his father's side he had inherited a love of medicine, he obtained an almost equal love of literature from his mother, whose forebears had migrated from Connecticut to carry Yale learning to the new country in the west. It was inevitable that he should have graduated in arts from Yale and in medicine from Harvard.

The attraction of Johns Hopkins Hospital was too strong to be resisted by the young graduate in medicine, and there began his life-long friendship with Osler and his apprenticeship in surgery under Halstead. During his early days at Baltimore, he commenced his experimental work, which he continued in Europe under Sherrington, Horsley, Mosso, Kronecker and Kocher. This training was to fit him to be a neuro-surgeon. In the early stages of his surgical career at Johns Hopkins, he had to persevere with his work in the face of a heavy mortality rate in his cases. It was Osler who encouraged him to keep on trying until success came.

Until 1912, when he was appointed to the chair of surgery at Harvard and surgeon-in-chief to the Peter Bent Brigham Hospital, Cushing was laying the foundations on which he built so well in Boston. Physiology and pathology were his favourite studies, but he did not neglect the equally important fields of neurology and ophthalmology. Every new development which could be of use in the study of diseases of the nervous system or employed in the treatment of them was eagerly improved and adapted by him for use in his clinic. With his translation to Boston came the great period of his life; he drew to himself pupils from every civilized country, endowed them with a knowledge of their craft, and engendered in them an affection proof against his ruthless criticism and one which grew with the years. He worked his pupils hard, and after they had set out on their own way, he plied them with questions and tasks which they answered and undertook because it was "the Chief" who had asked them.

Cushing's contributions to surgical knowledge must be his chief claim to fame, but his work on cerebral pathology and physiology is scarcely less outstan ing. His earliest monograph, on the pituitary bod (1912), was the starting-point from which most the present-day work on pituitary physiology ha sprung. He was a first-class clinician who neve neglected or overlooked a sign or symptom which h could not understand. His thoroughness and hi amazing powers of observation, coupled with judgment founded on his own experience, enable him often to arrive at a diagnosis in cases which ha baffled the skill of his colleagues and pupils. H treated the patient as well as the disease, and non better than he knew the value of a word of encourag ment or sympathy to a suffering man or woman.

The War of 1914–18 found Cushing in Franc early in 1915 working with the American ambulanc at Neuilly. Later he worked at No. 46 C.C.S. wit the B.E.F., and towards the end of the War wa transferred to the headquarters of the America Expeditionary Force as its senior consultant i neuro-surgery. He has told the story of those yea in his war diary, written mostly when he was wear after a long day's operating and benumbed with th damp cold of a Flanders winter.

On his retirement in 1932, Cushing left Harvar to return to Yale, there, as he so often expressed i to survey in peace his work on brain tumours and t give to his successors the results of his experienc In his suite of rooms he collected the case records all his patients. These, together with the afte history of each case, provided him with the materi which he used so well in writing his last monograp on the meningiomas. This work was not his onl interest at Yale. Since the early days of his friendship with Osler he had collected books. The histor of his own craft enthralled him and he collecte during the last forty years what must be a uniqu library of early medicine and surgery. When onl a little more than a year ago he came to Grea Britain, libraries and booksellers' shops claimed mos of his time, for he was engaged on a bibliography o his great hero Vesalius, of whose writings an Vesaliana he possessed an unrivalled collection.

In the world of letters, Cushing gained fame b his biography of Osler. Five years of steady readin and writing went into the making of this book, bu during the whole of this time he carried on his wor in hospital and laboratory. It was no mean achievement for a busy man. Others have directed attentio to his self-effacement in this book. That is a tribut to his own sense of modesty, but it removed fro the pages almost every trace of the great friendshi of two great men.

WE regret to announce the following deaths:

Mr. M. A. Bailey, director of the National Institut of Agricultural Botany, Cambridge, on October 16.

Prof. A. Gilligan, professor of geology in the University of Sheffield, during 1922–39, aged sixty-five years

Dr. E. P. Poulton, senior physician to Guy' Hospital and president in 1937 of Section I (Physiology) of the British Association, on October 18, age fifty-six years.

NATURE

SUPPLEMENT

Vol. 144 SATURDAY, OCTOBER 28, 1939 No. 3652

SHORT REVIEWS

ANTHROPOLOGY AND ARCHÆOLOGY

African Women

A Study of the Ibo of Nigeria. By Sylvia Leith-Ross. Pp. 367+8 plates. (London: Faber and Faber, Ltd., 1939.) 15*s*. net.

IT is, of course, no more possible to generalize about the African woman than it is about the women of Europe and still less Asiatic women. Notwithstanding the title of her book, Mrs. Leith-Ross makes no such elementary mistake. She gives her readers the results of a careful and detailed investigation of the position of women among the Ibo people of Nigeria; and even here, she is careful to discriminate. The specific problem with which she was concerned was the reaction of the Ibo woman to the changes which are taking place around her under European administration and owing to the contacts with white civilization. Mrs. Leith-Ross, whose acquaintance with the African is of long standing, directed her observations to female life and character in four different types of community: the isolated bush community, where traditional patterns have suffered little modification, or at least so it would appear; a semi-sophisticated rural community, in which certain ideas and movements are beginning to stir the surface, more especially in the women's societies and organizations, such as on a previous occasion gave rise to serious trouble; a town of some considerable size; and finally the commercial and administrative centre, in which society, both European and more especially African, is cosmopolitan or mixed.

The Ibo woman, like women among many other African peoples, is by no means the conventional down-trodden creature of popular conception. She has a sturdy independence, and in some respects is 'more of a man' than her husband. Nor is she cut to a single pattern. The contrast shown here between the women of the bush and the semi-sophisticated village is instructive, and goes deeper than any difference due to degree of white contact. Apart from such individual differences, however, the progression in change of behaviour and character as the author passes from one type of community to another is very clearly marked.

Manuel de préhistoire générale:

Europe, Asie, Afrique, Amérique. Par Prof. Raymond Furon. (Bibliothèque scientifique.) Pp. 398+8 plates. (Paris: Payot et Cie., 1939.) 50 francs.

DR. FORON'S manual covers a wider field than its title immediately suggests. It deals—as the author recognizes—with what is now termed proto-history as well as pre-history, telling the story of man from his earliest beginnings down to the iron age and the spread of the Celtic-speaking peoples.

As the aim of the author is to provide an introduction to archæological studies, rather than an exhaustive treatise, it would, perhaps, be less than fair to criticize a lack of balance in treatment. Nevertheless, it must be pointed out that while one half of the book is devoted to the descent of man and stone age culture down to the end of the palæolithic, and seventy pages are given to mesolithic and neolithic, one hundred pages have to suffice for the bronze and iron ages; while Australia and America are dealt with apart in twenty pages. As the whole of the Old World is covered by geographical regions throughout, it will be realized that in the later periods Mesopotamia, Egypt, Crete, and the various geographical regions of Europe come in for extremely short measure indeed. Nevertheless, so far as it goes, the matter is as informative as it can be in so brief a space, while the ampler treatment given in the earlier section relating to the physical development of early man and his predecessors, and the account of early stone age cultures, as known in 1937, the date of the latest reference, will be found most helpful as a general introduction. This applies in particular to the lucid account of the bearing of recent geological and palæontological research on the chronological problem in quaternary times.

Tools and the Man

By W. B. Wright. Pp. xvi+236+9 plates. (London: G. Bell and Sons, Ltd., 1939.) 12*s*. 6*d*. net.

IN one sense the late Dr. Wright's presentation and survey of present-day knowledge of the data bearing on early man and the development of his material culture in the early stone age supersede all previous manuals of the kind. It is the first of such handbooks available for the general reader and the student to review critically the earliest material from East Anglia which, it is claimed, shows evidence of human handiwork, and to give an account of the investigations of the Abbé Breuil on the gravels of the Somme and their bearing on and consequences in determining the dating of palæolithic industries, which, it would seem, must now be subjected to considerable revision. A summary account of the latter research by the Abbé Breuil himself for the benefit of British archæologists appears in the current issue of the *Proceedings of the Prehistoric Society*. Further, Dr. Wright, while pointing out that the familiar classification of palæolithic implements, based on the material from France, is too deeply rooted in archæological studies to be ignored in a general survey, adopts and expounds the core-flake classification of implements, entering fully into its technological, classificatory and ethnical implications, as affecting the world-wide study of stone age cultures.

Dr. Wright's critical examination of the evidence and of the development of hitherto accepted theory, consequent upon recent archæological discovery and discussion, gives this manual an authoritative position, and makes it, at present, unique in the English literature.

Studies on the Ice Age in India and Associated Human Cultures

By H. de Terra and T. T. Paterson. (Publication No. 493.) Pp. xi+354+56 plates. (Washington, D.C.: Carnegie Institution, 1939.)

As Dr. de Terra and Mr. Paterson themselves have already summarized the main results of their investigations for the benefit of the readers of NATURE, it would be a work of supererogation to deal here with their report in its final form in detail. It will perhaps suffice to indicate its scope and distribution of topics. The report is in five parts, of which the first deals with the ice age in south-western Kashmir; the second covers conditions in north-west and peninsular India, so far as indicated by investigations in two main regions, the Soan basin and the Indus river; the third section deals with the Nerbada valley Pleistocene; Part iv is concerned with the stratigraphy and typology of Madras; and the fifth and final section is devoted to the late stone age sites of Sukkur and Rohri on the lower Indus, a-proto-neolithic civilization, which it is held may suggest an indigenous evolution and not a foreign origin for Mohenjo-daro and the Indus civilization.

The Mind of Primitive Man

By Franz Boas. Revised edition. Pp. x+285. (New York: The Macmillan Company, 1938.) 12*s.* 6*d.* net.

It is a remarkable tribute to the enduring qualities of the work of the veteran American anthropologist that a new edition of this book should be demanded so many years after its original publication, and when so many developments have supervened in anthropological thought in the interval. The book on its first appearance attained a position of considerable authority not only on account of the originality of its views on the calibre of the mind of primitive man, but also for its statement of the results of the author's observations on changes in the physical characters of immigrants and their descendants after entry into the United States. In the new edition, which has been thoroughly revised, Prof. Boas denounces with unimpaired vigour, in a review of anthropological theories of race, the perversion of racial theory in the interests of political prejudice and propaganda.

(1) Masques Dogons

Par M. Griaule. (Université de Paris: Travaux et Mémoires de l'Institut d'Ethnologie, Tome 33.) Pp. x+896+32 plates. (Paris: Institut d'Ethnologie, 1938.) 275 francs.

(2) Jeux Dogons

Par M. Griaule. (Université de Paris: Travaux et Mémoires de l'Institut d'Ethnologie, Tome 32.) Pp. viii+290+12 plates. (Paris: Institut d'Ethnologie, 1938.) 87.50 francs.

(1) The masked dances which are the ritual manifestation of the ancestor cult of the Dogon of the French Sudan have been made the subject of an elaborate study by M. Griaule. This study is based upon material collected in the course of three expeditions between 1931 and 1937. Although the Dogon all recognize and worship a supreme creating deity, the masks, and the dances in which they figure, and the ancestral cult with which they are associated, take a much more prominent place in their daily life and thought. Of the ancestral spirits, some are regarded as immortal, while others, who belong to the time after death appeared on the earth, are held to be mortal. From the relations to the immortal ancestors, who have returned to exercise a protective function over their descendants, has originated a totemic cult; while the cult of the masks and the dances in which they are used is directed to those of the ancestors who have suffered death.

M. Griaule has made a comprehensive study of an extremely complicated system of religious beliefs, in which *nyama*, a belief akin to the *mana* of Pacific peoples, plays an important part. Students of the history of religions will find here much of the greatest interest.

(2) M. Griaule's record of Dogon children's games, as played in the Bandiagara-Sanga-Kassa district, a region 80 km. long by 10 km. broad, is no less detailed than his study of Dogon masks and dances. It includes a large number of games of every type and variety, some of them belonging to groups which have a very wide geographical distribution. Among the games appearing here which have a special interest are those of a proverbial character, involving a guessing competition, these being especially expressive of Dogon mentality. The author notes a large number of string figures, which have been both carefully recorded and fully illustrated. M. Griaule's monograph is a valuable and very instructive contribution to the literature of a fascinating study.

BIOLOGY

Intermediate Botany

By L. J. F. Brimble. Second edition. Pp. viii + 562. (London: Macmillan and Co., Ltd., 1939.) 8*s*. 6*d*.

THAT in a comparatively short time a second edition of "Intermediate Botany" should be called for is clear evidence that it has been appreciated by teachers and students and has been found as helpful to them as we expected when it first appeared.

While the subject-matter has not been materially altered, the text has been revised and brought up to date in certain directions. Thus in connexion with the discussion of the acceleration of germination a paragraph has been added pointing out the agricultural and economic importance of the recent researches of the Russian investigator Lysenko. By subjecting the germinating grain of winter wheat to low temperature he was able to get it to reach maturity even when sown in spring. This yarovization of grain, as it has been called, is one of the most important botanical discoveries of recent years and its implications will probably have far-reaching results.

In describing the interesting experiments dealing with growth-promoting substances or hormones Mr. Brimble has extended his account by directing attention to the horticultural importance of recent work on this subject, which aims at accelerating the formation of roots on cuttings by treating the latter with synthetic auxins and hetero-auxin. A figure showing the effect of these substances on the formation of roots on cuttings of Buddleia (not Buddleja) is given.

This and other new figures which have been added increase the attractiveness of the book and will be found helpful by its readers. In some cases also better illustrations take the place of some appearing in the first edition. Thus the photograph of the roadway through the base of the Big Tree (Sequoia) and the figure of the Venus fly trap are distinct improvements.

Speaking generally, the value of the book has been enhanced by the careful revision and by the additions made to the text and the illustrations. The second edition will receive as cordial a reception as the first has done.

Practical Botany

A First Year Course for University and Intermediate Science Students. By Dr. S. Williams and Dr. G. Bond. Pp. 96. (London: Edward Arnold and Co., 1939.) 5*s*. 6*d*. net.

THIS book follows the method now very popular in the United States for practical laboratory guides whereby the pages are loose; this, as the authors state, allows "for the interleaving of the book with drawing paper and thus the students' drawings should make the completed book a reasonably adequate factual text-book". The authors omit, however, to point out another important advantage of the method they have adopted, that is, the opportunity thus afforded of changing the order of things in conformity with varying laboratory routine.

The authors have wisely kept the number of illustrations down to the absolute minimum—eight figures in all.

The standard of the course is indicated in the title; but the course is very full, thus allowing a certain amount of choice, and accuracy and personal observation and experimentation are obviously the keynotes throughout.

Unlike many science text-books of this standard, this contribution will certainly fill a serious gap, for, so far as we know, there is no satisfactory practical guide to botany of the standard of post-School Certificate and post-Matriculation. It can be recommended to university departments of botany for the use of first-year students, and to schools where botany is taken in the Higher School Certificate examinations.

Vitamine und Hormone:

und ihre technische Darstellung. Von Dr. Hellmut Bredereck und Dr. Robert Mittag. Teil 1: Ergebnisse der Vitamin- und Hormonforschung. (Chemie und Technik der Gegenwart, herausgegeben von Dr. H. Carlsohn, Band 15.) Zweite neubearbeitete Auflage. Pp. xii + 138. 7 gold marks. (Leipzig: S. Hirzel, 1938.)

Vitamine und Hormone und ihre technische Darstellung

Teil 2: Darstellung von Vitaminpräparaten. Von Dr. Franz Seitz. (Chemie und Technik der Gegenwart, herausgegeben von Prof. Dr. H. Carlsohn, Band 20.) Pp. xi + 205. (Leipzig: S. Hirzel, 1939.) 10 gold marks.

THESE are two indispensable volumes for all who have to follow closely the progress of work in the fields of vitamin and hormone chemistry. They are skilfully prepared encyclopædias giving an immense amount of information in an unusually small compass. Particularly valuable is Dr. Franz Seitz's volume dealing with the technical aspects of the subject. A bibliography of technical and patent literature is given which is alone worth the cost. Two admirable works in a well-planned and well-executed series of monographs. J. C. D.

The Insect Legion

By Dr. Malcolm Burr. Pp. xiv + 321 + 16 plates. (London: James Nisbet and Co., Ltd.. 1939.) 12*s*. 6*d*. net.

MANY popular books on insect life have appeared in the English language but the present volume, from the pen of a mining engineer, is undoubtedly the best of them. Since Dr. Burr is also himself an original investigator of insect life, besides being a traveller and a linguist, he is able to approach his subject from the widest point of view. The result of his efforts is a book of real charm: it is moreover reliable and accurate as to its facts and details, and its author has widely combed the revelant literature for much of his information. We can unreservedly recommend it as an admirable introduction to its subject and one that will appeal to adults and juveniles alike.

CHEMISTRY

(1) Dyeing with Coal-Tar Dyestuffs

The Principles Involved and the Methods Employed. By C. M. Whittaker and C. C. Wilcock. Third edition. Pp. vii+326. (London: Baillière, Tindall and Cox, 1939.) 12*s*. 6*d*.

(2) Hair-Dyes and Hair-Dyeing Chemistry and Technique

By H. Stanley Redgrove and the late Gilbert A. Foan. A new edition completely revised by H. Stanley Redgrove and J. Bari-Woollss. Pp. xiv+214+8 plates. (London: William Heinemann (Medical Books), Ltd., 1939.) 10*s*. 6*d*. net.

THESE two books on dyes and dyeing are in such striking contrast to one another as to justify their inclusion in the same notice.

(1) The first is a succinct account of the general processes of dyeing with the so-called coal tar dyestuffs—a term better indeed than 'aniline' dyestuffs, but nevertheless redundant since there are nowadays no dyestuffs of importance that are not derived from coal tar intermediates.

The book is divided into fifteen sections each dealing with some group of dyestuffs and giving information of value to the users of dyes. Section xi on the dyeing of rayons, and Section xii on the dyeing of synthetic fibres with an affinity for wool dyestuffs, are particularly well written. The book will be of interest to all concerned with the subject of dyeing.

(2) The second is a most amazing book which will be found of great interest to a wide circle of readers. To the uninitiated it is a revelation by which one can recognize a host of friends. The dreadful devices to which the female of the species subjects herself in order, in her opinion, to make herself pleasing to the male, are set out here in all their terrible entirety. The illustrations alone give one a glimpse into the beauty parlour which must make every male shudder with horror. But so be it! Women have done it since the beginning and will do it to the end. J. F. T.

Inorganic Chemistry

By F. A. Philbrick. Pp. viii+396. (London: G. Bell and Sons, Ltd., 1939.) 6*s*.

THIS book provides a course in inorganic chemistry up to the standard of the Higher Certificate, Inter B.Sc. and First M.B. examinations. The author has wisely devoted the introductory chapters to a brief sketch of chemical principles such as the atomic and molecular theories, electrolytic dissociation and electronic theory of valency, which should prove of value to students who have little knowledge of physical chemistry.

The elements are classified and discussed in the order in which they occur in the Mendeléeff table; for example, copper and silver are described in the same chapter as the alkali metals, and manganese, a steel-forming metal, finds its way into the end of the chapter on the halogens. This old-fashioned and clumsy arrangement is not in keeping with the modern and up-to-date factual matter which is given in the text, and is partly responsible for the too brief inter-comparison of the elements. The omission, however, of detailed descriptions of unimportant compounds is a welcome feature, as is also the emphasis which has been laid on the practical applications of inorganic chemistry. The numerous photographic illustrations, collected from many different countries, are an additional attraction. Questions are given at the ends of the chapters, and a selection of revision papers is provided at the end of the book, together with answers to the numerical problems. The omission of logarithm tables is to be regretted, and the index is certainly too brief for a work of this calibre.

Apart from these criticisms, the book is a welcome addition to existing text-books of intermediate standard, and can be recommended to both teachers and students of chemistry. A. C. C.

Intermediate Chemical Calculations

By Prof. J. R. Partington and Kathleen Stratton. Pp. x+240. (London: Macmillan and Co., Ltd., 1939.) 6*s*. 6*d*.

IN accordance with its title, this book provides a complete course of numerical examples, intermediate in standard between the General School Certificate and B.Sc. examinations. A concise but clear account of the fundamental principles underlying the calculations is given at the beginning of each chapter or section, and then suitable examples are worked out in detail for the guidance of the student before he tackles the numerous problems. The latter are chosen in part from former Higher Certificate, M.B. and University Scholarship examinations, and answers are provided at the end of the book.

The subject-matter throughout is accurate and up to date; for example, problems are not set which imply that the extent of ionization of a strong electrolyte can be obtained from molecular weights in solution or from conductivities. It is gratifying, too, to find a clear distinction between the density and relative density of a gas. In the opinion of the reviewer, a copy of this book should be possessed by all teachers and university students, and should be available for the 'Science Sixths' of all schools.

A. C. C.

Wood Pulp

By Dr. Julius Grant. Pp. xi+209. (Leiden: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1938.) 7 guilders; 15*s*.

THIS is one of the "New Series of Plant Science Books" edited by Dr. Frans Verdoorn and printed and published in Holland. It is a comprehensive treatise and contains everything worth knowing on the subject of wood pulp. The multitude of uses to which this material is now put makes it at the present day one of the most valuable natural products that exist. Although the supply is enormous, especially in our jungles and forests, the cost of collection must be almost prohibitive except in places that are supplied with water-transport or other such facilities. Those who have been so fortunate as to visit Shawinigan will realize the speed with which forests in vourable positions are disappearing. The work of forestation lingers, alas ! far behind.

The book contains a very readable account of the lphite process, with a section devoted to the history this great discovery. The other chief processes of rification are also described, and those who are terested will find all the information they need. he book is well set up and is likely to be of great rvice to those concerned. J. F. T.

ENGINEERING

lectro-Acoustics

y Prof. Dr. Erwin Meyer. Pp. xi+117+12 plates. ondon: G. Bell and Sons, Ltd., 1939.) 10*s*. net.

BOTH the orthodox student of electricity and the orthodox student of acoustics are at a loss when nfronted with the intricate and subtle marriage tween the two classical subjects which has taken ace in recent years in response to public demand. Dr. E. Meyer, from the erstwhile Heinrich Hertz stitute, now known as the Institut für Schwingungsrschung, came, at the invitation of the University London, and gave a series of five lectures at the stitution of Electrical Engineers on his view of e present position of electro-acoustics ; the present lume records his material, showing that he disarged his task well. He speaks of what he s first-hand knowledge, and his almost entirely eutonic set of references shows that the Americans e not undisputedly in the lead in this field. The apters, corresponding to the lectures, deal with ysical and physiological foundations, which clude evidence that the strike note of a bell does t exist, and some new applications of supersonic ves ; electro-acoustical measurements, describing acoustic grating analyser, and the high-speed vel-indicator and the spectral analyser in use at e National Physical Laboratory ; microphones and ud-speakers, with reference to response-curves and ansient times, and the logarithmic modulation eter ; sound recording and electrical music, with me explanation of magnetic recording and note nthesis ; and architectural acoustics, in which ethods and results of reverberation measurements d the absorption of acoustic materials are considered. th an engaging reference to his scheme of measuring verberation periods with audience, by using isolated ords from a full orchestra and suitable filters. early Dr. Meyer could deal with few details, but e ground covered is impressive and gives a plan r those who are engaged in working in a small rner of it. L. E. C. H.

ndbook of Technical Instruction for Wireless legraphists

H. M. Dowsett. Sixth edition. Pp. xx+624. ondon: Iliffe and Sons, Ltd., 1939.) 21*s*. net.

HE present text is obviously of little use to the scientifically minded, but it serves two sential purposes very well. It shows clearly the pe of apparatus which the practical wireless man s to deal with, and its mode of operation, information which is of the greatest importance to researchers and developers of new types of equipment. At the same time, it forms an excellent record of the state of the art of radio communication at the moment, omitting only high-powered point-to-point working. The aim is to assist operators to get their certificates, and to acquaint them with every conceivable type of apparatus they are likely to come across, for communication, navigation, and for emergency. The circuit diagrams are particularly clear, and much information is tabulated for easy reference.

L. E. C. H.

MATHEMATICS

The Kelley Statistical Tables

By Prof. Truman Lee Kelley. Pp. vi+136. (New York: The Macmillan Co., 1938.) 20*s*. net.

THE normal or Gaussian distribution occupies a central position in statistical theory and practice, and is therefore naturally the most completely tabled distribution function. Prof. Kelley now takes a further step, and provides a table of the abscissæ and ordinates of the distribution to 8 decimal places against the cumulative probability as argument, proceeding by intervals of 0·0001. The table is clearly printed and of a convenient size, and the minimum of interpolation is required to provide results to the accuracy ever likely to be demanded in statistical problems.

Prof. Kelley takes the opportunity of including in the volume other useful tables. For values of p proceeding by intervals of 0·0001 from zero to unity he gives to 8 decimal places values of $\sqrt{pq}$, $\sqrt{1-p^2}$, and $\sqrt{1-q^2}$, where q is $(1-p)$. Statisticians will recognize these quantities as being of frequent occurrence in relation to the binomial distribution and the theory of correlation. Another table gives the coefficients of the cubic Lagrangian interpolation formula to 10 decimal places for an argument proceeding by intervals of 0·001. With modern calculating machines these coefficients are often more convenient than the Everett coefficients used in connexion with a difference formula.

Statisticians will appreciate the labours which have gone towards this well-produced volume.

The Theory and Use of the Complex Variable

An Introduction. By S. L. Green. Pp. viii+136. (London: Sir Isaac Pitman and Sons, Ltd., 1939.) 10*s*. 6*d*. net.

THE theory of functions of a complex variable is usually presented in exhaustive treatises, demanding high mathematical attainments from their readers. Yet engineers and others who have neither the time nor the specialized training in pure mathematics to master such treatises find that they require some of the leading ideas of the subject. Mr. Green provides an introductory account of the complex variable and of conformal representation in a very simple and compact form, demanding from the reader little more than elementary calculus and co-ordinate geometry, with some indication of applications to problems of mathematical physics, aeronautics and electrical engineering.

Miscellany

Borneo Jungle

An Account of the Oxford Expedition to Sarawak. By John Ford, C. M. Hartley, Tom Harrisson, Patrick M. Synge, Edward Shackleton. Edited by Tom Harrisson. Pp. x+254+32 plates. (London: Lindsay Drummond, Ltd., 1938.) 15*s*. net.

"BORNEO JUNGLE", which describes an expedition of the Oxford University Exploration Club to Sarawak in 1932–33, stands out in the class of travel books in virtue of its method of composition. Instead of one or two authors, it has five, each contributing a chapter. The result is both entertaining and instructive.

The organizer of the expedition, Mr. Harrisson, who notwithstanding his not very advanced years—the average age of the members of the expedition was then twenty years—has already won a reputation as a writer of original views, describes the organization and outlines the work of the expedition as a whole. The chapters by his colleagues all contribute some interesting observations of the daily life and character of the jungle folk of Sarawak; but without being invidious, special mention may be made of Mr. Patrick M. Synge's account of collecting epiphytes in the forest at different altitudes and his discussion of the relation, if any, of the æsthetic qualities of the flora to the art motifs of the people.

Members of the expedition and others working on the material collected have already produced twenty-nine scientific papers, while further studies are in course of preparation. The standing of the expedition, in a scientific sense, is therefore assured. It is necessary to say this, as Mr. Harrisson vigorously attacks scientific exploring expeditions in general, especially if their aim is the collection of specimens, and expeditions of the type of those organized by the Oxford Exploring Club more particularly as failing in their educational aim. This raises too large a question for discussion in a brief notice; but in part the author supplies an answer in recognizing the constraining influence of finance.

The Climate of Madeira

With a Comparative Study. By Vice-Admiral Hugo C. de Lacerda Castelo Branco. Translated from the French by Dr. Alberto Figueira Jardim. Pp. 118+9 plates. (Madeira: Delegação do Turismo da Madeira, 1938.)

THE little book by Vice-Admiral H. C. de Lacerda Castelo Branco on the climate of Madeira, or more precisely Funchal, an English translation of which is under notice, was written with the definite object of comparing the merits of the island with those of other favoured resorts, and it certainly contains a considerable amount of propaganda. Nevertheless the author, who was many years ago director of the meteorological observatory at Lourenço Marques, has been at pains to embody in it much scientific data and to direct attention to the need for further investigations. Some thirty earlier publications, dating from 1811 onwards, are commented on briefly as a preface to his own 'sketch' based upon observations at Funchal since 1923 and official averages for 1916–35. Both sets of figur show the well-known characteristics of mild winte and moderately warm summers. From a table p. 47, relating to the years 1923–32, the absolu maximum temperature in July (82·6° F.) appea lower than that in any of the other months fro April to October. It may be noted in passing th this is doubtless due to the shortness of the period. considerably higher values have been recorded in Jul

In the comparisons with other climates the auth seems over-lavish in his praise of the relative val of that of Funchal, but he is careful to state th conditions in other parts of the island may be le good. Further research is advocated not only regards the climate but also into certain medical a other matters affecting the general conditions of li there which are discussed in the concluding chapter

L. D. S.

Mineral Tables

For the Determination of Minerals by their Physic Properties. By Arthur S. Eakle. Third editio revised by Prof. Adolf Pabst. Pp. v+73. (Ne York: John Wiley and Sons, Inc.; London: Cha man and Hall, Ltd., 1938.) 7*s*. 6*d*. net.

PROF. A. S. EAKLE, of the University of Ca fornia, published tables in 1904 by which th common minerals could be 'run down' by using in systematic manner the properties of streak and colou and by the observation of other characters such hardness, crystal symmetry, cleavage and fractu the habit or structure of the mineral, the speci gravity, and the chemical composition. Dr. A. Pab has revised Eakle's tables, making such additio and changes as were necessary to bring them up date. About 200 minerals are included. For t application of the tables the only apparatus requir is a streak-testing plate of unglazed porcelain, pocket knife and set of minerals for the scale hardness, a magnet and a pocket lens. Admitted tests with this simple equipment do not suffice identify definitely every mineral, and recourse mu frequently be had to determination of speci gravities and to optical and chemical tests, but t application of the physical tests in a systematic w is good training for the student who will need identify minerals in the field.

The League of Nations and the Rule of Law, 1918–19

By Sir Alfred Zimmern. Second edition, revise Pp. xiii+542. (London: Macmillan and Co., Lt 1939.) 12*s*. 6*d*. net.

THE second edition of this book differs but lit from the first edition of 1935. It has not be extended beyond the limits then planned and althou it has been thoroughly revised and the references the literature brought up to date, new matter h been incorporated chiefly in the chapters on t drafting of the Covenant, and the history of t League of Nations, the latter merely bringing t account of the Abyssinian dispute up to 1936. No the less the book remains an invaluable guide to t problems involved in the re-establishment of the r of law between nations.

PHYSICS

igher School Certificate Practical Physics

E. Armitage. Pp. xx + 239. (London: John urray. 1939.) 6*s*.

THE author's aim in this book is two-fold: first, to enable a form of post-School Certificate pupils commence different experiments without wasting ne at the beginning of a practical period, and condly to cover the experiments that are likely to met in the various practical examinations for igher Certificate, Inter-B.Sc., and First M.B. aminations. The book includes more than a mdred experiments in all the necessary branches, d so a very useful selection can be made.

One outstanding feature of the book is the attempt ade by the author to have the complete account each experiment in front of the student while orking, thus obviating the necessity of having to rn pages over. This undoubtedly has its advantages, it it rather detracts from the appearance of the ok, inasmuch as some pages are of necessity left lf blank.

There are many diagrams in illustration of the paratus used, but these might in many cases have en larger and bolder.

The treatment of the experiments is very sound, d a pleasing feature is the attention paid to the pression of results graphically—a point which serves due emphasis—though the article on graphs the early part of the book seems scarcely necessary a book of Higher Certificate standard. Indeed ere are several instances of superfluous instructions d so on, since it must be assumed that most of the udents will have already gone through a course the handling of apparatus.

From a utilitarian point of view, the book is doubtedly a distinctly helpful one for those udents who wish to become accustomed to the type experiment they are likely to encounter in their actical examinations; it will, however, scarcely tisfy the needs of those who believe in learning a t of the theory of the subject through the practical proach, a method not to be despised even with igher Certificate students.

A useful addition to the book would be tables physical constants, also a set of mathematical bles.

actical Physics

y W. F. F. Shearcroft and J. H. Avery. Pp. xvi + 8. (London: William Heinemann, Ltd., 1939.) . 6*d*.

THIS book claims to provide for any course immediately following School Certificate or atriculation, and to cover Higher School Certificate quirements up to distinction standard. There is a rge selection of experiments—151 in all—though appreciable number of these experiments would rmally be dealt with in a School Certificate urse.

A good deal of time has evidently been spent in anning the treatment of the experiments, and one good feature which will undoubtedly appeal to students is the numbered instructions describing precisely how the experiment should be carried out.

Seventeen pages at the beginning of the book are devoted to introductory matter and experimental instructions, but one feels that quite a lot of this could be omitted from a book of this standard. In the electricity section, about nine pages are devoted to an explanation and diagrams of elementary apparatus, but surely this should scarcely be necessary. In view of the importance attached to diagrams by examining bodies, it would have been a better example to students to have used the space so taken up in the book to make larger and bolder diagrams of the apparatus, etc., used in the experiments, and to include diagrams where they are at present missing.

Due attention is very rightly paid to graphical work, and it is pleasing to see that in the experiments on light the 'optical bench' treatment, using actual beams of light, at least holds its own with the 'pin' or 'no-parallax' method.

A useful set of exercises is included at the end of the book, also two sets of tables, but one feels that this section could with advantage have been larger; mathematical tables in particular would be very useful to students. Finally, certain illustrations arranged vertically along the edge of the page are irritating, while the plate facing p. 204 would seem to be totally unnecessary.

Introductory Quantum Mechanics

By Prof. Vladimir Rojansky. Pp. x + 544. (New York: Prentice-Hall, Inc.; London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 5.50 dollars; 22*s*. 6*d*. net.

THE main difficulty which a text-book on quantum mechanics has to overcome, namely, to present the maximum of physical results with the minimum of mathematical formalism, is very well overcome in this book, by clever navigation between the Scylla of rigour and the Charybdis of obscurity.

The operator calculus, the theory of eigenfunctions and eigenvalues, the matrix method are well explained and illustrated by significant examples. Each chapter is provided with a collection of exercises which will be very useful for students as well as for teachers. The development of the physical notions does not follow the historical order. Schrödinger's method is introduced first and its fundamental assumptions are stated somewhat axiomatically. Heisenberg's and Dirac's considerations are described in later chapters.

The advantage of this procedure is its brevity, and the possibility of a logically coherent system, connecting all different aspects of the theory. This purpose has been achieved; the presentation of the fundamental statistical conceptions especially is very satisfactory. But a student who would learn quantum mechanics from this book only will get no impression of the intellectual struggle which led to the final theory. This unhistoric attitude is observable even in such details as the quotation of literature; the names of American authors who have added refinement to an existing theory are included, while those of the originators are omitted. Apart from these minor objections, the book can be warmly recommended.

Elementary Survey of Physics

A Non-Mathematical Presentation, with a Special Supplement for Pre-Medical Students. By Prof. Arthur E. Haas, with the collaboration of Prof. Ira M. Freeman. Pp. x+204. (London: Constable and Co., Ltd., 1939.) 7*s.* 6*d.* net.

THERE is a tendency to-day to impart a general acquaintance with physical science to students outside this field; even those in the college of liberal arts are now taught the elements of physical science as part of their general culture. A serious difficulty arises from the antipathy on the part of most students, including pre-medical students, to the application of mathematical methods. Prof. Haas has presented a survey of physics without introducing mathematics except of the most elementary nature. In spite of the absence of mathematics, the field covered is comprehensive, and the explanations are so lucid that no one need be deterred by the fear of failure to understand the physical picture of Nature delineated by the author.

There are two appendixes. The first deals with the more important applications of physics to medicine, especially in such fields as light therapy, electrotherapy, radium therapy, etc. The second appendix supplies a number of elementary formulæ which can be applied by anyone with only a very meagre mathematical equipment. It may be safely predicted that the work will commend itself to a large number of students, and the general public too will find it most readable.
M. D.

PSYCHOLOGY

Introduction to Psychology

By Edwin Garriques Boring, Herbert Sidney Langfeld, Harry Porter Weld and Collaborators. Pp. xxii+652. (London: Chapman and Hall, Ltd.; New York: John Wiley and Sons, Ltd., 1939.) 15*s.* net.

IT has been generally felt for many years that the writing of an up-to-date text-book on psychology required specialized knowledge of so many branches of the subject that it was beyond the power of any one man. Two or three years ago, three distinguished American psychologists, with the help of a number of collaborators, produced "Psychology: a Factual Textbook", which was very generally welcomed as a satisfactory text-book for courses in Great Britain also. As a result of the numerous suggestions they received from users of the book, they have now produced a new edition so radically different that they have given it a new title.

Their earlier edition followed the conventional order of treatment in which sensation and perception came first and led up to problems of personality and social psychology at the end. They have now ma the bold innovation of reversing this order. Th have felt that much of the treatment of sensati and perception, about which relatively much is know can with advantage be left to specialist courses. Al they have thought it an advantage to start with t functioning of the organism in the social environme about which the student has more previous knowled than he has of sensory functions. This is no dou true, but this method of approach sacrifices the a vantage of beginning with a part of the subje on which there is much exact scientific knowled

The previous edition proved itself a satisfacto text-book. It was up to date, accurate and eclecti In its new form, with additional matter and increased number of collaborators, it appears to ha sacrificed none of these merits. It should prove to as satisfactory as its predecessor. Whether the ne order of presentation is the better can only be to by trial.
R. H. THOULESS.

Children with Delayed or Defective Speech

Motor-Kinesthetic Factors in their Training. I Sara M. Stinchfield and Edna Hill Young. P xvi+174. (Stanford University, Calif.: Stanfo University Press; London: Oxford Universi Press, 1938.) 14*s.* net.

THIS most useful book describes the theory a practice of the Hill Young School of Speech Los Angeles. It is divided into two parts, the fi by Dr. Stinchfield, discussing the problem to solved in dealing with children with delayed defective speech, and the second by Mrs. Youn dealing with the practical side.

It is estimated that there are four million childr in the United States handicapped in the use of speec

The treatment consists briefly in training muscul action for whole words. There is a liberal supply photographs showing how the child is taught to u his muscles in the enunciation of the various wor used.

Man against Himself

By Karl A. Menninger. Pp. xii+485. (Londo Bombay and Sydney: George G. Harrap and C Ltd., 1938.) 15*s.* net.

DR. K. A. MENNINGER, who some years a produced an excellent book, "The Hum Mind", has given us a very interesting book on so of the wider implications of suicide in "Man agai Himself".

The book is largely based on psycho-analyti principles. After a brief consideration of suicide commonly understood, the author deals with wh he calls chronic suicide, which includes asceticis neurotic invalidism and alcoholic addiction, a then with focal suicide, which includes mutilatio purposive accidents, impotence and frigidity a polysurgery.

The treatment consists in self-reconstructi dealing with the aggressive, self-punitive and ero motivations.

NEWS AND VIEWS

Ministry of Information

Question time in the House of Commons during the past few days has produced a crop of inquiries about the Ministry of Information. As is well known, the staff of the Ministry has suffered drastic reduction as the result of the criticism levelled against it. On October 18, Sir John Graham Kerr asked the Parliamentary Secretary to the Ministry of Information, "in view of the important part played in modern warfare by science and in view of the importance of accuracy in public information regarding such matters, how many of the 190 members of the staff of the Ministry, of which particulars have recently made public, are university graduates in science ?" Sir Edward Grigg said in reply that the "information is not available and could only be obtained at an expense of time of which I should not feel justified in giving to the inquiry". He added that "scientific advice can be obtained whenever necessary from a large range of experts in Government service and outside it, and that it is therefore unnecessary to add on that account to the establishment costs of the Ministry". While it will not be denied that such advice is available, it is difficult to see how the Ministry, without scientific guidance from within, can hope to utilize to the full the scientific knowledge of the country.

Camouflage (Advisory Committee)

On August 2 last, an advisory committee on camouflage by the use of paint, was appointed by the Government, which agreed that it should include a scientific member. Sir John Graham Kerr asked the Home Secretary on October 19 how many meetings this committee had held since its formation. Sir John Anderson, in reply, stated that the first meeting of the committee was held on October 18. In reply to a supplementary question, Sir John Anderson said that "the committee has been so constituted as to bring to bear on this important question of camouflage the opinions of many people who hold differing views on the theoretical and practical aspects of the question. The reference to the committee is very wide, and I have no doubt that the committee will be in a position to address itself to the question". No explanation was offered of the lengthy delay between the setting up of this committee and its first meeting.

Advisory Research Council of the Chemical Society

The Council of the Chemical Society has formed an Advisory Research Council, under the chairmanship of Sir Robert Robinson, the main function of which will be, when approached, to bring to the notice of fellows and others engaged in chemical research, subjects for investigation likely to be of potential value to the nation at the present time. In the first instance such advice will be made available to unremunerated research workers (that is, unremunerated as research workers for some specific purpose) in universities, colleges and other research institutions, and to research students in receipt of grants not definitely related to any particular topic or in regard to which the topic can be changed. It is hoped to effect liaison with Government departments and industrial organizations so that the Advisory Research Council may be cognizant of pressing problems needing investigation and thus be able to suggest lines of research of national value. It will not be a function of the Council to exercise control over any research that may be undertaken. The field to be covered will embrace every branch of pure chemistry and include biochemistry and metallurgy. Chemists and various organizations (industrial and otherwise) will be invited to send in suggestions for research, and a list of topics for research considered of national importance will be drawn up and will normally be available to those wishing to make use of it for the purpose of initiating an investigation. Inquiries and suggestions may be sent to the General Secretary, Chemical Society, Burlington House, Piccadilly, London, W.1.

New Anthropological Periodical in India

India is so poorly supplied with anthropological literature that the appearance of a new periodical to be devoted entirely to the scientific study of anthropology must be regarded as something of an event. The work of the Indian Anthropological Institute, to which reference is made elsewhere in this issue of Nature (see p. 721), has been hampered seriously ever since its inception in 1936 through lack of an official organ for recording the deliberations and discussions of its members. Financial conditions proved an insuperable obstacle until the University of Calcutta, thanks to the good offices of the Vice-Chancellor, Mr. Syamaprasad Mookerjee, generously came to its assistance with an offer to assume responsibility for printing the *Journal* of the Institute free of charge. The first issue, which has appeared recently, includes communications received from members up to the close of 1938, among them the presidential address by Dr. J. H. Hutton, the first president, in which he puts forward the suggestion that the Institute should formulate a five years' plan of research, to be entrusted to sub-committees, and Colonel Gordon offers some pregnant, as well as pungently critical, comments on the methods and organization of archæological studies in India. Reference to both these communications will be found on another page. A cognate question is raised by Colonel Germano da Silva Correia, who after a critical examination of the various theories of the racial origins of the peoples of India, put forward by anthropologists from the days of H. H. Risley onward, suggests that the methods of inquiry hitherto pursued should be supplemented by a systematic survey of blood groups. Among other contributors Mr. Sasanka Sarkar puts forward a proposal for a classification of the nasal elevation index, and Dr. Biren Bonnerjea, profiting by his sojourn in the United States, discusses "Fish-Hooks in North America and their Distribution". We offer the new periodical a cordial welcome, and wish it a long and prosperous career.

Extension of Electric Power Supplies in U.S.S.R.

ACCORDING to "Russia Today" Press Service, the Commissariat of Power Stations of the U.S.S.R. is expending a sum of 1,056 million roubles on this purpose in the present year, when 882,000 kw. will be added to the capacity of the generating plants of the Union. The capacity of the power stations in the Ukraine has been augmented considerably, a notable addition being a 100,000 kw. turbine to the Zuyev Station, which is one of the largest in the U.S.S.R. Two large turbines have been added to the Moscow power system and three new heat and power stations are in course of construction in that city. The power system of the Urals has been augmented by a 50,000 kw. generator at the Central Urals Station near Sverdlovsk, which brings the capacity of this station up to 150,000 kw. A heat and power plant was recently put into operation at the Kamensk Aluminium Works in the Urals. Work on a large scale is also proceeding on hydro-electric power plants. This includes work on the world's largest power project, the Kuibyshev Hydro-Electric Centre (on the Samara Bend of the Volga), the power plant of which when completed will have a generating capacity of 3·4 million kw., and the hydro-electric power stations at Uglich and Rybinsk, two further links in the chain of the Greater Volga Project. The Uglich and Rybinsk stations will have a combined capacity of 440,000 kw. Construction is in progress on the first underground hydro-electric power station beyond the Arctic Circle, in the district of Kandalaksha, in the Murmansk Province. This station, which will have a capacity of 150,000 kw., will be the third power plant in the Soviet Far North. To provide power for the growing non-ferrous metal industry in the Altai Mountains, building has commenced for a generating station of 240,000 kw. capacity on the River Irtysh in Kazakhstan.

Precautions against Flooding in the London Tubes

IN order to protect railway and road transport services from the risks arising from air raids, London Transport, in conjunction with the Ministry of Transport, has undertaken a great programme of emergency work. The *Electrical Times* of October 19 states that the total cost of the programme, including that already completed at the outbreak of the War, will be about a million pounds. The most difficult part of the problem was how to protect the underground railways from flooding either from the Thames itself or from sewers or water mains where these are in close proximity to stations. There has been already a preliminary inspection of two examples of such protective works, namely, floodgates installed at Waterloo, where the tunnels of the Northern line go under the river, and work which has been done at King's Cross Underground, to guard against flooding from water mains and sewers. When the works are finished, all the stations and sections of line at present closed will be reopened and journeys on the Underground will be as safe as in peace time.

BOTH the floodgates installed at Waterloo and Charing Cross stations on the Bakerloo line are electrically operated. They enable the sub-fluvial sections of the lines between these stations to be isolated during an air raid and so the risk of damaging the under-river tunnels is avoided. Similar floodgates are being installed at Waterloo and Strand stations on the Northern line, which also runs under the Thames. Each gate is made of built-up steel of an overall thickness of thirteen inches and weighs very nearly six tons. In normal open position it is against the headwall of the station platform tunnel, against the tunnel mouth. It is made to slide horizontally into position across the tunnel mouth within a framework of cast iron and can be operated either electrically or by hand. For electrical operation control is by push-button. The gates would resist a force of more than 800 tons, which is several times greater than any possible pressure of water that might have to be borne. The gates on the Bakerloo line were actually closed during each of the three air raid warnings which marked the ourbreak of war, the time taken to close them being less than three minutes. The gates were designed by W. T. Halcrow, consulting engineer, in conjunction with London Transport's engineers.

Commercial Irradiation of Food

IT is now sixty years ago since it was first discovered that bacteria are killed by exposure to sunlight, and that the bactericidal effect is due to rays of short wave-length. For medical purposes the use of such ultra-violet rays is now well known, but it is not generally known to what extent irradiation is used commercially in the preparation of foodstuffs, and the engineering devices that are employed for obtaining the ultra-violet rays. Until recently, sterilization of water by ultra-violet radiation has been hampered by the complexity of the equipment available (*Elect. Rev.*, Sept. 23). Recently, Messrs. Hanovia, Ltd., have brought out the new 'Uster' type of sterilizer, which uses a simple straight generating quartz mercury arc tube with a 700-watt loading. This starts automatically by an electronic discharge from activated metal electrodes. One of these units can deal with 600 gallons of fluid per hour. Mr. Harding, a director of E. Harding and Sons, Birmingham, states that in a bakery he finds that dough which has been subjected to ultra-violet rays during the seven to ten minutes it is mixing not only gives a loaf a better colour, owing to the slight bleaching action of the rays, but also causes a definite improvement in fermentation. Another application of ultra-violet radiation is to determine quality or age by fluorescent effects. Many substances absorb ultra-violet rays and re-emit them as visible light of certain colours. The colours are specific and characteristic for each substance, but minute differences in chemical composition often cause large differences in the colours of the emitted light. An egg, for example, changes its colour from mauve-red when it is newly laid to pale blue as it grows older, and a mixture of margarine and butter appears an unmistakably different colour from pure butter.

A Geothermic Generating Plant

Italy has not confined its attention to developing hydro-electric power. At Bastardo in Umbria, Italian lignite is used to supply a large electric power station. In addition, there has recently been exploitation of the natural steam resources of the borax mines geysers in Tuscany. The Larderello geothermic electric station is the best known. Antonio Giordano, in an article published in the *Electrical Times* of October 19, gives an account of its growth from 1905 to the present time. Its capacity initially was 16,000 kilowatts. In the past twelve months, in association with the electrification of the Viareggio–Rome section of the Turin–Naples railway, running along the western Italian coasts, a new geothermic generating plant of 50,000 kw. capacity has been built. Its operation in the first few months has been so successful that the Borax Company of Larderello has placed orders for two new 12,000 kw. machines, for the necessary heat transformers, etc., and for the construction of a completely new power station at Castelnuovo, which will house five generating sets each of 12,000 kw. When the new developments are completed, the aggregate capacity of geothermic generating plants in Italy will amount to 135,000 kw., and the possibilities of further extensions are not exhausted. A problem connected with the exploitation of natural steam for power generation purposes is its purification. The difficulty was solved successfully by Prince Ginori Conti, chairman of the Larderello Company, by means of specially designed evaporator units. These consist of primary pipes through which the natural steam is circulated at a pressure of 3 kgm. per sq. cm., the pipes being immersed in water in a cylindrical tank. The energy is generated in the turbo-alternators at 25,000 volts and transmitted to the substations along the Viareggio–Rome railway, where it is converted to 3,000 volts direct current. The new station at Castelnuovo will also serve this railway.

Report of the Cambridge Observatory, 1938–39

The work carried out at the Cambridge Observatory under the directorship of Sir Arthur Eddington includes photo-electric observations for the purpose of testing the constancy of the light of stars similar in physical constitution to the sun (dwarf *G* stars). With the Northumberland equatorial, 165 measures of double stars were made, 51 being less than $1''$ in separation. Dr. Woolley began laboratory experiments in preparation for a determination of the sun's apparent magnitude, planned, in conjunction with Mr. C. R. Davidson, to be carried out in South Africa in 1940. The apparatus had been brought to a stage at which it is possible to measure with a probable error of 0·01 mag. the transmission in sensibly monochromatic light of a dark glass cutting down three magnitudes. The polarization of a spectrograph was carefully determined in several wave-lengths, and a preliminary determination of the coefficient of reflection from an unsilvered glass surface was made. Both theoretical and observational work have been carried out by research students: Dr. M. Krook (Isaac Newton student) investigating certain problems involving non-coherent absorption; D. S. Evans concluding his work on the influence of Stark effect on the centre-to-limb variation of the contours of the Balmer lines; J. Jeffreys (Isaac Newton student) on photometric work in conjunction with Dr. Woolley's research on the sun's apparent magnitude, and H. Corben working on relativistic quantum theory. The Director has investigated the problem of how far the properties of a star of variable polytropic index are intermediate between those of polytropes corresponding to the two extreme indexes. This research is given in *Monthly Notices*, 99, 4. By Grace of the Regent House on June 10, 1938, the Observatory was constituted a Department in the Faculty of Mathematics, and the Observatory Syndicate was discharged. The Syndicate had been in continuous existence for 109 years, an earlier Syndicate, appointed "for considering the propriety of building an Observatory", having met from 1818 until 1824.

Plant Hormones in Horticulture

The chemical recognition of plant hormones was quickly followed by the synthesis of substances capable of initiating the formation of roots in the stems of many plants. These substances have been used in plant propagation, causing almost in a 'catalytic' manner an acceleration of the rooting process accompanied by a more profuse root system. H. L. Pearse has now reviewed the work of thirty or more investigators who have endeavoured with considerable success to apply recent scientific discoveries to horticulture in this way ("Imperial Bureau of Horticulture and Plantation Crops. Technical Communication No. 12: Plant Hormones and their Practical Importance in Horticulture". By Dr. H. L. Pearse. Pp. 88. Bibl. 248. 3*s*. 6*d*.). There follows a valuable index showing approximately one thousand examples of propagation and the treatments used. This is not a complete list, and some difficulties in presenting the results of many workers in one table have been neatly overcome; but comparative reference would have been made easier by a standardized method of stating the concentrations employed. Results obtained by the additional use of vitamin B_1 (aneurin), known to influence the growth of excised roots *in vitro*, and other substances are also brought under review. The widespread use of aneurin is not recommended as yet, although at East Malling, as elsewhere, Pearse observed some stimulation in the subsequent growth of rooted cuttings which had received small quantities of aneurin. The bulletin reports effects on other plant organs of these substances of possible application in horticulture. It is impossible to include all the latest work; there is no mention here of tetrahydronaphthylidene acetic acid, or of α-naphthylacetamide, recently shown to be active substances inducing cell division and root formation, or of plants failing to respond to treatment the anatomy of which is under investigation at Kew. This bulletin forms a well-balanced review of the subject to date, and its value is increased by its practical outlook.

Earthquake in Bulgaria

During the night of Thursday-Friday, October 19–20, strong earthquake shocks accompanied by a roaring sound were reported from Orisovo near Tchirpan in south Bulgaria. Some alarm was caused among the inhabitants but no damage was reported, and thus the earthquake appears to have been of about intensity VI on the Rossi-Forel scale (oscillation of chandeliers, visible disturbance of trees and shrubs, some startled persons leave their dwellings). This area is definitely seismic, and violent local shocks were reported from the same region on April 14 and April 25, 1928. According to K. Jankov, of the Observatory at Sofia, the most active region is to the south-east of Kustendil, where 1,420 shocks occurred between the years 1749 and 1936, some of these being so severe as intensity VII on the Rossi-Forel scale (overthrow of movable objects, fall of plaster, etc., but no damage to buildings). The majority of the shocks appear to have been of shallow focus, only affecting a small area and probably being due to slipping along an active fault. The present shock may have been of a similar nature.

Earth Tremor near Ottawa

An earth tremor of intensity IV on the modified Mercalli scale (rattling of dishes, windows, doors) shook Ottawa on Friday, October 20. No damage was done. Small earth tremors are known to occur in eastern Canada from Baffin Bay to the Great Lakes including Newfoundland, though the nearest active epicentres to Ottawa appear to be those of Timiskaming (Quebec), where there was a shock on November 1, 1935, and in the region of the Sanguenay River, where shocks have been recorded from as early as February 5, 1663, and continuing to the present time. Further information concerning the shock of October 20 is awaited from the Dominion Observatory at Ottawa.

Discovery of Comet Giacobini-Zinner

An I.A.U. telegram from Copenhagen announces that this comet was discovered by van Biesbroeck on October 15 at 1h. 17·1m. U.T. Its position is given as R.A. 16h. 21m. 27·4s., N. Dec. 1° 18′ 53″. It is described as diffuse with central condensation, magnitude 15. In the "Handbook of the British Astronomical Association, 1939", the elements and ephemeris of this comet are given by Mr. F. R. Cripps, who applied the perturbations of Jupiter and Saturn to the 1933 elements. The comet is very close to the predicted position, and it is only necessary to make the corrections for perihelion passage 0·25d. later than that given in the "Handbook".

Rapidly Moving Spots on the Planet Jupiter

Mr. B. M. Peek, president of the British Astronomical Association and director of the Jupiter Section, has observed an outbreak of small dark spots on projections at the south edge of the North Temperate Belt of Jupiter. They appear to be rotating at such a speed that a complete rotation would take place in about 9 hours 50¼ minutes. There is a remarkable similarity between these spots and those which occurred in 1880, 1891 and 1929. Astronomers in possession of telescopes with apertures of 8 inches or more should be able to see these spots.

A Large Sunspot

A large sunspot appeared over the sun's east limb on October 19 and is now crossing to the west limb, which it will reach on November 1. The time of central meridian passage of the spot is October 26·0, its latitude 8° south and its area, corrected for foreshortening, on October 20, was 1850 millionths of the sun's hemisphere.

The Night Sky in November

The moon is new on November 11 at 7·9h. and full on November 26 at 21·9h. U.T. The bright star λ Geminorum (magnitude 3·6) is occulted on November 30, the disappearance as seen from Greenwich taking place at 2h. 22·8m. at position angle 102° from the north point, and the reappearance at 3h. 37·8m. at 282°. Mars, Jupiter and Saturn are bright planets in the evening or night sky. In mid-November, Mars souths at about 18¼h., Jupiter at 20¼h. and Saturn at 22¼h. Jupiter is in conjunction with the moon on November 21 at 22h. and Saturn on November 24 at 1h. Uranus is in opposition on November 13, when its distance from the earth is nearly 1,731 million miles. Neptune, near the border between the constellations of Virgo and Leo, makes a near approach (about 20″) to the eighth magnitude star BD + 3° 2549. At about 21h. in the middle of the month, the Milky Way passes from the eastern to the western horizon through the zenith of London. The most distant celestial object that can be seen with the naked eye—the Great Nebula in Andromeda—is on the meridian at an altitude of 79°. Vega is the brightest star in the north-west quadrant of the sky and Capella the brightest in the north-east. The Pleiades cluster is well above the eastern horizon, and Orion is then just rising. The Leonid meteors should be looked for about November 14–16; their radiant point, preceding γ Leonis, rises about 23h. The meteors of this well-known shower are characterized by swift flights and their greenish colour. Light variations in the variable star Algol (β Persei) may be noticed about one and a half hours before and after the following times of primary minima: November 14d. 3·1h.; 16d. 23·9h.; 19d. 20·8h. and 22d. 17·6h.

Military Service and the Professional Institutions

STEPS have been taken to ensure that members of all classes of the leading engineering and professional institutions, when called up for military service, will be posted to units in which their services will be best employed in the national interest and, in the case of graduates and students, to units in which the training will be of use to them on returning to civilian work. Members of engineering institutions should mention the fact when supplying particulars of their qualifications to 'interviewing' officers; a letter stating class of membership should be obtained from the Institution concerned for presentation to the officer.

Modern Wireless Communications

IN response to a request and with the view of meeting the needs of students and others who may wish to qualify for possible future service in the uniformed and non-uniformed radio branches of the Defence Forces, arrangements have been made by the Royal Institution for a series of lectures on modern wireless communications. The course will consist of twelve afternoon lectures, commencing on October 31, and will be given by Prof. C. L. Fortescue, Dr. R. L. Smith-Rose and Dr. E. V. Appleton. They will deal with important aspects of the installations, transmission of the signals and the phenomena of radio wave propagation. Tickets, for which there will be no charge, may be obtained from the General Secretary, Royal Institution, Albemarle Street, London, W.1.

The British Empire Naturalists' Association

THE British Empire Naturalists' Association has decided to suspend further publication of its quarterly journal *Country-Side* during the war, but in order to continue the maximum amount of activities, full power has been given to the various branches to carry on under their own organization until such times as normal conditions return. There will be circulated, however, the usual quarterly issues of the *Branch News*, in order to keep branches in contact with headquarters. The decision was made not without regrets, but the view maintained was that by conserving funds now, the Association would be in a stronger position to resume its full activities when peace returns, rather than to weaken itself by struggling against the rising costs and difficulties of voluntary labour. Numerous provincial natural history societies have cancelled their programmes, and others have adopted a method of meeting in the afternoons.

Institute of Metals

DURING the War the Institute of Metals is continuing its activities, other than those of a social character. The headquarters in Grosvenor Gardens, London, remain open, and the Joint Library and the Information Department are available to members. The *Monthly Journal* will continue to publish original papers, and also to provide abstracts, the importance of which becomes more apparent as members find it difficult to obtain access to technical journals.

Royal Geographical Society

THE Royal Geographical Society will, so long as is possible, carry out its programme of meetings for the session, but at modified times. All meetings will be at 5 p.m.; the evening meeting programme on alternate Mondays, the afternoon meeting and geographical films programme on the intermediate Mondays. At the first meeting, on Monday, October 30 at 5 p.m., Mr. F. Kingdon Ward will read a paper on "Six Months in the Assam Himalaya". The Asia Lecture will be delivered by Dr. G. M. Lees on November 27.

Announcements

MR. PERCY R. LOWE has been awarded the Verner von Heidstam Gold Medal of the Royal Swedish Academy of Sciences in recognition of his "important and successful endeavours to further the protection of the world's fauna, endeavours of great benefit also to the migratory birds of Sweden".

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 23, the following officers were elected: *President*, Prof. E. T. Whittaker; *Vice-Presidents*, Principal J. C. Smail, Prof. J. Walton, Dr. James Watt, Dr. Leonard Dobbin, Mr. J. A. Inglis and Prof. R. Stockman; *General Secretary*, Prof. James P. Kendall; *Secretaries to the Ordinary Meetings*, Dr. A. C. Aitken and Prof. R. J. D. Graham; *Treasurer*, Dr. E. M. Wedderburn; *Curator of the Library and Museum*, Dr. J. E. Mackenzie.

THE Rockefeller Foundation has recently awarded two grants, of 350,000 and 90,000 dollars, to the Johns Hopkins University School of Medicine, Baltimore. The larger sum is to be used over a ten-year period to equip and maintain a department of preventive medicine, while the second grant will be utilized as a research fund to be distributed among departments and to projects which stand in greatest need of carrying out research programmes.

MESSRS. FLATTERS AND GARNETT, LTD., 309 Oxford Road, Manchester, 13, have issued an abridged list of their microscope slides, dealing chiefly with biological subjects. This includes two sets, of thirty-six slides each, suitable for the zoology and botany respectively of Higher School Certificate and 1st M.B. students. The firm has a stock of 30,000 slides; no change has been made in prices.

PROF. S. CHAPMAN has noted some misprints in his article on the meeting of the International Union of Geodesy and Geophysics published in NATURE of October 21: p. 717, col. 1, line 10 from bottom, for "Signole" read "Signore"; line 9 from bottom, for "Lütschy" read "Lütschg"; p. 718, col. 2, line 5 from end of article, for "Sánchey" read "Sánchez". He also intended to emphasize the complete absence of French and Italian delegates and of Russian visitors, referred to in the article.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 755.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Taste-testing the Anthropoid Apes

At the recent International Congress of Genetics at Edinburgh, in the course of discussions on the possibility that the blood-group frequencies found in man were determined by a balance of selective influences, it occurred to one of the authors that evidence on the parallel possibility for taste-testing could be obtained by testing the anthropoid apes.

By the courtesy of Prof. F. A. E. Crew and Dr. Gillespie of the Edinburgh Zoo, a preliminary test was carried out before the Congress ended, which was successful in showing that, when the animals are calm and free from interference by others in the same cage, the test can be made without ambiguity, and that both tasters and non-tasters exist among the chimpanzees.

We have since tested nearly all the anthropoid apes in the Zoological Society's collections at Regent's Park and Whipsnade. The solutions used contained 2 per cent sucrose to make them moderately attractive, and, except for this, were equivalent to Nos. 3, 6 and 9 of the standard series used at the Galton Laboratory, where they were prepared. They contained respectively 6½, 50 and 400 parts per million phenyl-thiocarbamide. Human tasters would generally find the first perceptibly bitter, but not necessarily unpleasant if the sugar were desired; the second would be, to most tasters, unpleasantly bitter, and the third decidedly so. Non-tasters might notice some slight bitterness at the strongest level. The apes tested must have similar sensory perceptions at these strengths, for those classified as non-tasters continued to accept the strongest solution, while the 'tasters' showed reluctance or aversion, sometimes with the weak, and always with the medium solution. The strong solution was used whenever possible for confirmation.

With the exception of one chimpanzee, which was too shy to be tested, the results are shown in the following table (E, R, and W stand for Edinburgh, Regent's Park and Whipsnade):

Chimpanzees tested

	Females			Total	Males			Total	Both sexes
	E	R	W		E	R	W		
Tasters ..	2	7	2	11	4	2	3	9	20
Non-tasters ..	1	1	1	3	1	3	–	4	7
Total ..	3	8	3	14	5	5	3	13	27

Thus the chimpanzees show 7 non-tasters out of 27, or 26 per cent. Experience with man also gives regularly about 25–30 per cent.

The young female Jaqueline, both of whose parents are in the Regent's Park collection, and both non-tasters, was omitted from the table of frequencies, since her reaction as non-taster, while it confirms the genetical similarity of the situation in the apes and in man, adds nothing to our knowledge of the gene frequency in the apes.

With the orang-utan we found one male non-taster at Edinburgh, and two tasters, male and female, at Whipsnade. Two male gorillas at Regent's Park were both tasters. Two Whipsnade specimens of the gibbon (*Hylobates concolor*) were both tasters, but *H. lar lar* and *H. lar agilis* at Regent's Park were non-tasters. Numerous tests on primates and other mammals are in progress.

The existence of a dimorphism in the taste test, parallel to that known in man, in at least two of the manlike apes, is a most remarkable fact. Its significance is emphasized by the circumstance that, certainly in the chimpanzee, the proportion of tasters to non-tasters is nearly the same as in human populations, which, as Boyd has shown, vary somewhat among themselves. Without the conditions of stable equilibrium it is scarcely conceivable that the gene-ratio should have remained the same over the million or more generations which have elapsed since the separation of the anthropoid and hominid stocks. The remarkable inference follows that over this period the heterozygotes for this apparently valueless character have enjoyed a selective advantage over both the homozygotes, and this, both in the lineage of the evolving chimpanzees and in that of evolving man. Wherein the selective advantages lie, it would at present be useless to conjecture, but of the existence of a stably balanced and enduring dimorphism determined by this gene there can be no room for doubt.

R. A. Fisher.
Galton Laboratory,
(now at Rothamsted Experimental
Station, Harpenden, Herts).
E. B. Ford.
University Museum, Oxford.
Julian Huxley.
Zoological Society, London.
Oct. 14.

Acetylphosphate and Pyruvate Oxidation

Lipmann has recently reported[1] that adenylic acid is partially phosphorylated to adenosine polyphosphate by preparations of *Bacterium Delbrückii* in the presence of acetylphosphate, and suggested that this compound may be an intermediate in the oxidation of pyruvic acid generally. If so, acetylphosphate should give an increased oxygen uptake with enzyme preparations which oxidize pyruvic acid completely.

We have prepared acetylphosphate by the method of Kämmerer and Carius[2] and confirmed Lipmann's observation that the stability of the bound phosphate is similar to that of phosphocreatine. Traces of Ag^+ left in solution strongly inhibit respiration; we therefore removed Ag^+ by addition of sodium chloride and adsorption on kaolin. A neutralized solution containing a mixture of mono-, di, and triacetylphosphate was used.

Acetylphosphate is not oxidized by a dialysed brain dispersion[5] (pigeon) in the presence of phosphate, fumarate, and adenylic acid. A typical experiment is given in Table 1. Each sample contained 1·5 ml. enzyme (dialysed 4 hours), phosphate buffer (pH 7·3), 1·2 mgm. sodium fumarate, and 1 mgm. adenylic acid (total volume of 2 ml.).

Table 1.

μl. oxygen uptake in 30 minutes (air, 38°).

Blank	Acetyl-P (1·12 mgm. P)	2 mgm. sodium pyruvate	Acetyl-P + sodium pyruvate
89	66	496	450

Experiments with muscle extract, in which a rapid transfer of phosphate to adenylic acid from phosphate donators such as phosphopyruvic acid takes place, have been negative with acetylphosphate. The experiments of Table 2 were carried out with an acetone powder extract from rabbit's muscle dialysed 4 hours. Each sample contained (in 1·5 ml.) 1 ml. extract plus phosphate buffer (pH 7·3), adenylic acid (with 0·35 mgm. P), and either phosphoglyceric acid (0·8 mgm. P) or acetylphosphate (1·95 mgm. P) as phosphate donators. Phosphate was determined colorimetrically by the method of Lohmann and Jendrassik.

Table 2.

P donator	Incubation at 30°	mgm. direct P	mgm. pyrophosphate P
Phosphoglyceric acid	5 min.	0·37	0·49*
"	30 "	0·38	0·56*
Acetyl-P	30 "	2·16	0·00
"	60 "	2·30	0·04

*Theoretical value for complete phosphorylation of added adenylic acid to adenosine triphosphate, 0·70 mgm. P.

These results indicate that acetylphosphate is neither an intermediate in the oxidation of pyruvic acid by brain nor does it act significantly as a donator of phosphate to adenylic acid in muscle extract. They do not exclude the possibility that acetylphosphate might be an intermediate in the dehydrogenation of pyruvic to acetic acid by preparations of *Bacterium Delbrückii*, but the fact that some acetic acid is produced when pyruvate is oxidized by brain[4], and the indirect nature of Lipmann's evidence, make it more probable that there is some other, as yet unknown, phosphorylated intermediate common to both bacteria and animal tissues. The existence of such an intermediate is strongly suggested by the observation of Banga *et al.*[7] that adenylic acid is involved in a stage of pyruvate oxidation by brain beyond that of oxidative decarboxylation.

We are indebted to the Nuffield Trustees and the Rockefeller Foundation for grants in aid of this work.

S. Ochoa.
R. A. Peters.
L. A. Stocken.
Department of Biochemistry,
Oxford. Sept. 22.

NATURE, 144, 381 (1939).

Ann., 131, 165 (1864).

Banga, Ochoa and Peters, NATURE, 144, 74 (1939).

Long, *Biochem. J.*, 32, 1711 (1938).

Oxidation of Methyl Esters of Monocarboxylic Fatty Acids by Normal and Neoplastic Tissue

The metabolism of the fats in tumours has been little studied. Haven[1], feeding elaidin to rats, the method used by Sinclair[2] in classifying phospholipids into the metabolic and the non-metabolic type, found that the phospholipids of tumours are mainly of the non-metabolic type, having to do with cellular structure rather than with the burning of fatty acids for energy. According to Kisch[3], the Jensen sarcoma does not oxidize the low fatty acids. I have observed[4] that the oxygen uptake of slices of various experimental and human tumours is not increased when saturated and unsaturated monocarboxylic fatty acids in the form of sodium salts are added to the medium, and that in no instance were acetone (ketone) bodies formed. The β-hydroxybutyric acid, on the other hand, is oxidized into aceto-acetic acid.

The latter data exclude the fact that the neoplastic cell can β oxidize fatty acids. My aim was to find out whether the tumour could oxidize fatty acids by means of ω-oxidation.

I have studied manometrically the oxidation of methyl esters of monocarboxylic fatty acids from C_1 to C_8 in comparison with the corresponding free acids, in the presence of tissue slices of liver, kidney, spleen, brain cortex, striated muscle, Rous I sarcoma, round cell chicken sarcoma, and Ehrlich adenocarcinoma. It has been found that, without exception, the oxygen consumption of normal tissue slices is increased by fatty acids esters much more than by the free acids. For example, some esters increased the oxygen uptake in the liver eight times, in the brain cortex eleven times, and in the spleen seventeen times more than the corresponding acids. As a rule, the oxygen uptake increases as the fatty chain increases up to a maximum at about C_6–C_7, and decreases at about C_8, owing to the low solubility in water of this ester. With methyl formiate—in connexion with which a true ω-oxidation is obviously impossible—it is the ester which is mostly burnt in certain tissues (spleen, brain, striated muscle). Only the fatty acid component of the esters is burnt, whereas the alcohol component is not.

Neoplastic tissues do not oxidize the free fatty acids but actively oxidize the corresponding esters. The neoplastic cell in which enzymes of β-oxidation are lacking—with the exception of the enzyme which transforms the secondary alcoholic group of the β-hydroxybutyric acid into a ketonic group—can, by means of the ω-oxidation enzymes, use the fats as a source of energy.

E. Ciaranfi.
Institute of General Pathology,
University of Naples,
Italy. Sept. 14.

---

[1] Haven, F. L., *J. Biol. Chem.*, 118, 111 (1937).

[2] Sinclair, R. G., *J. Biol. Chem.*, 111, 515 (1935).

[3] Kisch, B., *Biochem. Z.*, 263, 379 (1933).

[4] Ciaranfi, E., *Amer. J. Cancer*, 33, 561 (1938).

A Cell-free Enzymatic Model of *l*-Amino-acid Dehydrogenase ('*l*-Deaminase')

Attempts to obtain cell-free enzyme preparations of animal origin effecting deamination of the *monocarboxylic* *l*-amino acids have hitherto been practically unsuccessful. (Specific enzymes deaminizing *d*-amino-acids and *l*-amino *dicarboxylic* acids have been obtained in solution and purified by several authors.) H. A. Krebs[1] attributes the deamination of *l*-amino-acids to an enzyme, termed '*l-deaminase*', depending for its activity upon the integrity of cell structure and rapidly deteriorating when the cells are damaged.

It appears from the data of Krebs that '*l*-deaminase' is even more sensitive to the dilution of cell-contents in ground tissue suspensions than to cell destruction as such, and further, that the *di*carboxylic amino-acids are oxidized at a very much higher rate than the *mono*carboxylic ones (in fact, *l*-aspartic acid was the substrate used in most experiments).

These facts point to the complex nature of '*l*-deaminase'. In a recent paper[2], one of us (A.B.) suggested that deamination of monocarboxylic amino-acids might proceed by way of their transamination with α-ketodicarboxylic acids, followed by deamination of the resulting amino*di*carboxylic acids, owing to co-operation of two enzyme systems: glutamic or aspartic aminopherase, and glutamic or aspartic dehydrogenase (with their respective co-enzymes, or hydrogen and amino carriers). The chain of reactions involved would be a reversal of the mechanism of amino acid synthesis in the animal body recently suggested by Euler and associates[3].

In support of this hypothesis, we have succeeded in constructing, from the above-stated constituents, a cell-free, almost water-clear enzymatic model system, deaminizing *l*(+)alanine at a fairly high rate under aerobic conditions, with pyocyanine as autoxidizable hydrogen carrier. The complete system consists of: (*a*) 2 ml. purified and dialysed glutamic dehydrogenase (from ox liver, after Euler[3]), (*b*) 3–4 ml. purified and dialysed glutamic aminopherase (from pig heart, after M. Kritzmann[4]); (*c*) 2–20 mgm. (14–138 mol. × 10^{-6}) α-ketoglutarate; (*d*) 2·5 mgm. cozymase (of about 60 per cent purity, after Ohlmeyer); (*e*) 0·3 mgm. pyocyanine; (*f*) 15–20 mgm. (170–225 mol. × 10^{-6}) *l*(+)alanine; (*g*) $M/15$ phosphate buffer, *p*H 7·6 to 10 ml. total volume.

In the complete model system, 10–15 per cent of the total amino-nitrogen is liberated as ammonia in the course of two hours shaking in an atmosphere of oxygen (Table 1).

TABLE 1.

Expt. No.	I	II	III	IV (3 hours)				V (4 hours)
α-Ketoglutarate (mols × 10^{-6})	160	135	117	117	58	29	14	6
	Ammonia liberated in 2 hours, mol. × 10^{-6}							
Complete system	23·6	12·9	24·3	23·6	21·0	20·0	17·0	19
Without glutamic aminopherase ..	0	1·6	—	—	—	—	—	—
Without glutamic dehydrogenase	5·6	0·7	2·0	0	—	—	—	—
Without ketoglutarate	0	0	0	0	—	—	—	—
Without cozymase . ..	—	0	—	0	—	—	—	—
Without alanine . .	0	0·7	0·7	0	—	—	—	—
Without pyocyanine .. .	0	—	—	—	—	—	—	—

In the same system, the direct deamination of *l*(+)glutamic acid proceeds more than twice as rapidly. Methylene blue may be used instead of pyocyanine, but the latter is more efficient. Practically no ammonia is formed from alanine if any one of the constituents is omitted. With low concentrations of ketoglutarate, it is advisable to add sodium arsenite in order to prevent breakdown of the keto-acid (glutamic dehydrogenase proved resistant to arsenite, like '*l*-deaminase').

Whether the 'indirect' mechanism of *l*-amino acid oxidation here discussed is actually at work in the metabolism of living tissues must be ascertained by special studies, now in progress in this laboratory.

A. E. BRAUNSTEIN.
S. M. BYCHKOV.

Dept. of Physiological Chemistry,
A. M. Gorky Institute of
Experimental Medicine,
Moscow.
August 12.

---

[1] Krebs, H. A., *Biochem. J.*, 29, 1620 (1935)

[2] Braunstein, A. E., NATURE, 143, 609 (1939).

[3] Euler, H., and Adler, E., *et al.*, *Z. physiol. Chem.*, 254, 61 (1938).

[4] Kritzmann, M. G., *C.R. (Doklady) Acad. Sci. U.R.S.S.*, 21, 42 (1938); *Biochimia*, 3, 603 (1938).

Localization of Electrolytes in Muscle

THE volume of the free interspaces within the freshly excised sartorius of the frog has a mean value of 9 ml./100 gm. when measured by inulin agreeing with the results from the magnesium method[1]. (The inulin method when applied to rabbit muscle[2] after preliminary injection into the blood stream gives 7 ml./100 gm.)

Comparing this figure with that for chloride in muscle, which is 14 per cent that in the plasma, it will appear that all the chloride is not free in the interspace water. That the difference is mostly due to the penetration of the fibre membrane by chloride is shown by the evidence now accumulated in this laboratory. Here some of the facts immediately related to the chloride and sodium localization are given.

(*a*) When immersed in sulphate solution (1·3 pe cent sodium sulphate) the chloride in the freshly excised sartorius comes out entirely within abou twenty minutes, but when immersed in glucose solution (3·2 – 3·8 per cent) it diffuses in two parts The first. corresponding to the interspace fluid, comes out rapidly, nearly if not quite as rapidly as in sulphate. The second and comparatively small fraction takes upwards of three hours for complete emergence. During the first period the potassium diffusing out is much less than either chloride o sodium, but during the second period it is considerably greater.

(*b*) Even when immersed in a solution resembling as closely as possible the inorganic composition of plasm (including carbon dioxide with glucos to maintai the osmoti balance, th chloride in th sartorius increases to 2 per cent of th external chloride within about twenty minutes and then remain steady. During this time sodium increases by onl 4 per cent of the external sodium, and this i accounted for by a corresponding loss of potassium There is no correspondence between the movemen of sodium and chloride, which negatives an adsorption explanation of the increased chloride, but i easily accounted for by an interchange with othe permeable anions within the fibre.

The chloride, so increased by preliminary immersion, diffuses into glucose solution in two parts a before, the second being now much increased ove the similar fraction of the normal content, wherea the first remains the same.

(*c*) Sodium diffuses from the fresh sartorius int glucose solution in a very similar manner to chloride the second sodium fraction taking likewise three t four hours for complete emergence.

(*d*) When all or practically all the sodium o chloride has emerged from the sartorius into glucose solution, the potassium is still present in considerabl quantity (50–60 per cent of the original content) an continues to diffuse out.

We may deduce that about 9 per cent of th external sodium or chloride is contained in the fre interspaces and can diffuse out rapidly, the remainde of the chloride and sodium being contained within the fibre. The fact that practically all the sodium and chloride diffuse out with less than half the potassium shows that a considerable proportion of of this exists in some region free from sodium and chloride or with a mere trace of chloride. This region we may identify with the myofibril, and regard sodium as being present only in the sarcoplasm.

The presence of a second membrane with somewhat different permeabilities is shown by the fact that in Ringer[2] at 2–3 C. potassium has diffused out to one half or so of its full amount, and sodium has entered in corresponding quantity, but within the next three days there is almost no change in the potassium or sodium content. After four or five days there is a sudden emergence of the remaining potassium and corresponding entrance of sodium accompanied by considerable swelling.

The above research has been supported by a grant to one of us from the Irish Medical Research Council.

E. J. Conway.
F. Kane.
P. Boyle.
H. O'Reilly.

University College,
Dublin.
Sept. 1.

---

[1] Conway, E. J., and Cruess-Callaghan, G., *Biochem. J.*, 31, 828 (1937)

[2] Conway, E. J., and Fitzgerald, O. (unpublished observations).

Source of the Moulting Hormone in Rhodnius (Hemiptera)

Two known factors are concerned in the control of growth in Rhodnius: a 'moulting hormone' which initiates cell division and subsequent ecdysis, and an 'inhibitory hormone', secreted in the first four nymphal stages, which prevents the development of imaginal characters. The inhibitory hormone is secreted by the corpus allatum[2].

I originally suggested that the moulting hormone might come from the same gland[1], but I have been unable to produce satisfactory proof of this. Recently I have re-investigated the question by transplanting isolated corpora allata, brains and parts of brains from 5th stage nymphs shortly after the 'critical period' into 4th stage nymphs decapitated at twenty-four hours after feeding.

In no case (11 experiments) did implantation of the corpus allatum and the associated sympathetic ganglion induce moulting; in 15 out of 17 experiments, moulting was induced by implantation of the brain. When different parts of the brain were tried, negative results were obtained with the suboesophageal ganglion, the optic lobes and the ventral half of the central mass of the brain; large pieces of fat body also gave negative results.

Positive results were obtained only with the dorsal half of the central mass of the brain. This is the region in which Hanström has recently demonstrated in Rhodnius the presence of peculiar large nerve cells which may have a secretory function[3]. I have confirmed the presence of these cells but have been unable to satisfy myself that they show histological signs of increased secretory activity during moulting.

V. B. Wigglesworth.

London School of Hygiene and
Tropical Medicine,
Keppel Street,
W.C.1.

Quart. J. Micro. Sci., 77 (1934).

Quart. J. Micro. Sci., 79 (1936).

Lunds Univ. Arsskrift, N.F., 34, No. 16 (1938).

A Peculiar Phenomenon Observed in Larval Populations of the Flour Beetle *Tribolium confusum* Duv.

I have observed that if small masses of coarsely sifted whole-wheat flour (64 gm. in a 150 c.c. beaker) are seeded with more than 800 eggs of the flour beetle *Tribolium confusum* Duv., and maintained at a suitable temperature and relative humidity (27° C., and 75 per cent r.h.), a peculiar distortion of the originally flat, level, upper surface of the flour mass occurs. There is a slight initial bulging upward commencing on the sixth day when the eggs hatch, no doubt due to the loosening of the flour by larval movement. This bulging increases up to about the twenty-first day, as shown in Fig. 1. There then takes place a more or less rapid moulding of the surface into the rather graceful form seen at the bottom of Fig. 1, and in Fig. 2, which is a photograph of a median vertical section of a culture on the twenty-eighth day.

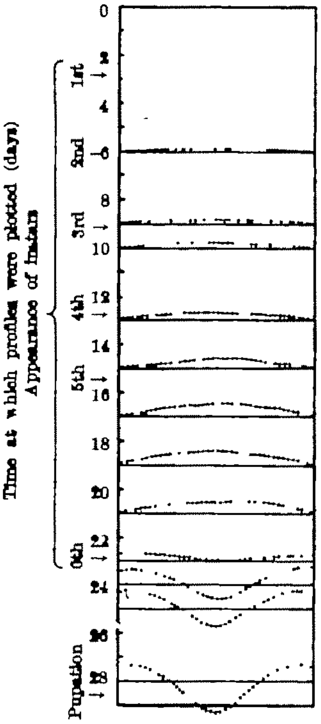


Fig. 1.

The horizontal lines are the original flour surface.

It will be noted from Fig. 1 that the distortion is not due to a mere sinkage of the central parts, but to a radial translocation of the flour, the circumferential drop being due, it is believed, to peripheral migration of the larvæ. The degree of distortion of the original flat surface depends on the number of larvæ present, being almost imperceptible with 600, marked with 800, and extreme with 1,600, there being almost 0·75 inches between the highest and lowest parts at this last concentration. With more than 1,600, interference between the moving larvæ occurs, and the figure is less marked.

The effect is dependent also on the diameter of the vessel, the optimum diameter appearing to be about 2 in., which is that of a 150 c.c. beaker. The effect does not occur if the flour is very fine, probably due to higher internal friction in such flour. Vertical

X-ray photographs do not disclose any marked non-random distribution of the larvæ, though some small evidence of peripheral migration is afforded by the presence of circumferential tunnels.

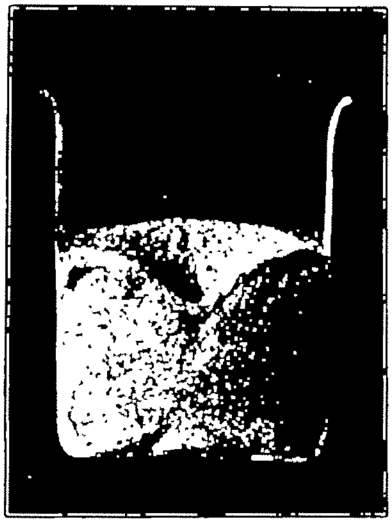


Fig. 2.

This problem is being investigated experimentally, and also from the point of view of a mathematical analysis, and will be reported on later in a publication made elsewhere. I wish to acknowledge the financial support of the National Research Council of Canada and the Science Research Committee of Queen's University in connexion with the work on the growth of populations of Tribolium, of which this is a part.

John Stanley.

Queen's University,
Kingston, Ontario.
Sept. 1.

Limits of Validity of Quantum Mechanics

We proposed some years ago[1] a modification of the formalism of the quantum theory for the cases in which the following condition is satisfied:

$$\xi = \left|\left(\vec{p}_1 - \vec{p}_2\right)^2 - \frac{1}{c^2}\left(E_1 - E_2\right)^2\right| \gtrsim p_0^2 \qquad (1)$$

$$p_0 = \frac{h}{r_0} \sim 137\, mc,$$

where $\vec{p}_1$, E_1 and $\vec{p}_2$, E_2 are 4-vectors corresponding to two states of a particle in a quantum transition, and r_0 is a universal length, $r_0 \sim 10^{-13}$ cm.

Such a method consists in the introduction of some relativistic 'convergency-factors' $G(\xi)$, which $\rightarrow 0$ if $\xi \rightarrow \infty$ and which give rise to convergent results instead of many divergent results of the present quantum theory. In the cases where $\xi < p_0^2$, $G(\xi) \cong 1$ and the rules of the ordinary quantum theory are obviously obtained. This condition $\xi < p_0^2$ is therefore the condition of validity of the quantum mechanics and it can be examined independently of the method of the 'convergency-factors'.

Let us show that by operating within the limits of validity of the present quantum theory, the measurement of a co-ordinate x cannot be made with $\Delta x < r_0$. Such a measurement can only be performed by using incident waves of a wave-length $\lambda < r_0$ and by operating in such a manner that the scattered radiation which enters the measuring apparatus (for example, the Heisenberg microscope) has also a wave-length[2] $\lambda < r_0$; $|\vec{p}_2| > p_0$.
We have indeed:

$$\Delta x \cong \frac{\lambda_2}{\sin\, \alpha}. \qquad (2$$

Thus we can suppose

$$|\vec{p}_1| \gtrsim |\vec{p}_2| \gg p_0 > mc,$$

and, from the condition of validity of quantum theory $\xi < p_0^2$, we obtain the following condition for the angular deviation Θ in the collision process:

$$\xi = \vec{p}_1^{\,2} + \vec{p}_2^{\,2} - 2\,|\vec{p}_1|\,|\vec{p}_2| \cos\Theta - (E_1 - E_2)^2 \sim$$

$$2\,|\vec{p}_1|\,|\vec{p}_2|\,(1 - \cos\Theta) < p_0^2. \qquad (3$$

$$\left(2 \sin\frac{\theta}{2}\right)^2 < \frac{p_0^2}{|\vec{p}_1|\,|\vec{p}_2|};\;\; 0 < \frac{p_0}{p_2};\;\; (|\vec{p}_2| = p_2).$$

Only by operating within these limits can we b sure of not introducing unknown phenomena and o being able to apply the ordinary rules of the quantum theory. But in the case we are dealing with, wher the measuring apparatus is, for example, a γ-ra microscope, we can only use scattered particle within a small angle α. The numerical aperture o the microscope $\sin\alpha$ must satisfy the condition

$$\sin\alpha < p_0/p_2. \qquad (4$$

From (2) and (4) we have

$$\Delta x \gtrsim \left(\frac{h}{p_2}\right) \Big/ \left(\frac{p_0}{p_2}\right) = r_0. \qquad (5$$

The nuclear phenomena belong to the conditio $\xi \sim p_0^2$. It is very remarkable that, in the cosmi radiation, phenomena belonging to the conditio $\xi \gg p_0^2$ have not been observed so far. This seem to justify the assumption that such phenomena hav a very small probability of occurrence, a fact i agreement with the assumptions of the method of th 'convergency-factors'[3].

G. Wataghin.

Departamento de Physica,
Universidade de Sao Paulo,
Brasil.

---

[1] *Z. Phys.*, 88, 92 and 547 (1934). *C.R.*, 202, 833 (1936). *La Ricer. Scientifica*, S. II, Anno IX. 1.

[2] Heisenberg, W., *Ann. Phys.*, 32, 20 (1938). *Z. Phys.*, 110 (193

[3] Nature, 142, 393 (1938). *C.R.*, 207, 358 and 421 (1938).

Hyperfine Structure in the Spark Spectrum of Iodin

In a recent short note[1], Th. Schmidt states th he cannot agree with my measurements and con clusions relating to the hyperfine structures of tw lines in the iodine spark spectrum. In my analys of 33 terms in this spectrum[2], I found that in eigl there were deviations from the interval rule. Among these the terms with $J = 2$ did not fit the quadrat interaction law of the type suggested by Schüler ar Schmidt[3] and by Casimir[4], but could be fitted in a cubic law:

$$E = A + B \cos IJ + C \cos^2 IJ + D \cos^3 IJ.$$

In particular, I have found it necessary to empl this formula for the structure of (${}^2D$) $6s$ ${}^3D_2$, whi has been derived with a high degree of exactness from the line 6127. This same line has been measured by Schmidt, who obtains very different results, leading to a different term analysis. An entirely independent analysis for the term in question has recently been published by Murakawa[5], who has achieved high resolution in analysing the structures of the lines 5407, 5678, both of which involve the above term.

In the accompanying table are given the intervals derived for (^3D) 6s $^3D_2$, by Schmidt, Murakawa and myself. In addition, I have independently analysed Murakawa's *experimental* data and have enclosed the results in brackets. It should be pointed out that the nature of the lines 5407, 5678 is such that errors due to overlapping might cause small displacements, but *only* in the lower F levels.

F	Schmidt	Murakawa		Tolansky
9/2				
7/2	246	236	(235)	234
5/2	227	236	(237)	238
3/2	182	181	(181)	185
1/2	117	114	(114)	110

It will be observed that Schmidt's data differ onsiderably from those of Murakawa and myself, particularly in the first two intervals, which are the very ones in which the accuracy of my measurements is at its best (± 1 unit). It appears that the position of $F = 7/2$ is incorrectly given by Schmidt, since Murakawa and I are in agreement.

I wish to re-emphasize strongly what I have previously stated, namely, a cubic interaction formula need not of necessity imply the existence of a nuclear *octopole* moment. I suggest that it is possible that the existence of configuration interaction will convert the quadratic expression characteristic of electrical quadrupole moment into a cubic interaction law, the size of the cubic term depending upon the degree of configuration interaction. It is to be hoped that theoretical workers will examine this effect, since, if configuration interaction can distort hyperfine structures, *no* reliance can be placed upon any calculated nuclear electrical quadrupole moment until the existence of such interaction can be excluded with certainty.

S. Tolansky.

Physics Department,
University,
Manchester.
Sept. 6.

---

[1] Schmidt, T., *Z. Phys.*, 112, 430 (1939).

[2] Tolansky, S., *Proc. Roy. Soc.*, A, 170, 206 (1939).

[3] Schüler, H., and Schmidt, H., *Z. Phys.*, 98. 239 (1939).

[4] Casimir, H., *Physica*, 7, 719 (1936).

[5] Murakawa, K., *Z. Phys.*, 112, 234 (1939).

Points from Foregoing Letters

Human beings can be divided into two groups according as they experience a bitter taste or not with dilute solutions of phenylthiocarbamide, and the proportion of 'non-tasters' to 'tasters' is regularly 5–30 per cent. Tests by R. A. Fisher, E. B. Ford, nd J. Huxley on manlike apes in zoological collecions show that some of them cannot taste phenylhiocarbamide. The proportion of non-tasters in the chimpanzee agrees with that in man. It appears hat in the ancestries both of man and of the apes balance of selective forces must have maintained he gene ratio at a nearly constant value.

S. Ochoa, R. A. Peters and L. A. Stocken find that acetylphosphate is not oxidized by brain enzyme preparations and does not transfer its phosphate to adenylic acid in muscle extracts. They conclude hat the compound is not an intermediate in the oxidation of pyruvic acid by brain.

E. Ciaranfi finds that the esters of fatty acids increase the oxygen consumption of normal tissue lices much more than the fatty acids themselves; only the fatty acid component of the esters is onsumed. Neoplastic tissues do not oxidize he free fatty acids but actively oxidize their sters.

A. E. Braunstein and S. M. Bychkov claim that hey have obtained a cell-free enzymatic system able to deaminize *l*-alanine at a fairly high rate under aerobic conditions and with pyocyanine as autoxidizable hydrogen carrier.

Using an inulin method, the volume of the interspaces in the excised sartorius of the frog is shown by E. J. Conway *et al.* to be 9 ml./100 gm. muscle, whereas the chloride represents 14 per cent of the external concentration. This, supported by other facts, indicates the presence of chloride within the fibres. Evidence is given for the localization of sodium within the sarcoplasm and the existence of a second membrane, presumably that of the myofibril, which can, under certain conditions, show permeabilities differing from those of the sarcolemma.

V. B. Wigglesworth has induced moulting in decapitated nymphs of Rhodnius by implantation of the brain removed from other nymphs during the 'critical period'. Implantation of the corpus allatum and sympathetic ganglion gave negative results.

When a small quantity of coarsely sifted wholewheat flour in a beaker is seeded with eggs of the flour beetle and conditions favourable to development are maintained, J. Stanley finds that the surface of the flour gradually assumes a distinctive form. The effect appears to be due to radial movement of the flour.

By the introduction of certain relativistic convergency factors, G. Wataghin deduces the condition for the rules of the ordinary quantum theory to hold, and examines these conditions by an independent method.

S. Tolansky criticizes the hyperfine structure measurements in the iodine spark spectrum published by Th. Schmidt. It is suggested that a quadrupole quadratic interaction formula might be converted into a cubic formula, as a result of configuration interaction.

RESEARCH ITEMS

Finger Weaving in Canada

The question whether the brightly coloured sash and garters of the Indians of Canada are of native origin and whether finger weaving, which they involve, is a pre-Columbian technique or an introduced feature which adapted itself to new surroundings, is considered by Marius Barbeau in "The Assomption Sash" (National Museum of Canada: *Bull.*, 93, *Anthrop. Series*, **24**; 1939). The Assomption and Achigan sashes are so called from their place of manufacture as a home industry of the French Canadians for the fur traders of Montreal to barter with the Indians. They were also known as arrow sashes from their pattern, which includes a row of continuous arrow heads; and although there were others known by appropriate names, the arrow sash became the standard type, when the Hudson Bay Company nearly forty years ago began to import a cheap manufactured sash from England, as it does still; this ruined the home industry, and attempts have been made recently to revive it. Research directed to the character of the older sashes preserved in museums in America and Europe, and study of the technique of finger weaving and its distributions has failed to produce evidence of its practice in Europe, which would account for its introduction into Canada in Colonial days. The Indians when they wore belts—and this seems to have been exceptional before 1800—were strongly under the influence of the French; but there is no evidence of finger weaving in France, or elsewhere in Europe, except only in Norway and possibly Lapland, where finger woven garters are made. It is possible that it was a traditional handicraft in other European countries and has been forgotten. The alternative would seem to be that it was, as demonstrated by Wissler and Amsden, a type of weaving widely diffused in prehistoric and historic America, which was adopted from the Indians and further elaborated by early French colonists.

Periodicity of Influenza

Various attempts have been made to determine the periodicity of influenza epidemics. If this could be done, it would be possible to foretell when an epidemic might be expected and to take some measure in advance for dealing with it. Brownlee in 1919–23 accounted perfectly for the outbreaks from 1890 to 1895 on the basis of a 33-week cycle, but this 'one phase' theory failed for the series of waves after 1895. Douglas Webster now claims that by adopting a 'two phase' theory, the epidemic waves of influenza may be accounted for (*Edinburgh Med. J.*, 46, No. 9, 591). The standard period is 33 weeks, with a ± 3 weeks' variation (phase 1), though missed periods often occur. Sixteen to seventeen weeks after the peak of a phase 1 major epidemic, a phase 2 minor epidemic is likely to occur and to be repeated every 33 weeks or thereabouts; that is, a major or minor epidemic tends to occur every 16 or 17 weeks with occasional misses. On this basis, all the epidemics from 1918 to February of this year appear to be accounted for, and a major epidemic is due in February, 1941, with a phase 2 epidemic of some severity in February, 1940.

The Panama Canal as a Fish Highway

Has the opening of the Panama Canal enable fishes from the Atlantic Ocean to enter the Pacific or vice versa? There is the difficulty of negotiatin the locks, and the greater difficulty for most o enduring a journey of forty miles through the fres water between the locks at the opposite ends of th Canal. Samuel F. Hildebrand to some extent answer the question in his account of the fishes which hav been found throughout the Canal and the invertebrates which inhabit the various locks (*Zoologic* 24, 15; 1939). He finds that while the locks do no form serious barriers, the difference in salinity doe and that as a consequence the fishes which occu beyond the sea-locks and are most likely to complet the journey from ocean to ocean belong to specie which inhabit almost indiscriminately salt, brackis and fresh water. These include the gobies or guavina several species of Centromorphidæ and Gerridæ, few species of burros (Pomadasys) and the tarpo Indeed the tarpon has been known to have traverse the Canal from Atlantic to Pacific on at least fou occasions. The locks shelter a varied invertebrat fauna, which includes sponges, Hydrozoa, Alcyonari Mollusca, crabs and shrimps, and these may help to sustain the migrating fishes during part of their journey

Evolution of a Sun-fish

The disk-like shape, excessive lateral flattenin and abbreviated body of a sun-fish are so unusu that special interest attaches to the elucidation the stages by which such an oddity arose. Some yea ago (1933), W. K. Gregory suggested a probabl evolution based upon skull characters; now Henry Haven, convinced that other parts of the anatom may be traced in evolution as well as the skull, h arranged what approximates to an evolutionar series illustrating the development of the locomot apparatus (*Bull. Amer. Mus. Nat. Hist.*, 76, 143 Sept. 1939). The series runs from a normal perc morph fish, the striped bass, to the acanthur Hepatus, the trigger-fish Balistes, the porcupine-fi Diodon, and by way of a hypothetical intermedia stage to the nipple-tailed sun-fish, Masturus. A lar plate illustrates very strikingly the modifications musculature and fin-arrangement which lead to t sun-fish, perhaps the most remarkable change bein the loss of a tail fin and the formation of a new pseudo-caudal fin by extension of the dorsal and an which meet around the caudal end of the vertebr column. It is surprising to learn that the characte of the alimentary tract indicate that sun-fishes a bottom-feeders, that the skin, skeleton and the lo of the air-bladder suggest that they live in de water, and that the form of the fins with the powerful muscles indicates an active existence.

Trichinosis in Pigs

An extensive survey of pigs in eastern Canada h been carried out in 1937 and 1938 with the view determining the incidence of *Trichinella spiralis*. samples were selected at random and no selecti was made, except that samples were examined on from hogs of which the district of origin was know (*Canadian J. Research*, 17, Sect. D., 151, 193

. W. M. Cameron finds that of 2,000 hogs examined, ly 15, or 0·75 per cent, were infected. In the nited States during the same years the Bureau of nimal Industry reports in 1937 an infection of 3·4 r cent where the hogs were fed on garbage and 32 per cent where they were not fed on garbage, e corresponding figures for 1938 being 10·0 per nt and 1·0 per cent. In Canada the feeding of hogs on uncooked garbage is prohibited, and Cameron's gures agree closely with the corresponding statistics om the United States. There seems little doubt, erefore, that the majority of pigs infected with ichinosis in North America owe their infection to eding upon raw garbage. Where garbage has been oked before being served to the pigs, the incidence the parasite falls to a level similar to that associated ith clean food.

ultiple Allelomorphism in Cotton

R. A. Silow (*J. Genetics*, 38, 229–276; 1939) has vestigated further the multiple allelomorph series verning leaf-shape in cotton, which now includes o further members, one from *Gossypium anomalum* d a strain of *G. arboreum*. The author shows that e two pairing complements which influenced leaf-ape (lobe- width and length) are controlled inde-ndently by the genes. In regard to lacination, the der of genes is $L^l - L^a$ and $L^a - L - l$, and in regard to be-width $L^l - L^a$ and $L - L^a$ and l. It is suggested that e gene is compound with two gene centres con-olling lacination and lobe width respectively. th field and mutant allelomorphs exhibit a similar gree of partial dominance, a situation which is ought to be different from the previously accepted minance relationships. Theories relating to the ture of gene action and dominance are discussed, d a theory is put forward that dominance is a nction of the interaction of allelomorphs, dependent on the possible expression of the particular aracter, and also upon other genes working to the me effect.

igin of the Duke Cherries

It has been suggested that the Duke cherries $n = 32$) are hybrids of the diploid sweet cherry $n = 16$) and the sour cherry ($2n = 32$). Again some ve thought that the Duke cherries are tetraploid rms of the sweet cherry. K. Hruby (*J. Genetics*, , 125–132; 1939) has investigated the problem by alysing the meiosis of the Duke cherries and of eir triploid hybrids with the sweet cherry. In ace of bivalents, as in the sour cherry, a high pro-rtion of quadrivalents are found in the Duke erries and 100 per cent trivalents are found in e third of the meiotic cells of the triploid hybrid. is provides strong evidence that the Duke cherries e auto-tetraploids of the sweet cherry.

ructures of Diacetone Dulcitols

Pizzarello and Freudenberg in 1930 proposed uctures for the two diacetone dulcitols (originally scribed by Fischer in 1915) in which they were presented as enantiomorphous, the α-compound ing 3, 4 : 5, 6-diacetone dulcitol and the β-compound 2 : 3, 4-diacetone dulcitol. The absence of optical tivity and the ready separation of the two com-unds by fractional crystallization, as well as other operties, are strongly against the structures proposed by Pizzarello and Freudenberg, and R. M. Hann, W. D. Maclay and C. S. Hudson (*J. Amer. Chem. Soc.*, 61, 2432; 1939) have now shown that the two compounds are structural isomers. The β-diacetone dulcitol is 2, 3, 4, 5-diacetone dulcitol, a *meso*-form. The α-diacetone dulcitol is 2, 3, 5, 6-diacetone-D, L-galactitol, a racemic form. A cyclic acetal shift was shown to be the cause of the unusual changes noticed by Fischer and Bergmann in the acylation of α-diacetone dulcitol, which corresponds with the passage of 2, 3, 5, 6-diacetone-D, L-galactitol to 1 : 6 dibenzoyl-2, 3, 4, 5-diacetone dulcitol.

Palladium-Deuterium Equilibrium

In continuation of the measurements of the isotherms for the absorption of hydrogen by palladium made by Gillespie and Galstaun (1936), the corresponding system with deuterium has been measured by L. J. Gillespie and W. R. Downs (*J. Amer. Chem. Soc.*, 61, 2496; 1939). The results with hydrogen were confirmed, and a series of isotherms for deuterium and palladium black was obtained from 200° to 300°, including a critical point at 276°, 35 atm. pressure and 0·25 atom D per atom Pd. A reluctance in forming the second solid phase was overcome by pretreatment with hydrogen. For a given temperature and pressure the absorption of deuterium is less than that of hydrogen; horizontal lines appear in the deuterium isotherms at pressures 2·3–2·5 times the pressures of the corresponding hydrogen horizontals. The locus of compositions of coexistent solid solutions in the phase diagram is smooth and continuous without rising steeply at any simple atomic ratio; hence it is concluded that no palladium deuterides exist in the region above 200°. As the composition of the second solid phase is practically Pd$_2$D at 200° (like the hydrogen system), further work at lower temperatures might show the existence of this compound.

Structure of Glaciers

M. F. Perutz and G. Seligman (*Proc. Roy. Soc.*, A, 172, 335; 1939) have investigated the transition of granular compacted snow (firn) into glacier ice, and the mechanism of glacier flow. The experiments were conducted on the Great Aletsch Glacier and formed part of the work of the Jungfraujoch Research Party of 1938. Samples of the glacier were taken and the size, shape and orientation of the crystals determined by the methods of optical crystallography. It was found that during the transition of firn into glacier ice the crystals grow largely by the refreezing of melt water retained in the capillaries. The firn crystals are largely oriented with their hexagonal axes normal to the glacier surface—this is ascribed to the influence of the temperature gradient present during refreezing or sublimation. In the course of 6–8 years, the crystals assume random orientation, and it appears that in the firn region there is no laminar flow, and that the motion of the glacier is due to haphazard motion of small crystalline units. This was shown by observing rows of indicating pins in pits and crevasses. In the ice region lower down the glacier both laminar and non-laminar flow occur. The crystals again become partly oriented with axes normal to the direction of flow, and the size of the crystals increases. The phenomenon is compared to the rolling of a metal sheet—it involves the growth of crystals in certain favoured orientations and their deformation by gliding.

WORK OF THE ARCHÆOLOGICAL SURVEY OF INDIA*

SIR LEONARD WOOLLEY'S report on the archæological survey of India is a comprehensive document covering in some detail the large number of problems which presented themselves to its author during his three months' stay in the country, and is characterized by a frankness of statement and freedom of criticism unusual in an official publication. It is, however, clear that with issues vital for the future of archæological studies and of interest not to India alone but also to the whole body of scholarship concerned with the scientific investigation of past civilizations, the situation necessitated plain speaking. As Sir Leonard points out, moneys from a reduced allocation from public funds were being wasted by misdirection, evidence was being destroyed through ignorance, incompetence or lack of training, and at the same time not only was no attempt being made to remedy lack of knowledge of India's cultural history or fill in the gaps in the archæological record, but also the very existence of these defects was barely realized.

The original terms of reference upon which Sir Leonard was invited to report by the India Office in March 1938 covered the most promising sites or areas for excavation; the best methods for the speedy and fruitful development of exploration activities in general, regard being had not only to Government but also to non-official agencies, such as universities, learned societies, etc.; the best method of training or selecting officers for exploration work; and finally, any general points bearing on the field of exploration and excavation not covered in the preceding.

This formulation of the problem of archæological exploration in India obviously leaves something to be desired; and Sir Leonard was unlikely to overlook its defects as the charter of any commission he could undertake. He had in mind, of course, the report of the Museums Association on the museums of India. He pointed out to the India Office that matters coming under the head of "general points" might well be of crucial importance, such as the character of the museums available for the custody of antiquities, finance, the capacities of the staff, and the like. He was assured that the more complete the report, the more it would be welcomed.

Sir Leonard began his study of the situation with some knowledge of the conditions which placed difficulties in the way of "fruitful development of exploration activities". On further examination, however, he found that his impression, gathered from the printed reports, that the unfavourable comparison of the work of the Department with that prior to the departure of Sir John Marshall in 1931 was due to financial stringency was entirely erroneous. After his inspection, he was forced to the conclusion "that the lack of money is not the principal reason for the setback in the progress of archæology in India . . . an increase in the grant unaccompanied by other changes would actually do more harm than good, for the truth is the Department is altogether lacking in men trained for the work they have to d Everywhere plenty of enthusiasm, intelligence an learning were encountered; but experience and trai ing were lacking and for this the members of th staff were not to blame."

In regard to the staff, it is further pointed o that owing to the lack of differentiation and specia ization, each member is expected to be a supe man: he is expected to be proficient in the work conservation and excavation, may at any time put in charge of a museum, and is in addition saddle with a mass of clerical work for which he has n special qualifications. Not only is differentiation i function essential, but also the training and tuitio required cannot be obtained within the departme as at present constituted. For this and other reaso Sir Leonard recommends the appointment of temporary adviser on archæology, who could de with all the points at issue.

Sir Leonard then proceeds to expand this gener criticism and to put forward his recommendatio in several chapters of his report, each dealing with so specific aspect of the situation—sites for excavation excavation by non-Government bodies, the selectio and training of officers, the work of an archæologic department, excavation museums, general, an finance and personnel.

Apart from criticism of the work of the Depa ment, the brief survey here given of the present sta of archæological knowledge of India's past is illum inating. By 1931 the work at Taxila on the Bh mound had thrown a little light on the few centuri preceding the Christian era, and Sirkap had do much for the Scytho-Parthian period. The religio monuments of the Buddhist age between the seco and fifth centuries A.D. had been well exemplified the north-west, and stray monuments of the Maurya and Gupta period had been brought to ligh Mohenjo-daro and Harappa had illustrated richly o phase of a culture about which no one could agr whether it was or was not Indian; and between and Asoka, the next of which anything at all w known, there was a gap of two thousand years blank ignorance. Of the cultural history of Ind not even the skeleton existed, and even for tho periods which may be called historical the sequen of cultural history was quite unknown. From coi and scattered inscriptions there had been construct a regnal sequence to serve as a framework of histor but that was all, and in any excavation it w impossible, unless coins or dated inscriptions we forthcoming, to fit to that framework such discoveri as might be made.

As further evidence of the little prospect of advanc ment of knowledge, reference is made to the absen of the surest basis for the establishment of a chron logical scheme of cultural history—the study pottery. Except for the pottery of the Indus cultu no information is available, and a pottery type cann be dated within a thousand years. In South Ind the position is even worse. Of the two, or possib three, phases of 'prehistoric' culture, not even t sequence or time relation has been ascertained, a

---

* A Report on the Work of the Archæological Survey of India. By Sir Leonard Woolley. Pp. ii+47. (Simla: Department of Education, Health and Lands, n.d.)

: the positive date of objects of clay, iron and ronze be demanded, the answer must allow of a argin of error of anything up to three thousand ears. Of the minor arts of the historic period othing is known at all; between 'prehistoric' and istoric there is no correlation, and so far as cultural istory is concerned, 'prehistory' may be said to ontinue to the sixteenth century A.D.

After such a scathing indictment of wasted oppor- unity, almost any recommendation would probably e acceptable; but Sir Leonard, while indicating here and on what considerations operations in the eld might be extended, wisely counsels that in resent conditions increased expenditure on excava- ion would be harmful rather than a benefit, until he work of the Department has been placed on a ound basis.

Except in so far as they are directed to ensure he increase of archæological knowledge in accordance ith scientific method, Sir Leonard Woolley's recom- endations in detail are the concern of the admin- strative authorities of the Government of India, ather than of interest to archæologists at large. In iew of Sir Leonard's long experience and his wide nd profound knowledge of the problems of archæ- gical exploration, it may be accepted that his ecommendations are such as to secure that the rchæological staff shall be fully efficient to carry on xcavations on sites chosen for their anticipated ossibilities of advancing knowledge, in co-operation with a museum service also working to that end, the service being equipped and organized in such a manner as to afford facilities for the training of future officers; while the curtailment of unnecessary and wasteful activities, especially in misdirected conservation, will avoid excessive increase in the Department's budget. One recommendation to which heartfelt welcome will be given outside India is that for the appointment of two specially qualified officers to deal with the earlier prehistoric period, namely, the stone ages.

Of wider general interest are the sections of the report which deal with excavation by bodies other than the Survey and by organizations from outside. Much disappointment has been expressed in one quarter and another that enlargement of the provisions of the Antiquities Law has failed to attract non-official excavation. Sir Leonard rightly points out that the responsibility is to be laid on a law which, liberal as it is in form, allows no prescriptive right to the excavator of a share in the finds, but leaves this open as a matter of interpretation. This and other matters, including training in excavation for officials by reservation of the right of the Department to attach one of its officers to an expedition's personnel, are covered by amendments to the law here suggested. Provision for early publication is also made; while the importance of early publication in accessible and suitable form at a reasonable price by the Survey itself is strongly urged.

THE INFORMATIVE CONTENT OF EDUCATION

THE second report of the Committee of the British Association appointed to consider the aps in the content of education to which Mr. H. G. Vells directed attention in his presidential address to ection L (Education) at Nottingham was presented at he Dundee meeting. The first report revealed a eneral agreement that Mr. Wells's suggestions were o wide in scope and too advanced for the capacity f the pupils concerned. There were, however, ifferences of opinion, and the present report shows answer to inquiries by the committee the sults attained by school-teachers in the studies ommended by Mr. Wells. He, of course, when ddressing the Association, used grown-up language itable for his audience but not for children of the ge of 7–11 years. It is clear now that much of the formation he wished to see taught can be learnt nd might be acquired with advantage by young ildren.

The results here noted and tabulated by school- achers are very promising, in view of the small ortion of time available for such teaching, and it is ally important. We are not getting at present nything like the return we are entitled to expect om the vast sums spent yearly on education, and is criticism applies particularly to science and such lied subjects as geography, which reaches out on ne side to history and on the other to scientific search. Though experts may differ as to the way which geography should be taught, every one will gree that small children should learn to understand d use maps, so that they can find their own way bout with confidence and help others, when ques- oned, by intelligent replies.

Nature study, so far, has had but poor results, though a host of useful books are available. One thing is evident: young children must, whenever it is possible, have the actual objects used before them. The plot of ground designed by one school for study is an excellent idea. Here "the course is recreative rather than formal, but at the same time special studies are made where accuracy is insisted on". The comment shows the survival of the view that education must be carefully dissociated from amusement. Biology for the young is not easy, and is perhaps best taken in connexion with personal hygiene. Many friends of education have long been convinced that too much is attempted in the curriculum of to-day. Thus the "Civics Course" of one school reminds us that in Russia this subject with a pronounced tinge of 'red' was forced on schoolmasters, who repudiated it and went back to teaching on the old lines. Here at least, in Mr. Wells's requirements, we are concerned with practical knowledge promoting good health and the pleasure and utility of good observation for all children. The juvenile standard of intelligence in this way in children in Great Britain is not equal to that shown by foreign children. Knowledge of other lands and ways of life is rightly emphasized. The sort of patriotism which declares that your own country is the only one which is right is out of date.

The juvenile sections of free libraries should be a great help and more useful, as implying effort, than B.B.C. talks. In general, the schemes of work printed are excellent, but a pertinent question asked is: How can the teacher find time or opportunity to keep up with all this, especially when he is confronted with the very wide method of stimulus known as 'encyclopædia work' practised in a London junior school? The observations on the junior schools note many omissions in science. Even if we agree that some of Mr. Wells's ideas are beyond young folks, some of the simpler work is disappointing; in elementary physiology, for example, questions about seeds and animals. The senior schools do not supply many records, but those given are elaborate enough to suggest the need for real refresher courses for teachers. Interest in science of some sort may be regarded as universal. Unfortunately it is not, and where teachers lack interest they are not likely to provide the stimulus which leads to permanent keenness in their pupils.

EDUCATION AND INDUSTRY

THE discussion on education as a preparation for industry which followed Dr. A. P. M. Fleming's presidential address on education for industry to Section L (Educational Science) of the British Association, delivered on August 31, was opened by a paper, read in his absence, by Mr. W. O. Lester Smith, director of education of Manchester, who stressed the importance of a sound general education and the significance of Hadow reorganization. Our educational neglect of the adolescent has led to wastage of human material. The wanton blow struck at the day continuation school clauses of the Fisher Act by the 'Geddes Axe' was probably the unkindest cut our educational system has ever suffered; it has prevented local authorities from making a satisfactory job of the youth problem.

Discussing the organization of technical education, Mr. Lester Smith referred to the value of regional co-operation and the necessity for a constant revision of the subject-matter of technical education to meet the needs of a competitive and scientific age. Although the Trades Union Congress adopted a cautious attitude to some modest suggestions in the Spens report for the infusion of technical teaching into the later stages of the secondary school curriculum, there are signs of a change in outlook. Employers are more disposed to see value in general education, and teachers are appreciating more fully the additional interest which an occupational bias can give to the last stage of school life. There is no strong evidence, however, in the post-graduate work in universities of a desire to assist industry to grapple with new problems. Industry as a career is regarded as a side-line, and industry and commerce will continue to rely mainly for its personnel, both leaders and rank and file, upon the less academic institutions and schools administered by local authorities. Finally, Mr. Lester Smith referred to the importance of facilities for training technical teachers and providing for the adequate dissemination of knowledge of new processes or of the achievements of research.

Sir Richard Gregory described opportunities open to apprentices at Portsmouth dockyard, while Dr. K. Fisher, headmaster of Oundle School, referring to the criticism of public schools that they give their pupils no chance of contact with the rest of the youth of the country, suggested that compulsory national service may remove that disability. Public schoolboys and other youths may thus become conscious of a common bond. Moreover, employers are increasingly anxious to find public schoolboys to enter their service.

The allied discussion on education in industry, which followed on September 1, was opened by Mr. J. D. Langmuir, who emphasized the responsibility and obligation of all who employ young workers to see that they have adequate practical and technica training to suit their abilities. The narrow specific workshop or office training should be provided by the employer, but the responsibility for technical training should be shared with those responsible for education There is little or no organized and systematic workshop training in Scotland, and the position of technica education is equally unsatisfactory. There has been no co-operation between education and industry, and real progress in technical education is impossible in its absence and until employers take more interest in both day-school and technical education.

After criticizing both Scottish day-school and technical education, Mr. Langmuir advocated a bolder policy of grading, which would give the pupi free choice of a course suitable for his occupationa desires. A boy with an occupational objective is more likely to remain to obtain the certificate which would facilitate entrance to his chosen career. Education should be less bookish; attempts to convert secondary schools into miniature universities resisted Supporting the idea of the junior technical school, he pleaded for closer co-operation with industry on the lines of the Edinburgh continuation class scheme He stressed the obligations of employers for technical education of young workers and the limitations of works schools, and he also discussed the possibilities of introducing day continuation classes. Before this is possible, he said, leaders of industry and commerce must recognize the importance of such education. In technical education we are far behind Belgium Denmark and Germany, and the provision of a well thought-out scheme of technical education for the rank and file of our workshops and commercial houses is long overdue.

A written communication by Mr. G. L. Darbyshire of the London Midland and Scottish Railway, which was read by Dr. Fleming, described the methods o recruitment and qualifications required for engagement by that company, as well as the training arrangements, both internal and external. In addition to classes for instruction in such special branche as block signalling, locomotive working, permanen way maintenance, etc., and lectures on special problems arranged internally, the staff are encouraged to proceed in further education. Films as well a departmental publications are used freely for instructional purposes.

Discussing part-time education outside the works Principal J. Cameron Smail, of the Heriot Wat College, Edinburgh, referred to the strain on individuals involved by part-time education in evenin classes, although the results have justified the method The outstanding results achieved with day classes i the dockyard scheme, however, have shown th possibilities of a daytime system for educated students; the psychological value of the sandwich system is also insufficiently appreciated and merits further investigation. Principal Smail referred to the danger of taking too narrow a view of technical training, to difficulties of staffing and equipment and to the importance of full contact between teachers in technical schools and current workshop and factory practice.

Dr. F. J. Chapman, of the Board of Education, stated that the most urgent educational problem before industry in Great Britain at present is the training of craftsmen. For craftsmen, as well as for technologists and managers, training involves the learning of techniques, the acquisition of skill and the study of technology. The main problem in the first is the apportionment of the training required between systematic instruction in schools on one hand and practical experience on the other; and in regard to the second, the best methods of co-operation between industry and educational institutions.

Mr. S. E. Goodall described the form of apprenticeship developed by the Metropolitan-Vickers Electrical Co. Ltd., while the concluding paper, by Prof. Willis Jackson, dealt with post-advanced education. During the past few years, provision for post-graduate practical training has been considerably extended, and on the electrical side of engineering practically every firm of note has now introduced a scheme of post-graduate apprenticeship. In exceptional circumstances only are graduates recruited direct to technical or other positions. It is now widely recognized by industrial concerns that the primary function of university courses in applied science is not to provide them with ready-made specialists, but rather to develop the ability to think deeply and critically in terms of those fundamental principles which underlie all the specialized branches of a particular applied science.

One of the advantages of the post-graduate apprenticeship system lies in the opportunity it affords for the acquisition of general engineering knowledge as well as specialized information. The ability to acquire information by such independent effort is one of the greatest assets which a man can possess, and one which our educational institutions should seek to develop. In this connexion, the recent development in local areas of post-graduate courses of instruction—termed post-advanced courses, since they also serve the needs of men who have proceeded through part-time evening courses to Higher National Certificates—of a specialized technological character appropriate to the industrial needs of those areas, is of special value. Prof. Jackson outlined certain of these courses and stressed the educational significance of the success and extension of such schemes.

WORK OF THE FORESTRY COMMISSION

IN the nineteenth annual report of the Forestry Commission for the year ending September 30, 1938 (London: H.M. Stationery Office, 1939), there are some interesting particulars on private forestry. Seven eighths of the woodlands in Great Britain, it is stated, are privately owned.

Early in 1938 the Commissioners commenced a census of all private woods, a field staff of sixteen being employed on the work. This undertaking was being carried out by trained men, data regarding area, type, age, condition, species, volume by species and girth classes of each unit of woodland being recorded. So far, 613,000 acres had been dealt with. Although the visits of Government officials on private estates are never greeted with unmixed approval, yet it may be said for this piece of bureaucratic work that the results aimed at justify the means adopted. Both in the national interests and in those of the private owner the information obtained will be invaluable. Many private owners of woodlands were aware that their property of this type was by no means yielding an adequate return; whilst a considerable percentage, through neglect and ignorant management, brought in no return whatsoever. The remission of taxation of young, properly grown woodlands which cannot in the nature of things bring in any return to the planter until they have reached a marketable value—usually a certain dimension—is understandable and mere justice. But there appears little justification to grant remission of this type on areas of poor and neglected woodland the marketable value of which is nil. From statements in this report and articles in the Press, it is evident that landowners have become alive to this problem and are endeavouring to come to an understanding upon a broad forest policy to be followed. That this is a necessary preliminary step is demonstrable. For when all is said and done, as the Continent of Europe well shows, the policy of a State forest department is not in all particulars adapted to the private owner; and is often quite impracticable for such.

The report has some interesting remarks to make upon amenity, the New Forest, and national parks, all of which have already been noted in NATURE.

The total addition to the woods of Great Britain through the operations of the Commission during the year under review was 20,300 acres, approximately 54 million trees being planted; of these, 47 per cent were Norway and Sitka spruce, 24 per cent Scots and Corsican pine, 9 per cent European and Japanese larch, 1 per cent Douglas fir and 16 per cent broad-leaved species.

The public, through the Commissioners, owned 125 forests in England and Wales and 107 forests in Scotland. The total area afforested during the nineteen years of the Commission amounts to 365,000 acres. Some of the earlier planted areas are now having the first thinnings made in them. The total area now controlled by the Forestry Commission in Great Britain amounts to 1,100,000 acres.

The year under record had some dangerously dry periods in it, commencing as early as late February in parts of Great Britain. Consequently the fire danger and damage were serious, being the worst year on record for the Commission except for 1929. The Commission attributes the damage done to railways and the general public.

SCIENCE NEWS A CENTURY AGO

G. T. Vigne's Travels in Central Asia

AT a meeting of the Asiatic Society on November 2, 1839, the director, Prof. Horace Hayman Wilson (1786–1860), introduced the traveller Godfrey Thomas Vigne (1801–63), who had recently returned home from India after a journey of seven years during which he had passed through Kashmir, Great and Little Tibet, the Punjab, Kabul and other regions, some of which had never been visited by any European, or at least had never been fully described.

After referring to the travels of the Jesuits, of Foster, Moorcroft, and Jacquemont, Prof. Wilson said, "the country north-east of Cashmere is quite new ground, and the visit of Mr. Vigne to Iskardo cannot fail to be of very great interest. His observations in that quarter will add very materially to our knowledge of the geography of that lofty region, and to that of the course of the Indus, from the frontiers of Ladakh to its issue upon the plains of India. It was to be regretted that Mr. Vigne had not been able to visit the district of Nobra and to trace the course of the Shayuk, from its confluence with the Indus to its source, but he had visited a good deal of the lower part of this northern branch, and had accurately traced the main body of the river on the west of Iskardo, to where it turns to the south, and breaks through the mountain barrier which opposes on that side. The hill States of Chambra, and others on this quarter, had also been visited for the first time; and the knowledge thus obtained had enabled us to complete the geography of the upper part of the Punjab".

Three weeks later, on November 25, Vigne gave an account of his journeyings to the Geographical Society.

Duty of Steam Engines in Cornwall

IN its issue of November 2, 1839, the *Athenæum* reviewed the "Historical Statement of Duty performed by the Steam Engines of Cornwall" compiled at the request of the British Association by Thomas Lean and Brother.

In its remarks on the statement, the *Athenæum*, after referring to the work in Cornwall of Savary, Newcomen, Smeaton and Watt, and of the improvements made, said: "Yet it is wonderful how slight is the effect which the experiments of this remote county have produced on the practice of the other parts of the mechanical world, and especially of Great Britain. While the world teems with idle projects of ridiculous 'improvements' . . . and while every one of these finds its devotee and dupe, it is truly wonderful, and most melancholy, that the simple, but very important practical truths, provisions and maxims, so well known, and so ably practised, by the Cornish steam-engineers, have made their way so slow among their fellow countrymen—truths, whereby power is obtained and economized, and fuel saved, to a greater extent, in every day's practical experience, than had been imagined possible, even by the most wild and ignorant schemer. Yet these great results have been obtained by the Cornish engineers, not from any complex or intricate mechanism—not from any patent or secret process—not from any great discovery or invention—but from the quiet and unpretending application of the best known and most common-place truths to the common steam-engine."

UNIVERSITY EVENTS

CAMBRIDGE.—E. S. Shire, of King's College, has been appointed University lecturer in physics.

B. G. Wilkinson, of Downing College, has been appointed to the Frank Smart Studentship of botany.

LEEDS.—The West Yorkshire Coal Owners' Association is renewing its donation of £1,000 a year to the Mining Department of the University for a further period of seven years.

LONDON.—The title of reader in chemistry in the University has been conferred on Dr. Fred Barrow, in respect of the post held by him at Birkbeck College.

SHEFFIELD.—Dr. A. H. Lamberton has been appointed assistant lecturer in chemistry.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT MASTER (GRADUATE IN ENGINEERING) in the Consett Secondary School and Technical Institute—The Director of Education, Shire Hall, Durham (November 8).

PSYCHOLOGIST (EDUCATIONAL AND MEDICAL) in the Child Guidance Centre and for the Mental Hospital of Sunderland County Borough—The Medical Superintendent, Cherry Knowle Hospital, Ryhope, near Sunderland (November 9).

ENGINEER SUB-LIEUTENANTS (two) in the Royal Indian Navy—The Secretary, Military Department, India Office, Whitehall, S.W.1 (quoting R.I.N. Recruitment) (November 14).

TEMPORARY FORECASTERS, GRADE II (MALE) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

TEMPORARY METEOROLOGICAL ASSISTANTS (MALE) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.J., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1938–1939. Vol. 59, Part 2, No. 22: Integration of a Certain System of Linear Partial Differential Equations of Hyper-geometric Type. By A. Erdélyi. Pp. 224–241. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1*s*. 6*d*. [610

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 10: Chlorine. Pp. v+7. (London: H.M. Stationery Office.) 3*d*. net. [910

Historic St. Andrews and its University. By Prof. John Read. Pp. 80+7 plates. (St Andrews: W. C. Henderson and Son, Ltd.) [910

Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1939. Pp. 20. (Kirkhill: Hannah Dairy Research Institute.) [1110

Other Countries

The Rockefeller Foundation: International Health Division. Annual Report, 1938. Pp. ix+233. (New York: The Rockefeller Foundation.) [410

South Australia: Department of Mines. Mining Review for the Half-Year ended 31st December 1938. (No. 69.) Pp. 107+4 plates. (Adelaide: Government Printer.) [910

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), January to June 1938 (No. 792.) Pp. ii+148. (Ottawa: King's Printer.) 50 cents. [1010

Department of Agriculture, Fiji. Annual Bulletin of Divisional Reports, 1938. Pp. iv+106. (Suva: Government Printer.) 2*s*. 6*d*. [1010

The Future of Medicine. By Baidya Nath Charan Roy. Pp. iv+18 (Calcutta: The Author, 7 Loudon Road.) [1110

Annual Report on Forest Administration in Malaya, including Brunei, for the Year 1938. By J. P. Mead. Pp. iii+87. (Kuala Lumpur: Government Press.) 1 dollar; 2*s*. 4*d*. [1110

Indian Forest Records (New Series.) Utilization, Vol. 2, No. 1: The Formation of Growth Rings in Indian Trees. Part 1: (a) Chir (*Pinus longifolia*), (b) Cutch (*Acacia catechu*), (c) Jaman (*Eugenia jambolana*), (d) Laurel (*Terminalia tomentosa*), (e) Sal (*Shorea robusta*), (f) Semul (*Bombax malabaricum*), (g) Teak (*Tectona grandis*). By K. Ahmad Chowdhury. Pp. iv+40+8 plates. (Delhi: Manager of Publications.) 2.2 rupees: 3*s*. 6*d*. [1110

Editorial & Publishing Offices
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, NOVEMBER 4, 1939 No. 3653

SCIENCE MEETINGS IN WAR-TIME

WAR conditions, though they may make unprecedented demands on our scientific know-dge and technical skill, throw us, in some of their spects, back to simpler ways of living and to the se of more primitive appliances. The horse has ome into his own again; venerable carriages, earers of long-forgotten names—who, in this wentieth century generation, can readily disinguish between barouche, victoria, cabriolet and hisky?—appear in provincial streets and country ads, astonishing all but the oldest inhabitants; nd we find new merits in the performances of luly-shaded) hurricane lamps and wax candles. railway journey, prolonged after sunset, adds a ew terror to life for those of us who are not ontent to sit and think. We look back with somehing of envy to those spacious days when our randparents travelled luxuriously and read in omfort by the light of some candle-bearing conraption which could be hooked to the back of a ailway-carriage seat. Meetings, even in neutral nd reception areas, are not to be attended without ue consideration of the perils associated with a ourney through 'blacked-out' streets.

Nevertheless, it is a matter of no small imporance that our scientific societies, restricted and e-orientated as some of their activities necessarily ust be, should carry on their work to the fullest xtent possible under these new conditions of life. hasty and ill-considered cutting-down of work rings many evils in its train. Fellows tend to orget the existence of the society, and its memberhip roll falls off in consequence, the economic ife of certain sections of the community suffers nnecessary and undeserved hardships; the world t large fails to realize that a scientific society can lay as weighty a part in war as in peace. It was ever more important than it is now to conserve and to extend our mental resources; to meet and to exchange ideas; to cultivate a sane and objective outlook on the problems of a world poised insecurely on the brink of chaos.

Travel is difficult; so it was two centuries ago, and provincial towns formed, each for itself, societies for the advancement of learning. Members are scattered; and does not this very fact ensure the presence, in most of our large towns to-day, of men and women sufficiently interested in their different branches of knowledge to welcome an opportunity to exchange views and to seize an hour for the friendly discussion of intellectual problems? Cinemas may be filled to-day—and it is all to the good that they should be—even in evacuation areas; there is little room to doubt that, if the opportunity be given them, scores of scientific workers would welcome the chance to discuss the ever-changing problems of their sciences, and to find, now and again, a period of their day which would be free from the problems of war.

The past has its lessons for the present; material conditions for travel and for social intercourse were more difficult in 1770 than they are now, and we find in consequence that the greater cities of Britain tended each to cultivate a social life of its own, a social life that was dominated, in many instances, by the bearers of names now honoured in our country's history. The intellectual standard of our university towns in that age has not passed uncriticized. Gibbon has told us of Oxford; Byron, at a slightly later period, had some unkind things to say of the Cambridge fellows:

> "Where on Cam's sedgy banks supine they lie,
> Unknown, unhonoured live, unwept-for die:
> Vain as their honours, heavy as their ale,
> Sad as their wit, and tedious as their tale";

Johnson made shrewd thrusts at Scottish learning. But these are partisan views, and an impartial observer will find that the contributions of the university towns of that age to the advancement of learning and to the critical discussion of those advances were by no means unsubstantial. Other towns, as we have noted, made their contribution mainly through one or two families of dominating interests. The Taylors and Martineaus made such a group at Norwich; the Roscoes at Liverpool; and at Birmingham above all, Boulton, Watt, Small, Erasmus Darwin, Priestley and Wedgwood formed a group whose contributions to knowledge were a considerable factor in the development of eighteenth century science.

This group had, as early as the 1760's, formed the excellent habit of dining at each other's houses monthly "to exchange views relating to literature, art and science; each contributing his quota of entertainment and instruction". For the convenience of the members the meeting nights were fixed for evenings as near to that of the full moon as possible. Art had not then provided an effective means for lightening the darkness of the streets and lanes; why not make use of the illumination provided by Nature?

It is no part of our purpose to tell in detail the fortunes of the Lunar Society as it was happily named—it is sufficient to say that many discoveries of the first importance were discussed at its meetings before they were communicated in regular fashion to the Royal and to other societies; that the "learned Lunatics", as Erasmus Darwin styled his fellow-members, helped to finance much of Priestley's work; and that even when the Society, by death and dispersal, had lost most of its members and was moribund, Leonard Horner could say of it, in 1809, that "the remnant of the Lunar Society and the fresh remembrance in others of the remarkable men who composed it are very interesting. The impression which they made is not yet worn out, but shows itself, to the second and third generation, in a spirit of scientifi curiosity and free inquiry which even yet makes some stand against the combined forces of Methodism, Toryism and love of gain."

The spirit of free inquiry has to-day to encounter forces other than those which excited the concern of Horner, and the learned societies of th democratic countries—indeed, of all countries—may even to-day learn something from the zea and unselfishness which informed the work of th Lunar Society. In one small matter they migh very well profit by the return to some of th conditions of life as it was lived in the days of Erasmus Darwin, and hold meetings on nights nea the date of the full moon. If secretaries of th learned societies of London were to consult thei almanacs and maps of Britain, they would surely find times and places favourable for the holdin of informal meetings suited to present-day needs as the Linnean Society is already doing (see pag 778); and the Lunar Society would enter on a new lease of life.

NATURAL AND POLITICAL PHILOSOPHIES

Science and Politics in the Ancient World
By Prof. Benjamin Farrington. Pp. 244. (London: George Allen and Unwin, Ltd., 1939.) 10*s*. 6*d*. net.

IN Plato's City-State, the ruler or lawgivers were held to be justified in inventing or approving useful or pious lies if the best minds were convinced that the community was incapable of understanding the truth. The State had to decide what was good for the people to know and accept, whether relating to governmental legislation or religious beliefs. The right appreciation of truth was regarded as the prerogative of a select few and, as popular intelligence was not prepared for enlightenment, it was inexpedient to teach the masses anything which would disturb either their social complacency or superstitions. Socrates himself, to whom many of the political principles represented in Plato's "Republic" can be ascribed was condemned to die because he would not cease to "corrupt the young" by his teaching; and Galileo might have saved himself from imprisonment by ceasing to disturb the traditional teaching of the Church as to the stability of the earth in the centre of the universe.

It is with repercussions of this kind in the ancient worlds of Greece and Rome that Prof Farrington is concerned in his critical survey of philosophies of science in relation to political action from the period of Thales and Anaximander in the sixth century B.C., through Empedocles Leucippus and Democritus, creators of theories of atomism, which, with Hippocratic medicine, are the two great achievements of pre-Socratic science, to Plato, Epicurus, Lucretius and some theological philosophers of the Christian era. Beginning with appreciative references to the brilliant work of the early philosophers of the Ionian school, who may be said to have founded physical science, Prof. Farrington traces the decline of the spirit of inquiry into the nature of things and attributes it largely to the influence of Platonism. They made few actual experiments, but they understood the difference between theory based upon observations of natural phenomena and metaphysical speculations. Had their spirit not been suppressed because it was not believed to be expedient to politics or religion that the people should partake of the new knowledge, there is no doubt that, within the limits of observation available, experimental philosophy would have made great advances in the ancient world.

The view of the Governments and leaders of thought in the class-divided societies of classical antiquity was that the mass of the people should be guided only with knowledge which was considered to be "wholesome" for the good of the State, and that it was therefore permissible to maintain control through the use of the "Golden Lie". There are many to-day who see in modern science nothing but a disturbing influence which threatens the destruction of all that is worth preserving in civilized life, and regret that its progress has not been strictly impeded. The purpose of suppression of ideas in the ancient world was to secure the stability of a slave State; and the social problems raised by the increase of power by machines and in weapons of war had not arisen. Whatever the consequences, Prof. Farrington maintains that, with the actual progress of knowledge, modern society is unworkable without a wide understanding of the results. He remarks:

> "These considerations reveal to us the further fact that there is a connection between the character of science and its dissemination. In this matter our democracies are at the cross-roads. Either our science must transform itself by the recognition that the history of its development is unintelligible without an understanding of its social origin, that men cannot be adequately trained in applied science without instruction in its social functions; and that the obstacles to the progress of science can be external to it, in the sense that they rise out of the structure of society as well as out of theoretical errors; either this transformation must take place or science must retreat. The future of science is now plainly a political question. Either we must base our civilization more thoroughly on scientific foundations, or we must destroy science itself. Both processes are taking place in the world to-day."

Nearly one half of Prof. Farrington's book is devoted to the social and political, as well as the scientific, implications of the works of the two great classical writers, Epicurus and Lucretius, who carried on the traditions of Ionian natural philosophy, and helped to free the minds of men from the fetters of superstition. In his support of the Ionian tradition, and his advocacy of popular enlightenment, Epicurus was fundamentally opposed to the philosophy of Plato He identified philosophy with a knowledge of Nature, and laid emphasis on sense evidence as the criterion of truth. It was Epicurus who endowed the atom with an element of spontaneity of movement, or "swerve", and he connected this with the idea of the freedom of will in man. He did not invent the theory of atomism, with the precise development of which the name of Democritus, who lived a century earlier, is now rightly associated, but to him must be ascribed the introduction of the element of intrinsic movement, as, for example. in the jump of an electron from one orbit to another, which modern atomic theory has to take into account.

The opposition to Epicurus and his disciples did not arise from these scientific aspects of atomism, but from teaching which would deprive religion of its value as an instrument of political domination. To the Epicurean, the history of man and civilization was part of the natural history of the universe; and it was the specific originality of Epicurus to have defended freedom of the will in man as a product of evolution. Lucretius presented this philosophy with passionate intensity in his "De Rerum Natura". His poem was a protest against the use of superstitious beliefs for political authority and a plea for the rational study of natural events and phenomena. It represented "the last great cry of Greek science, expressing not only its devotion to truth but its devotion to humanity"; and because it was as contrary to the political system of the rulers of Rome as it was unacceptable to the oligarchies of earlier Greece, the Epicurean philosophers were expelled by the Roman Senate in the year 173 B.C. With the birth of Christianity, another element for the regeneration of ancient society came into existence, but physical science had no place in it, and suppression of all knowledge of Nature except that derived from the Hebrew Scriptures prevailed for a thousand years.

Prof. Farrington's scholarly and original survey of the reactions between natural science, religious beliefs and political power is of particular interest at the present time when civilization is in the melting-pot, with these three elements as the main constituents of a compound which, whatever its nature, will have a determining influence upon human evolution for many generations. The social relationships which he submits to critical analysis are those of City-States, but the crucible into which they have now been thrown is that of the world, and all who believe in truth and righteousness as standards of value should contribute whatever is within their power to make the fiery proces through which we are now passing a means o constructing a world organization of society worth of the intelligence of twentieth century civilization.

R. A. Gregory.

ANIMAL PHYSIOLOGY

An Introduction to Animal Physiology
By W. B. Yapp. Pp. xv + 320 + 4 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 8s. 6d. net.

THE quotation from "Through the Looking Glass" which precedes the text of this book gives the clue to its contents.

> "Come, tell me how you live," I cried,
> "And what it is you do."

The author, assuming a knowledge of animal morphology and organic chemistry on the part of the reader, uses these as the basis for the more mechanistic side of comparative physiology, and this in its turn serves to explain the working of the animal body as a whole, its reactions to the outside world, the co-ordination of its vital processes, and its adjustments to the environment in so far as these can be considered from a mechanistic point of view. There are chapters on nutrition, excretion, respiration, effector systems and reproduction, dealing with the working of isolated tissues and organs, and on co-ordination, behaviour and regulation, describing the reactions of the animal as an individual. Each chapter is subdivided on the lines of the Dewey system, so that a subject can be traced either from the index or from the table of contents. This is important, since one chapter may range over the whole animal kingdom and all parts of the animal body. Thus Chapter iv, the effector systems, contains an account of the working of cilia and flagella, pseudopodia, muscles, glands, electric organs, luminescent organs, nematocysts and chromatophores.

All who are concerned with zoological work will welcome the appearance of this book. There is no doubt that it will satisfy a need, both in the schools where biology is taught and in the universities. Its subject-matter is sound and well chosen, and the author has made careful use of the current literature. It is a thoroughly competent piece of work. The criticisms which follow are mostly of a minor character and in no way minimize the value of the book as a whole.

So much material has been incorporated into th book that much of it might consist of lecture notes and it lacks the literary style that makes a boo readable. The first chapter suffers most from thi defect, but in later chapters there is considerabl improvement, as though the author had got int his stride. The subject-matter in the chapter o nutrition is illogically arranged and sometime obscurely expressed. For example, the *physica* side of the process of digestion is neglected unt the whole of the *chemical* reactions have bee dealt with, and after the digestion of protein fats and carbohydrates has been described, an the digested matter has been absorbed throug the walls of the villi, the reader comes to a sectio which begins, "In man and many other mammal the food in the mouth is masticated". Since thi physical breakdown of the food is preparatory t any chemical action, why should not this sectio (1.315) have preceded the other? Moreover, b placing it first, the reader is reminded of the cour of the alimentary canal as a whole, and is bette prepared to understand the chemical section where morphological sequence cannot be followed

Some of the statements are misleading. "I man about a litre of saliva is produced a day. I contains a protein called mucin, and its chief valu is to act as a lubricant". There is no mention o ptyalin in this section (1.31) although the enzyme of the stomach are recorded. Again, "One . . . i called a male or a spermatozoon, and the other . . a female or an ovum" (p. 252). "The vertebrat kidney . eliminates water, nitrogen and man other substances". Such sentences require more accurate presentation of the facts.

So much subject-matter has been utilized tha one hesitates to name omissions. But since mos university students dissect the nerves supplyin the taste buds of the teleost fish, the brief statement on p 209 might be expanded, and Herrick' paper on the gustatory organs of fishes added t the list of references. The inferiority of the sens of smell in man (p. 211) is both physiologic and morphological, yet no use is made of th latter contribution, although sniffing in order t lift the odorous particles above the naso- an maxillo-turbinals (innervated by the trigeminal nerve) to the pocket in which lie the ethmo-turbinals (innervated by the olfactory nerve) is an adaptation which explains the statement that the sense of smell in man is very poor compared with that in dogs and many other animals. Graham's paper on the crystalline style (*Proc. Zool. Soc.*, 109, 1; 1939) probably appeared too late for inclusion, but why is Russell's work on behaviour not mentioned? Also Parson's "Biochemistry" is an almost indispensable companion volume.

The book has been well produced by the Oxford University Press and there are few misprints. Schäfer's name is wrongly spelt on both occasions when it is mentioned, *inhalant* should be replaced by *exhalant* on p. 9, line 17, and Henle has no accent on the final e. There are four plates and forty text-figures, most of which are copied from other authors. Figs. 4 and 40 are poor and inaccurate.

On the whole, however, the book is an admirable effort in a new and rapidly expanding field of biology. We hope the author will now produce a volume of practical exercises in animal physiology.

RACE QUESTIONS IN EUROPE

(1) The Races of Europe

By Prof. Carleton Stevens Coon. Pp. xvi + 739 + 16 plates. (New York: The Macmillan Company, 1939.) 31*s.* 6*d.* net.

(2) The Races of Central Europe

A Footnote to History. By Dr. G. M. Morant. Pp. 164. (London: George Allen and Unwin, Ltd., 1939.) 5*s.* net.

1) IN 1899 W. Z. Ripley produced his classic work on "Races of Europe" and the appearance of a book prepared at his suggestion to bring matters up to date is of considerable importance, especially in these days when race-study is suffering so severely from political perversions. Coon has read very widely and tries to bring together data from archæology and physical anthropology; his syntheses are often bold but always suggestive, and he indicates in several places that evidence on particular points is specially defective.

Coon's broad conclusion is that the present-day biological types in Europe are derived from: (1) a basic *Homo sapiens* related to the remote ancestors of the Mediterranean types; (2) a blend of (1) with some *non-sapiens* form of general Neanderthaloid form; (3) various blends of (1) and (2), all being present and widely distributed in Europe while collecting, hunting and fishing were still the only means of getting food; (4) peoples from Asia and North Africa of Mediterranean types who introduced the arts of food production.

To Group 1 the author considers we should ascribe the Galley Hill skull which he accepts as Middle Pleistocene, the so-called Negroids of Grimaldi, and the male skeleton from the Upper Palæolithic of Combe Capelle, France. They are short, long- and very narrow-headed with a high cranial vault, moderate cheek bones and lower jaws, fairly wide nose and little projection of the mouth. To Group 2 he ascribes the Cro Magnon man and the Solutré skulls among western and west central European types and notes the tallness, the greater width of the head than in Group 1 and the very broad facial development with low orbits and narrow noses. The east-central European variety is again tall and bony but is extremely long-headed like Group 1.

Once he had adapted himself to the cold, in the second phase of the Würm glaciation, man followed the retreat of the ice northwards and there thus came into existence the basic elements of population in north-west Europe, the east-central variety of Group 2 being increasing'y important. Coon looks upon the west-central variety of Group 2 as the root stock of later central European broadheads, but thinks there may be factors other than Mendelian dominance connected with the remarkable spread of broadheadedness, now almost universal in central Europe; the mean cephalic indexes he gives for different parts of Germany range from 80 to 85.

Coon notes the zoning of pigmentation from blondness in the north-west to predominant dark colouring of head and eyes in the south and south-east. For him, as for most unprejudiced students, there is not a blond long-headed tall type distinct from the beginning of the story. The spread of the arts of food production and of settled life he sees as an accompaniment of the advance of the Mediterranean types into Europe, sometimes handing on their knowledge to descendants of the varieties of Group 2. He thinks the early Danubian peasantry were of Mediterranean type and that the people who made corded pottery, and were of the east-central variety of Group 2, blended with survivors of Palæolithic men who had followed the retreating ice, and that this mixture, with loss of pigmentation, became what is known as the Nordic group. But this summarizes his account too severely, and students should read his pages, realizing, as he does, that his synthesis may well be modified very greatly as knowledge grows. The one thing that appears ever more clearly is that civilization did not originate in the Germanic-West Baltic area as some have tried to argue.

Coon looks upon the Lapps as to some extent early European broadheads related to the west-central variety of Group 2, modified by immigrants from Asia along the north. Another interesting hypothesis is that the people with flat-backed high broad heads, commonly called Dinaric, are the result of a blend between a tall variety of the Mediterranean group and the early broad-heads of Central Europe. He shows that Alpine or Central European, as well as north-west European elements, have entered to a large extent into the composition of the modern Jewish groups, which vary greatly from place to place and in any one place include very diverse individuals. The basis, like that of the European population, is Mediterranean. One welcomes the wisdom of the author in avoiding assertions about racial superiority or inferiority and in insisting on the importance of past blending and intermixture in the racial history of Europe.

In a second edition one hopes the author will include some discussion of the Milankovitch chronology, will perhaps be a little more critical here and there on the physiological side, will clear up a few expressions and printer's errors and slips of memory such as one on p. 375 which mixes refugees after the revocation of the Edict of Nantes (1685) with those who fled from the atrocities of the Duke of Alva (1567–73), and penslips such as one on p. 372 which says the Irish Goidels invaded Scotland from the east.

The fifty plates, mostly with twelve photographs on each, usually giving full face, profile and semi-profile views of persons whose measurements are also given, set a high standard, especially as explanatory text accompanies the photographs and often summarizes clearly the arguments in the body of the book.

(2) Dr. G. Morant's little study of "The Races of Central Europe" is essentially a tract for the times and is a careful exposition of his point of view backed by a mass of information concerning details, and very ably put together. Dr. Morant represents the older biometric school of anthropologists which holds that it is best to deal with samples of populations as units and to describe them by means of average values for the different physical characters; those who feel the weakness of this mode of approach are anxious to pay their tribute to the ability and sincerity of Dr. Morant's work.

Both Coon and Morant in their diverse ways emphasize that greater differences can be found between German-speaking groups in Central Europe than those between certain German and certain non-German peoples, and Morant has worked this out for blood-agglutination figures as well. The proportion of O and the ratio of A to B vary together to a large extent, a high proportion of O being accompanied by a high ratio of A to B Both these figures are far higher for samples from the pre-Munich Germany than for samples from lands to the east. East Prussian, Silesian and Austrian samples are characteristically intermediate between the non-strictly German ones and those for Polish, Czech, Slovak, Magyar or Rumanian areas, while such information as we have for Russia shows still smaller values for O and for A/B.

Morant considers that in the *Völkerwanderungszeit*, the German peoples were longheaded (indexes 72–76), that in the Merovingian time there was a great infiltration of broad heads (indexes above 80) in two main waves. These two waves completely swamped the earlier type which disappeared There is a considerable measure of truth in this statement, but it is well to remember, as Morant does, that the number of skulls available is not large and may represent a selected, perhaps an aristocratic, group. Morant emphasizes that, for Central Europe, cephalic index, colouring and stature are less important criteria than blood agglutination groups, and the latter have the advantage that they appear to remain constant throughout life, while samples of males and females respectively in the same district correspond closely. Also, here we have to do with distinctive characters, not with measurements and ratios that shade into one another.

Concerning utilization of averages and the difficulties involved, we note that Morant gives (Fig. 3) the marking to Bohemia and Moravia that indicates an average stature of 168–170 cm., as against 166–168 cm. in Bavaria and Austria, etc., and 164–166 cm. in Germany. Coon, on the other hand, gives 167 cm. as the average Czech stature Differences of sample can affect the result and in this case the acceptance of Coon's figure would put the Czechs into the same grade as the Austrians and Bavarians. Quite possibly Morant's statement is nearer the truth, but averages are of doubtful value.

Morant is clear that race cannot be used to rearrange the political map of Europe and that racialism as between Europeans is rubbish. All his fellow-workers will subscribe to this conclusion whatever reserves—and they are many—they have about his utilization of Pearson's coefficient of racial likeness. He sees that it is only a rough instrument of analysis; many others feel it has led to such errors as should put it out of court.

THE ELECTRIC DISCHARGE IN ENGINEERING SCIENCE

Gaseous Electrical Conductors
y Prof. E. L. E. Wheatcroft. (Oxford Engineering
cience Series.) Pp. xi+265+6 plates. (Oxford :
larendon Press ; London : Oxford University
ress, 1938.) 21*s.* net.

THE earliest industrial applications of the phenomena associated with strongly ionized ases, or 'gaseous conductors', appear to have een the introduction in England of the carbon rc for illumination in the early eighties, followed hortly by Moore's nitrogen and carbon dioxide ischarge tubes in America. In the beginning of e twentieth century, electric discharges first egan to be used on a considerable scale in chemical ngineering, notably for the production of ozone connexion with air and water purification, of tric acid from the air, and of lubricants by the lymerization of light oils ; about the same me discharges were also applied to the precipi-tion of dust and mist, and to the generation of igh-frequency currents for radio communication. he phenomena associated with 'free' electrons in igh vacua have been applied in the development the present rich variety of X-ray tubes, wireless alves, and cathode ray tubes. The development the transmission of electric energy has brought light the importance of discharge phenomena relation to the design of high-tension cables, sulators, condensers, and switchgear ; and the hysics and chemistry of the ionosphere are rectly related to many problems of radio com-unication. Not the least important is the ignition stem of all petrol-fed internal combustion engines, hich depends on a gaseous electric discharge.

The comprehensive title, and the preface of rof. Wheatcroft's book, which is the latest ddition to a distinguished series, lead the reader expect it to be the first English book dealing ith gaseous discharge phenomena in relation to e rapidly growing applications in many branches engineering ; the author explains that his aim expanding his lectures to undergraduates is to roduce a book that will be useful to those who embark upon research in this very interesting d important field". The book is in two parts : e first deals with the physical background ; the cond relates to applications, but of these the ly ones considered are thermionic valves ('hard' d 'soft'), the mercury arc rectifier, circuit reakers, and discharge tubes as illuminants.

In giving the physical background in Part 1, e emphasis has not been fairly divided between ure' electron gas as a conductor, and electron gas admixed with ion and neutral molecular or atomic gas, the former being allotted much the greater space ; and a whole chapter is devoted to electrons *in* metals. For example, the motion of electrons in a 'dense' gas is dismissed in three pages with a few equations and without any reference to the experimental data of Townsend and others ; the result is that the uninitiated reader would gain a totally false sense of simplicity and never realize the essential complexity of the phenomena. Townsend's coefficient of ionization is needlessly and erroneously renamed "the ionization constant α". Also, there is no point in giving Townsend's early theory of this coefficient without indicating the unjustifiable assumptions now known to be involved in it, or to offer an alternative makeshift theory without referring to the detailed analyses of the problem which have been given both for atomic and molecular gases.

Part 2 opens with a long chapter on "Vacuum Electron Valves", which, however, contains much that is irrelevant to this book ; for example, the discussion of high-vacuum valve design. The three following chapters on gas-filled valves, the mercury arc rectifier, and circuit breakers, are good, profusely illustrated, and bespeak an intimate acquaintance with these applications. It is this part of the book that the reader who seeks succinct but adequate information will find most useful. The last chapter, on luminous discharge tubes, is startingly inadequate to a branch of gas discharge engineering which is of ever-increasing importance.

The attempt to introduce further complication and changes of convention in the nomenclature for units is to be deplored ; for example, the electromagnetic unit of potential is termed the 'centimicrovolt', and engineers have long since decided that the microfarad is a more convenient and practical unit than the farad.

The presentation of the material in this book reflects too often those digressions which are illuminating in a lecture but distracting in a book. Despite the collation of much useful information, and the beautiful production to which we are accustomed from the Oxford University Press, the book falls short of the high standard set by the rest of the series. Nevertheless, for the reader who is willing to spend the time disentangling the information he requires (the joint author-subject index is too brief to be very helpful), there is much in this book which is worthy of attention.

L. S. Harley.
R. Winstanley Lunt.

THE PROBLEM OF PAIN

By Prof. P. T. Herring,
University of St. Andrews

At the Dundee meeting last September of the British Association, Section I (Physiology) paid a visit to St. Andrews, where a discussion was held in the Physiology Department of the University on the problem of pain.

The physiology of pain, interesting and important though it is, is still unsolved. Pain must be regarded as a physiological sensation of a protective character; but like many other physiological phenomena it can become pathological, and the boundary between the two is indefinable. We have no means of determining the intensity of pain, and the psychological element is often an important factor. Many different kinds of pain are described, some of which are due to the admixture of other sensations in consciousness.

For the production of sensation certain anatomical structures are essential—receptors, afferent nerve fibres and a nerve centre or centres which translate the impulses into a conscious sensation. Not all the receptors capable of receiving pain-producing stimuli are known; but the more highly specialized nerve endings can be dismissed, for modern work has shown that they are adapted to specific stimuli only. The cornea of the eye provides an example of a structure which is supposed to be capable of receiving no other sensation than that of pain, and in the cornea the nerve endings are naked axis cylinder terminations intimately associated with the epithelial cells which cover it. The receptors in the epidermis of the skin are believed to be of the same nature, but lying more deeply placed in the living epithelium. In the connective tissues of the true skin there are also many endings of the same kind. The skin is the protective covering of the body, and any form of stimulus which injures it is an adequate one for the production of pain.

There is a pattern of so-called pain spots in the epidermis, and by the use of a finely pointed needle it may be shown that the skin varies in the amount of pain produced by a strictly localized injury. It is not known how the nerve terminations are stimulated to discharge nerve impulses. Nerve fibres are relatively resistant to mechanical stimulation, and it is not improbable that it is the living epithelial cells which respond to injury with the production of some chemical substance which provides the adequate stimulus. The persistence of the sensation of pain after injury favours the view that a chemical agent is the exciting factor.

There is even less satisfactory evidence as t the nature of the afferent fibres which convey t impulses to the central nervous system. There a at least two possibilities. According to Müller law of the specific irritability of nerve, the should be special fibres for the conveyance of t impulses that give rise to pain. Some observe have claimed the existence of special pain fibre Ranson states that they are small in diameter a non-medullated. They may belong to Erlang and Gasser's *C* group; but these have a slo conduction rate, and, as Adrian points out, it scarcely likely that pain—a danger signal—dependent solely upon slowly conducting fibre It is more probable that fibres of this descripti are concerned with the conveyance of pain fro the viscera, but not from the outer covering the body where the more rapid the response t better the protection afforded. The other pos bility is that pain-producing nerve impulses a carried by nerve fibres which are normally co cerned in the production of other effects, and th a more rapid series of impulses, or a greater ma effect, floods the central nervous system and ove flows into tracts which convey pain-produci nerve impulses from more sensitive areas. T work of Adrian and others is on the whole oppos to this theory, and the trend of physiologic opinion is at present in favour of the existence specific pain fibres.

In the production of visceral pain, the utilizati of nerve fibres ordinarily concerned in reflex acti unaccompanied by conscious sensation is perha more likely, for it seems unreasonable to postula the existence of special receptors and nerve fibr in organs which for many generations of individu are never called into use.

However conveyed, all pain impulses appear enter the central nervous system in Hughlin Jackson's lower level. In man a second neuro arises in the grey matter of the same side, d cussates and runs upwards in the antero-later columns. Cases of syringomyelia support the vi that in man there are special fibres in the spin cord associated with the conduction of pa impulses. The fibres must make numerous co nexions, for severe pain excites reflexes involvi cardiac, respiratory and other vital physiologi processes.

Afferent nuclei in the optic thalamus appear be the basal receiving centres, and these in tu nsmit certain of the impulses to the grey matter the cortex. There is reason to believe that pulses reaching the optic thalamus give rise to in, but that the sensation produced there differs some respects from that perceived by the cortex ebri, the pain being more diffuse, less well alized and of a peculiar character. Pain felt the thalamus has some of the characteristics of otopathic sensibility. Head's classification of dy sensation into protopathic and epicritic has en much debated. There is no doubt the stinction exists; but its exact significance nains to be determined.

The physiology of pain in structures that lie per than the protective covering of the body sents further problems. Many tissues and organs the body are capable of pain, but the adequate mulus is often a specific one, and the injuries ich produce pain in the skin or parietes fail to duce any sensation whatever in many of the cera. Muscle, whether skeletal, cardiac or ceral, can be cut, burnt or otherwise injured hout the production of sensation. Yet pain, d pain of a very severe character, can be exienced by muscle. The adequate stimulus is w believed to be tension, and particularly tension the absence of an efficient circulation. Sir omas Lewis, from experimental evidence, beves that muscle under these conditions liberates ne metabolic substance which diffuses rapidly d affects the sensory nerve terminations tside the actual muscle fibres. The nature the pain-producing substance, factor *P*, is known.

The capability of experience of pain by the cera may to some extent depend upon the sence in or around them of connective tissue aths. Peritoneal, pleural and other memaneous coverings carry their own nerve supplies, d these may be important factors in the reception d localization of pain. Pain from the viscera commonly referred, not to the organ in question, t to some area of the body surface endowed th higher sensibility, and is then known as ferred' pain. Prof. Waterston suggests that pain this nature should be called 'heterotopic' to tinguish it from 'homoiotopic', or pain referred its actual site of origin.

Ross was one of the first to attempt an explanan of visceral pain. He described two types, erred pain and true visceral or splanchnic pain. ckenzie, impressed by his own observations on insensitivity of the viscera, elaborated Ross's ory of the radiation of pain from the viscera the parietes through an irritable focus in the nal cord, but denied the existence of true ceral pain. Mackenzie believed that pain ociated with a diseased viscus is never felt in that organ, but is always referred to an area of higher sensibility in the body wall. The pain may be extremely severe, and accompanied by reflexes, local and general. The local manifestations are of great value to the clinician in that they give him information as to the site and extent of the disturbance. The details of the work of Ross and Mackenzie have been much debated. Prof. Morley, who spoke at the meeting, considers that Mackenzie failed to appreciate the difference between referred pain from the parietal peritoneum and that from an intraperitoneal viscus. Morley believes that referred pain arises from the irritation of nerves sensitive to those stimuli which produce pain when applied to the surface of the body. He considers that pain from the urinary system, which is retroperitoneal, harmonizes with Mackenzie's view, though gastro-intestinal pain does not. The difficulty arises because of the complication introduced by the presence to a varying extent in the abdominal viscera of peritoneum and mesentery, structures carrying their own nerve supplies, and differing in their sensitivity.

Mackenzie believed that excessive contraction of muscle is the cause of pain in whatever viscus it is found. Colic and the pain of hunger may be cited as examples. Payne and Poulton, in a series of careful experiments, came to the conclusion that visceral pain from muscle is caused, not by its contraction directly, but by tension, and that the stimulus is a stretching and deformity of pain endings in the wall of the stretched viscus. The frequent association of pain with contraction is explainable on the assumption that excessive tension is put upon the tissues with which the contracted fibres are in continuity.

Headache presents another interesting problem. Apart from local conditions, such as neuralgia affecting the scalp, and vascular spasm in the tegumentary covering, headache is often a referred pain, and its source some part of the alimentary tract. The afferent nerves are those of the visceral fibres of the vagus, and the pain is referred to areas supplied by the trigeminal nerve. Some disturbance in the abdomen gives rise to pain which is felt as a headache. When the pain is of intracranial origin, its cause is now commonly ascribed to vascular changes in the pia-arachnoid membrane of the brain. The intravenous injection of histamine sets up severe headache. Histamine is a powerful vasodilator, and congestion of the blood vessels induced by its action is thought to be the cause of the pain. Withdrawal of cerebrospinal fluid by lumbar puncture has much the same effect by decreasing the intracranial pressure. The receptors are apparently in the pia-arachnoid membrane, but may also be present in the choroid plexuses.

Even more interesting than pain is the problem of its relief. Intractable pain is fortunately rare but does occur in some diseases. Opium and its derivatives, though of great value, are not altogether satisfactory, especially when the pain is lasting; and they have other drawbacks. Section of afferent nerves, extirpation of ganglia and other destructive procedures, have been used in intractable pain. All such methods are attempts to prevent the passage of pain-producing impulses by t afferent nerves to the central nervous syste Mr. Todd described a method of alleviation b the intrathecal injection of alcohol. This paralys the afferent fibres in the spinal canal, and h proved valuable in cases suffering from pa in the pelvis and lower limbs. There is st room for some drug which will possess the ide properties.

METAMORPHISM AND IGNEOUS ACTION*

By Prof. H. H. Read, F.R.S.,

Imperial College of Science and Technology, London

APART from the question of the time-continuity of the progressive series represented by, say, the Barrovian zones, there is the chemical continuity to be considered. How far do the zones of Barrow represent an isochemical series of pelitic rocks? The degree to which such processes as metamorphic differentiation and diffusion have operated obviously affects the compositions of members of the series at any stage. Such possible departures from the isochemical series arise through processes inherent in the rock. There is, however, another aspect of this topic which, though usually ignored in Great Britain, must in my opinion be carefully considered. The possibility of the introduction of material of so-called magmatic origin is one that certainly cannot be dismissed in the higher grades, and one that might apply even to the lower grades of regional metamorphism. It will be convenient for the development of my argument, however, if we transfer ourselves to the domain of ultrametamorphism, and I discuss the reality of granitization, for, if granitization is real, certain consequences seem to follow.

In a paper which has appeared during the writing of this address, granitization is defined by Malcolm MacGregor and Gilbert Wilson as "the process by which solid rocks are converted to rocks of granitic character". It includes all such operations as palingenesis, syntexis, transfusion, permeation, metasomatism, migmatization, injection, assimilation, contamination, and the like. These authors conclude that exchanges take place between the country-rocks and their pore-fluids—whether these are entirely indigenous or reinforced by accessions from magmatic sources—and that these exchanges are selective so that there is a convergence, both chemical and mineralogical, of rocks originally different. They consider two processes to be concerned in granitization; first, a metasomatism under the influence of "perme ing highly energized fluids—emanations—ahead advancing magma", and second, a mechani penetration by magma. I consider that no reaso able objection can be raised to these conclusio notwithstanding the uncompromising attitude Rosenbusch and others.

The question of room in migmatization is o that has caused difficulties to many observe This room-question was answered by Hugh Mil fifty years ago, and has been answered many tim since. Replacement is the essential process in t formation of the migmatites. It is unfortuna that the term injection-complex, used in Gre Britain, emphasizes injection, since permeatic imbibition and metasomatism are more wid spread phenomena. As I have pointed out el where, the formation of banded gneisses and li par-lit complexes is best explained by a process replacement to different degrees along layers different permeabilities. The many examples the tracing of the regional country-rock structu through granitic masses, the existence of th plane screens of country-rock in them, the gre extension of minute *lits* of quartzo-felspath material in migmatites, and the detailed heter geneity of many granites are all readily explicab by a replacement origin for these rocks.

Replacement in sedimentary rocks will be co trolled by the original structures of such rock Permeation by the emanations or ichors will ta place preferentially along certain layers dependi upon both the chemical and physical nature these layers. Original platy minerals lying in th bedding planes will become enlarged if they su the new chemical environment, and new-form minerals will grow so that their direction greatest crystallization-velocity agrees with th old planes of weakness. The original sedimenta structure may thus become preserved until a hi

---

*Continued from page 731.

degree of granitization has been reached, and the bulk composition of the rock has been greatly changed. I consider the foliation of granitic gneisses, for example, as essentially controlled by previously existing sedimentary structures, and not by any process of dynamic metamorphism or piezo-crystallization.

Whether the granitizing solutions are thought of as emanations of no specified ancestry, or as ichors from a granitic magma-body, opinion is agreed amongst workers in this subject that they are highly mobile and capable of great chemical action. Working in conjunction with the pore-fluids of the country-rock, they can transform vast portions of the crust. In connexion with direct granitic invasion, gases may be of great importance; when they have condensed to solutions and have received assistance from the true liquid residuals and from the pore-solutions, they must be capable of gigantic results. I wish to emphasize, therefore, that granitization and felspathization are valid processes, and that they are essentially based upon replacement.

In regions of granitization there has been an afflux of material, either from a 'magmatic' body or from some unspecified source. It is reasonable to believe that during the resulting replacement there occurs an emigration of material. Holmes has put the whole matter graphically—"the 'granite' is the balance of what was there originally, *plus* what has migrated in, *minus* what has been driven out". The emigrating material moves into the country-rocks adjacent to the theatre of granitization.

The material thus moving through the country-rocks is of several origins and qualities. It consists of (i) the material expelled from the region of granitization; (ii) the direct emanations from the granitizing agent; and (iii) the pore-fluids of the country-rocks. Its diverse constituents must move with different speeds, perhaps depending, as Backlund has ingeniously suggested, upon the ionic radii of the participating elements. Various overlapping belts of precipitation may come into being, and from each a further expulsion may take place. By some such processes zones of various characters arise about the granitization or migmatite core.

Wegmann has elaborated a magnesia-metasomatism dependent upon the expulsion mechanism in granitization; he expects to find a zone characterized by cordierite in close proximity to the migmatite area, whilst farther away would be found lower-temperature minerals like andalusite, kyanite, garnet, etc., and farther still tourmaline. The formation of 'fronts' of more or less marked chemical individuality can be exemplified by the soda-fronts of Stavanger, Sutherland, and Cromar, Aberdeenshire, by the potash-front of Hango, Finland, and by the magnesia-front of Orijärvi; there is no need to elaborate these examples.

One of the most firmly established facts of metamorphic geology is the close association in the field of highest grade metamorphic rocks and migmatites. The significance of this coincidence has been differently interpreted. I adopt the view of the company familiar with migmatites and see with them a direct causal relation between the highest grade of regional metamorphism and migmatization.

In my opinion, therefore, the cordierite and sillimanite zones are genetically related to granitization. But these zones are the final stages of the apparently continuous progressive series of Barrovian zones which as a whole supply the common types of regionally metamorphosed rocks. It seems reasonable to me, therefore, to believe that regional metamorphism as a whole is genetically related to 'igneous' activity of some kind.

Out from the central theatre of granitization there pass waves of metasomatizing solutions, changing in composition and in temperature as they become more distant from the core and promoting thereby the formation of zones of metamorphism about it. Very often a spurious depth control appears to have operated, since the flow of solutions must be largely towards higher parts of the crust. Such a metasomatic metamorphism accounts for the superposition occasionally observed of high-grade zones on lower-grade, and does away with the infelicities attending the alleged inversion of metamorphic zones. Further, the difficulties that the idea of static or load metamorphism fails to meet are surmounted. Deeply buried sediments remain unmetamorphosed unless igneous material gets access to them. In metasomatic metamorphism, original sedimentary textures can be reasonably preserved, mimetic crystallization can prevail, schistosity and bedding, even in violently folded strata, can coincide. Finally, all those phenomena which Daly felt to be "truly inexplicable by pure dynamic metamorphism", are satisfactorily explained.

A continuous series of changes in composition from low-grade regionally metamorphosed rocks to migmatites has been established by many investigations. Even in the low-grade rocks changes are perceptible, and all must be ascribed to the activity of material from a granitizatio centre. To move this material and to promot the recrystallizations and replacements t ocu in cubic miles of rock, great quantities o are required. It seems to me unlikely solvents in action are indigenous to the rocks—*they* are more reasonably to be from a granitic source. When the en extent of migmatite granites is considered, it is clear that sufficient water is available to promote the changes seen in the regionally metamorphosed rocks.

Are there any indications in low- to medium-grade rocks, not visibly associated with igneous activity in the field, which point to solutions from magmatic sources having travelled so far from the locus of migmatization? In my opinion, we see such indications in the presence of tourmaline in rocks of all grades. Admittedly, this opinion is one not generally accepted in Great Britain, but on balance I prefer to regard most tourmaline in metamorphic rocks as due to impregnations from granitization fluids. Tourmaline occurs not only in pelitic derivatives but also in rocks of other compositions. In many examples of high- and medium-grade rocks it is clearly introduced, as shown by its relation to the other minerals present. I believe that the ubiquitous tourmaline in regionally metamorphosed rocks is an indicator of the action of 'emanations' throughout all grades.

Whilst I have belittled the role of the dynamic factor in regional metamorphism, it is of course true that in the lower grades it must be of considerable importance. How can this be reconciled with the view that migmatization is the prime cause of regional metamorphism? The reconciliation may be sought, I suggest, in the stresses set up by the increase of volume consequent upon the invasion of the crust by the migmatite front. Relief is obtained in the outer and cooler zones by shearing; in the inner and hotter zones by internal reconstructions. The unity of the zonal series may thus be preserved.

I have shown my predilection for dividing all rock transformations into two groups, one those of dislocation-metamorphism associated with dislocations of the crust, and the other those of regional and thermal metamorphism associated with igneous activity. My remarks, I trust, will receive thorough criticism. I am prepared for this, for, just as things too absurd to be said can yet be sung with perfect propriety, so views too tenuous, unsubstantiated and generalized for ordinary scientific papers can yet appear with some measure of dignity in presidential addresses.

POWDERED FUEL: PROGRESS AND PROSPECTS

THE necessity imposed by the demands of war to make use of any available materials in order to eke out inadequate supplies of the usual commodities is frequently the means of bringing to practical use ideas and inventions which might otherwise languish for years. An example is the introduction in the Napoleonic era of the present method of making soap in consequence of France being cut off from the usual supplies of kelp. The use of powdered fuel in aero-engines may, owing to Germany having difficulty in getting adequate supplies of petrol, be one of the results of the present hostilities; that the Germans have been working in this direction is evidenced by patents covering the use of powdered fuel. Patent literature shows that two distinct methods of operation have been envisaged. One consists in mixing the fuel with air and introducing the mixture into the combustion chamber, thus following the cycle used in petrol engines. The other adopts Diesel practice in injecting the fuel directly into the combustion chamber, though obviously with a fuel in the form of a powder some important modifications at the injection stage would be necessary.

Powdered coal cannot be described as a tractable material for the purpose of being metered out small quantities for injection into the com[illegible]stion chambers of a high-speed engine. Freshly pulverized, it is light and fluffy but, in the presence of moisture it readily tends to change its physical characteristics and to pack itself into a dense and rather inert mass. It is necessary, therefore, that it should be well dried before the final pulverization, and it is desirable also that it should not be kept in storage but rather used at once. After a long period of trial, it has now become well established as a boiler fuel, and a brief statement of its history in this connexion may indicate its possibilities.

In 1831, a patent was granted to John Dawes, ironmaster, for a method of introducing fuel into the blast of furnaces. Later patentees include the name of Mushet who, it will be noted, was also interested in steel furnaces. The first to advocate pulverized fuel seems to have been John Bourne, in whose "Treatise on the Steam Engine" of 1861 it is stated that "the fuel and air must be fed in simultaneously and the most feasible way of accomplishing this object seems to be in reducing the coal to dust and blowing it into a chamber lined with firebrick so that the coal dust may be ignited by coming into contact with the red hot surfaces". In 1868, T. R. Crampton experimented on the use of pulverized coal in steam boilers and puddling furnaces, and the views he put forward in a paper read before the Iron and Steel Institute

1873 have proved to be fundamentally correct. e was strongly insistent on the importance of the ze of the fuel particles and of the intimate mixture air and fuel.

It was not until 1895, when powdered fuel began be successfully used in rotary cement kilns, that e system can be said to have become established. this branch, however, its success has been so arked that it can be claimed to account for about our fifths of the world's output of portland ement. In this same year a remarkable result was btained from tests carried out by Bryan Donkin Berlin. A Cornish boiler was operated for one ay by hand-firing on the ordinary grate; two ays later, after being fitted with the Wegener pparatus, it was given a day's run on powdered oal. On the first occasion the thermal efficiency as 54 per cent, whereas on the second it was 7 per cent, the total duration of smoke in the wo tests being 105 minutes and 6 minutes spectively.

In view of these figures, it is remarkable that e development of this method of firing has been retarded and that in England, even now, the umber of plants in operation is very limited. This not explained by any inherent difficulty, as the ushing, drying, pulverizing and delivery plant re of robust construction and generally reliable operation. The risks associated with the use f pulverized coal can be controlled by strict ttention to cleanliness in the boiler house and to e cleaning of all-pipes when closing down. The owdered fuel is entrained in a limited blast of ir which, before entering the furnace, is enabled carry with it the additional amount of air quisite for combustion. As the carbon dioxide ercentage may be as high as 15, it can be seen hat the proportion of excess air is lower than that eeded for ordinary coal firing, where 12·5 per cent the normal figure for carbon dioxide. The ash roduced is a very finely divided flocculent powder, nd the amount which escapes to the atmosphere an be reduced to any desired degree by suitable terceptors.

The history of the efforts made to use coal dust directly in internal combustion engines is in strong contrast to the record just given, as the main problems have not been satisfactorily solved. It is an interesting fact that when Diesel, about 1890, was planning the type of engine which now bears his name, his primary idea had been to employ coal dust as fuel. After several years of experimental work, the engine which he constructed proved to be adapted to oil fuel but not at all to coal or even gas, and so for this as well as economic reasons its ultimate development was directed toward the utilization of oil. At the Glasgow Exhibition of 1901 there was shown an engine made to the patents of 1894 and 1900 of P. F. MacCallum, which developed 100 B.H.P. at 150 r.p.m., using coal dust as fuel. The difficulty of completely consuming the solid particles was never fully overcome, no matter how finely the coal was pulverized, and this continues to be one of the chief problems to be solved. The ash is also troublesome and inevitably so, for the limited combustion space offers little scope for devising means of interception and control.

These considerations suggest that, instead of the direct use of coal dust in the engine cylinders, some indirect or semi-direct method might be developed. The use of a special form of gas producer is an indirect method, but so much so as to come under a different classification, the engine becoming a gas engine supplied by gas from an individual gas generator. The term semi-direct is intended to suggest an arrangement whereby the processes of combustion are isolated from the cylinder, but in which the working substance is the gas formed by combustion. The indirect method, on the other hand, would be one in which the products of combustion do not enter the cylinder but are enabled through another medium to do work on the piston. It is never possible to forecast how practical conditions may modify theoretical suggestions, and it will be interesting to see by what means the coal-firing of engines, if indeed it is practicable, will be realized.

OBITUARIES

Dr. W. B. Wright

DR. W. B. WRIGHT, lately of the Geological Survey of Great Britain, died on October 11 at the age of sixty-three years. Wright received his university training at Trinity College, Dublin, which 1928 honoured him with the Sc.D. He approached eology through mathematics, being attracted by roll's astronomical theory of ice ages. He joined the Geological Survey of Great Britain and Ireland in 1901, and to begin with had the good fortune to work in the Dublin, Belfast, Cork and Limerick districts under the inspiring leadership of the great glacialist Lamplugh. During these early years Wright's most original contribution was a joint account with Maufe, published in 1904, of a low pre-Glacial raised beach preserved at many points around Ireland. A similar feature had long been familiar to geologists on both sides of the English Channel and in South Wales and Yorkshire.

During 1904, a year before the separation of the Geological Survey of Ireland, Wright came to England. Here in the Midlands he encountered the Millstone Grit and Coal Measures, which later came to mean so much to him. He also learnt at close quarters the elusiveness of the Older Glaciation of this district.

In 1906, eager to rejoin his friend Maufe, Wright transferred to Scotland, where he worked officially in the West Highlands and Midland Valley, and unofficially everywhere on the coastline. His main discoveries were: two earth movements separated by a period of igneous activity and recorded in the disturbed Torridonian of Colonsay; a pre-Glacial 100-ft. beach in the same and neighbouring islands; and north-west symmetry in the Tertiary volcanic centre of Mull. Wright was in at the beginning of the detailed study of Mull, and though one contribution is here singled out for special recognition, he had a lion's share in the elucidation of the whole. Wright also played an important part in developing the coalfield technique of the Edinburgh office of the Survey.

In 1910 Wright was appointed to the Irish Survey, where he did good work during the next ten years. It was in this period that he sponsored a deep bore at Lough Neagh, in search of a concealed coalfield, but the results, published in 1924, proved disappointing from the economic point of view. In 1914 Wright produced his *magnum opus*, "The Quaternary Ice Age", which put all the world in his debt by collecting and correlating in one volume a vast amount of international literature, not easy of access and definitely difficult to assess.

In 1921 Wright was invited to return to England to undertake for the Geological Survey of Great Britain the organization of a branch office in Manchester and the revision of the Lancashire coalfield. His success was outstanding, and his staff has covered the area with excellent maps and descriptive memoirs. He gave special attention to palæontology and to actual inspection of underground workings. At first he studied the Millstone Grit, and here received much help from Bisat, the chief of goniatite experts; but the return he made was generous. Moreover, he brought the modern work to the notice of a wide public in his section on the Millstone Grit contributed to the "Handbook of the Geology of Great Britain", a compilative work that appeared in 1929.

Presently Wright specialized on the Coal Measures, and produced splendid results in the form of subzones, based on freshwater mussels. Like certain others of his countrymen, Wright had a pugnacious tendency, which has perhaps concealed the comradeship that exists in this difficult field, or, one would like to say, pool, of research. He stood for the definition of a fossil species in terms of a type specimen that one can handle, rather than in terms of a synthesis derived from an assemblage of specimens, which, in the researcher's opinion, would have been able to interbreed if they had lived together in tim and space. There is evidently more than one wa of attacking this difficult problem, but Wright method of convenience has certainly given valuabl results, valuable to industry as well as to science.

Wright's latest publications have been a secon edition of his "Quaternary Ice Age" (1937), an "Tools and the Man" (1939). These clearly reve that whatever else caught his fancy on the way, remained ever true to his early glacial love.

Wright is survived by a widow and a daughte both of whom take an active interest in zoology.

E. B. BAILEY

Dr. G. A. Sutherland, C.B.E.

WE regret to announce the death on October at the age of seventy-eight years of Dr. Geor Alexander Sutherland, consulting physician to th North West London Hospital and the Paddingto Green Hospital for Children. Although ill-health h compelled him to retire from practice many yea previously, he was at one time one of the best-know London specialists in children's diseases. He w born in 1861 at Aberdeen, the third son of the Re James Sutherland, and was educated at Aberdee where he graduated M.A. in 1882 and Edinburg where he became M.B. in 1886 and M.D. in 189 after which he took a post-graduate course in Vienn

Sutherland took an active part in the formation 1900 of the Society for the Study of Disease in Chil ren, as well as in the amalgamation of this Socie eight years later in the Royal Society of Medicine. 1906 he was made president of the Pædiatric Secti for the annual meeting of the British Medical Associ tion at Toronto, and in 1911–12 was president the Section for the Study of Disease in Children the Royal Society of Medicine. In addition contributions to periodical medical literature a to Latham and English's "System of Treatment he published in the series of Oxford Medical Pu lications works on "The Treatment of Disease Children" (1907 and 1913) and "The Heart in Ear Life" (1914). In 1917 he delivered the Lumlei Lectures before the Royal College of Physicians, which he had been elected a fellow in 1903, h subject being "Modern Aspects of Heart Disease He was also editor of a "System of Diet a Dietetics" (1908), to which he contributed thr chapters on diet in diseases of the lungs, the feedi of infants and children in health, and diet in diseas of children. During the War of 1914–18 he w appointed consulting physician to the Royal Air For and was created C.B.E. in recognition of his servic He was unmarried.

J. D. ROLLESTON.

WE regret to announce the following deaths:

Mr. T. D. Rice, senior soil scientist of the Bure of Chemistry and Soils, U.S. Department of Ag culture, on September 12, aged sixty-one years.

Prof. R. V. Wheeler, professor of fuel technolo in the University of Sheffield, on October 28, ag fifty-six years.

NEWS AND VIEWS

Nobel Prizes for Physiology and Medicine

Prof. C. Heymans

PROF. CORNEILLE HEYMANS is professor of pharmacology in the University of Ghent, being the direct successor in that chair to his father, the late Prof. . Z. Heymans, in collaboration with whom he had carried out researches, involving some of the inenious methods of cross-circulation and artificial perfusion, which he has later developed in the series f masterly investigations which have just been ecognized by the award of the Nobel Prize for Physiology and Medicine for 1938. Some of Prof. Heymans' most important work has dealt with the sensory mechanisms in the vascular system, through which the arterial blood pressure is kept under reflex nervous control. This sensory function of the carotid sinus had been discovered and described by H. E. Hering and E. Koch in Germany, but the work of Heymans greatly extended knowledge of its imortance and demonstrated the presence of analogous sensory apparatus in other parts of the vascular system. Heymans also discovered the sensitiveness f the carotid sinus to chemical changes in the blood, nd its consequent importance in regulating the activity of the respiratory centre. Prof. Heymans is esponsible for many other important advances in hysiology and pharmacology, largely concerned with the control of the circulation. He is well known utside his own country, and a frequent and welcome visitor to Great Britain, where his remarkable command of English, as of several other languages, nables him to give clear and fluent accounts of the progress of his researches, and where the honour now done to him will be warmly greeted by his many riends and admirers.

Prof. G. Domagk

PROF. GERHARD DOMAGK, who has been awarded he Nobel Prize for Physiology and Medicine for 1939, is the pathologist to the medical and biological esearch laboratories of the Bayer Company of Elberfeld. Domagk was comparatively little known, beyond the range of those familiar with the work of hat institution, until, nearly five years ago, he made a discovery which has led to one of the most rapid and remarkable advances on record in therapeutic science and practice. The late Paul Ehrlich began his researches in chemotherapy with the attempt to find substances which would deal directly, as disinfectants, with bacterial infections in the living body. He, like many others who have followed, abandoned what seemed to be a hopeless quest, and urned his attention to the discovery of chemotherapeutic remedies for infections due to protozoa and spirochaetes, the most important outcome being the discovery of salvarsan. It had almost come to be assumed that bacterial infections were beyond the each of chemotherapy, though Morgenroth's 'Optochin' and its allies had given some hope of eventual success. Domagk appears to have examined a series of dyes for their action on streptococcal infections in the living body, irrespective of a lack of disinfectant properties outside it. In January 1935 he described the remedial effect on streptococcal infections in mice of a red dye, named 'Prontosil', an amide of chrysoidine, which had been prepared by Mietzsch and Klarer, chemists on the staff of the Bayer Company. Some confirmatory clinical results were obtained, but the first organized trial of 'Prontosil' on a uniform series of cases of streptococcal infection in man was made by Colebrook in Great Britain.

MEANWHILE, it had been found by Trefouel, Nitti and Bovet, in France, that a simpler, uncoloured component of 'Prontosil', sulphanilamide, had a similar action; and there seems reason to believe that this is the direct antistreptococcal agent, being split off in the body from 'Prontosil'. Since then, each month has seemed to bring evidence of the therapeutic importance in some new direction of 'Prontosil', sulphanilamide, or one of the numerous derivatives made from the latter in many countries; a conspicuous example being the pyridyl-sulphanilamide (M. & B. 693) made by Ewins in Great Britain, and shown by Whitby to have special activity in pneumococcal infections, such as lobar pneumonia. The result of this development has the aspect of a revolutionary advance in therapeutics, and there will be general satisfaction, among medical research workers and physicians in all countries, that the Nobel Committee have thus recognized the pathologist whose initial discovery opened the way to such a great development.

Prof. V. L. Komarov

IN honour of his seventieth birthday and in appreciation of his great services to science, the Soviet Government has awarded the Order of Lenin (the highest Order in the Soviet State) to Prof. V. L. Komarov, president of the Academy of Sciences of the U.S.S.R. The name of Vladimir Leontievitch Komarov will always be inseparably associated with the flora of Manchuria. Komarov was attached to the Russian expedition to Manchuria in 1896, and during this and subsequent years made extensive botanical collections, duplicates of which were distributed to the principal herbaria of the world. The outcome of these collections was the valuable and detailed three-volume "Flora Manshuriæ", published in parts in the *Acta Horti Petropolitani* from 1901 until 1907. In 1908 Komarov joined the expedition of Theodor Pavlovitch Riabushinsky to Kamchatka, where he remained for two years, collecting assiduously. Accounts of the botanical results of the expedition were published by Komarov in "Zwei Jahre auf Kamtschatka" (1911) and in "Voyage en Kamtchatka en 1908–1909", forming part of the official account of the expedition (1913). During 1931–32, in collaboration with Mme. Klobukova-Alisova, Komarov published a "Key to the Plants of the Far Eastern Region of the U.S.S.R." in two volumes, and in 1934 appeared the first volume of the magnificently conceived and executed "Flora U R S S". This truly monumental work, of which at least seven volumes have already appeared in rapid succession, is the result of the collaboration of numerous Russian botanists under Komarov's general editorship. We sincerely trust that Prof. Komarov may live to see the completion of his crowning work.

German Culture in Prague

A REPORT from the Protectorate of Bohemia and Moravia announces that the German University of Prague has been reconstituted as a Reichsdeutsch University "to serve as a centre for German cultural expansion to the south-east of Europe". This status was made legal on October 1 and necessitates the appointment of Nazi professors to Prague. They are to be accompanied by a large body of students drawn from all parts of Germany. In the past, this German university in Czechoslovakia attracted many well-known specialists from Germany and Austria. Indeed, it was the policy of the former Czech Ministry of Education to encourage such appointments in order to ensure a high standard both of teaching and scientific research. The new appointments are, however, avowedly not for scientific advancement but for Germanization, a process that is being pursued also by the schools throughout the protectorate as well as in the Sudeten territory acquired by Germany in September 1938. Meanwhile, Czech and non-Nazi professors are drafted into labour corps. A number have succumbed to this inhuman treatment, including Profs. Charvat and Bělohradek. Despite the deplorable setback to science and learning in Central Europe, the Czechs are still attempting to continue with their investigations. An instance is afforded by the recent archæological excavations near Mělnik, where a prehistoric settlement has been unearthed. The objects discovered are believed to date from the time when Slav tribes first settled in the Elbe valley.

The Linnean Society

IN addressing the Linnean Society of London meeting on October 26, the president, Dr. J. Ramsbottom, said that the Council had already taken steps before May last to protect the Society's treasures; the Linnean collections (specimens and books) were moved, and the medals and other valuables from the Iron Chest. Since the outbreak of hostilities the Smithian Herbarium and some smaller collections have been moved and stored in what is hoped to be a safe place. It is the unanimous decision of the Council that the Society should carry out its normal activities so far as is possible. This is in the best interest of fellows, of the Society, and of the subjects in which the Society is interested. Apart from the communications at meetings it is essential that biologists should have an opportunity for informa meeting at some central place in London. Therefor the Society is keeping its rooms open and allowin them to be used by other societies or bodies of biologists who are in need of such a meeting-place eithe for formal or informal discussions. In 1914 the time o meeting was altered from 7 o'clock to 5 o'clock becaus of moonlight nights—moonlight nights had bee favoured in the early days of the Society, befor streets were properly lighted. Now because of th black-out it is necessary to hold meetings earlier The next meeting will be held at 2.30 and the following—summer-time being ended—at 2.15.

Museums and the War

ON the outbreak of war many museums wer closed to the public, following the example of th various national museums under Government control It was a regrettable move on the part of the Government, for these institutions are centres of educatio and mild recreation, as well as repositories of valuab specimens, and the use of them would have been a welcome relief from more stern affairs to many of th public and the troops. Now in a pamphlet issued b the Board of Education, entitled "The Schools i War-time" (Memorandum No. 4), "The Use o Museums" is discussed, and we have the curiou spectacle of the president of the Board of Educatio urging the value in war-time of museums and urgi the use of museums, while those museums over whic he has some measure of control remain closed Nevertheless the policy which he urges in thi pamphlet is the right one, and War Circular No. of the Museums Association on "Museums and th War" gives a lead. Not only is it desirable, accordin to this circular, that existing museum services shoul continue, but also that additional educationa services should be provided. Ways are shown i which museums can help. It is probable that i many cases reduction of staffs may render specia efforts impossible; but it is not a serious matter t make halls and galleries, as many as the number o attendants will allow, available for the public.

The Electrical Grid in Great Britain

IN view of the decision of the Institution o Electrical Engineers to hold no meetings of th Institution in London during the first half of th session, a copy of the address of Mr. Johnston Wright, president of the Institution and chairma of the Central Electricity Board, which he would hav delivered normally on October 26, has been posted t every member in the United Kingdom and Eire. Hi choice of the construction and operation of the Gri as the subject of his address was a happy one, owin to the significant coincidence that the incomin president on the outbreak of the War of 1914–1 was the late Sir John Snell, to whose vision, enthusiasm and advocacy the Grid is so largely due. Th deficiencies in national electrical organization reveale by that war resulted in the establishment of the Grid It is not too much to claim that the Grid has a vit national role in the present struggle. The Grid con uction and standardization of frequency planned comparative prosperity of 1924–29 and carried t largely in the period of acute depression which lowed, resulted in a large increase above the rmal capital expenditure of the industry at a time en such expenditure was most needed. The policy d the valuable effect of affording manufacturers in eat Britain extensive and intensive experience in igning and constructing large high-voltage power nt, thus putting them in a position of equality th their competitors abroad.

In 1924–25 seventeen different frequencies were ployed in the A.C. system of Great Britain. The perts advising the Weir Committee considered that standardization desirable for grid purposes, if dertaken in 1924, would cost 10½ million pounds rling. By the time the work was actually put in nd, on dates spread over the period 1928–30, the imated gross cost was 18½ million pounds. The ual expenditure when the work was complete was 3 millions, some part of which is recoverable. Had decision to standardize been delayed until the sent time, the cost would have been well over millions. The savings attributable to the Grid tem, already large, would not have been on the ne scale had standardization not been undertaken. e national defence requirements have undoubtedly n simplified by the existence of a national standard quency basis. In conclusion, Mr. Johnstone Wright d that the parts to be played by the Institution mproving and developing the personnel and equipnt required by the electrical industry and in thering the cause of international engineering operation, are both onerous and honourable.

incarnation of a Dalai Lama

During the five years which have elapsed since death of the Dalai Lama of Tibet, reports have peared of the progress made in the search for his cessor. According to Lamaistic belief, when a lai Lama dies, his spirit is reincarnated in the dy of his successor, born at the moment of his th. The records of early travellers in Tibet bear ness to the elaborate precautions taken to ensure true succession to the holy office, and the careful, everent, regimen to which its youthful occupant subjected. Lhamo Dhondhup, the new Dalai ma, now some five years of age, was born in odo Ari, near Kumbum, in Silling and at his th there was a rainbow over the house. Some rticulars of the signs by which the authenticity of reincarnation was attested, as reported from bet, are transmitted by the Delhi correspondent of e *Times* in the issue of October 29. Not only d the existence of the reincarnated Dalai Lama d his whereabouts been indicated in a vision, ording to precedent, but also when visited by e search party, disguised as traders, he recognized ir holy calling and distinguished between the tus of the individuals who composed the party. took hold of the rosary which had belonged to e late Dalai Lama, telling the beads and repeating the Buddhist formula "Om Mane Padme Hum". In a further test, when the Dalai Lama's rosary, small drum and walking stick were offered him, he chose those which had been his own in his previous incarnation in preference to the replicas presented to him at the same time—a test in which another aspirant to the office failed.

African Studies

In "African Survey", Lord Hailey, in discussing the future of African studies, stressed the fact that there was no less need for organized research in the social sciences than in the natural sciences. It was inevitable in a survey of so wide a scope that any recommendations made would cut across existing activities. This was recognized in the credit accorded to existing organizations, in which prominence was given to the work of the International Institute of African Languages and Cultures, not only on account of its specific interests, but also on account of its facilities for collecting information through its international relations. In the recently issued report of the Executive Council of the Institute (*Africa*, **12**, 4, 1939) it is recalled that discussion of plans for future research had been postponed pending the publication of Lord Hailey's "African Survey". It is now announced that on the appearance of that report, the authorities of the Institute initiated conversations with Lord Hailey with the view of obviating the dangers of overlap in a common field and competition in the sources from which funds are derived. The possibilities of co-operation are now under discussion, and a scheme for associating the continuation of the Hailey Survey work with the work of the Institute has already been approved in principle by the Council for elaboration by the Institute's officers.

British Museum (Natural History): Recent Acquisitions

Mr. Robert W. Oates has presented a portrait of J. J. Audubon, the father of American ornithology. This portrait is a copy by Lance Calkin of the so-called hasty portrait which Audubon drew of himself in Liverpool in 1826, and which was reproduced in Buchanan's life of Audubon. Unable to find sufficient subscribers in the United States for his projected work on the birds of America, Audubon, at the age of forty-one, came to England for the purpose of finding additional supporters. After visiting a large number of towns in England and Scotland, exhibiting his pictures and meeting a number of well-known people, Audubon collected sufficient subscribers to enable him to commence publication of "The Birds of America". This great work—unique of its kind—was published in London in four volumes (elephant folio), with life-size drawings of the different birds, between 1827 and 1838. Mr. J. F. Marshall has presented to the Trustees five large oil paintings of birds by R. Havell, who engraved many, if not all, the illustrations for Audubon's book.

A beautiful specimen of foliated gold in quartz, probably of Australian origin and formerly the property of the late Walter Claude Johnson, founder of Messrs. Johnson and Phillips, has been presented to the Department of Mineralogy through his friend Mr. G. Leslie Wates. Further gifts of tourmaline, sapphire and hæmate from Burma have been made by Mr. A. C. D. Pain. A new find of tektites, small glass bodies of curious shape and unknown origin, has recently been made in Texas and a few good specimens have been acquired by exchange with the University of Texas. Also a slice of the New South Wales meteoritic stone Narellan, new to the Museum collection, has been acquired by exchange with the Australian Museum. Among the few purchases approved by the Trustees are included two good crystals of olivine from the Red Sea, and some parti-coloured tourmalines and cordierite from Brazil. The Department of Botany has received about 1,750 plants from North Burma and Assam collected by Captain F. Kingdon Ward on his latest expedition. He visited China intending to proceed to the Shan States and south-west Yunnan, but after six weeks (a month of which was spent under open arrest) he left China and went to North Burma. In 1938 he spent six months in the Eastern Himalayas and then joined the Vernay–Cutting expedition to the Burma-China frontier.

Electric Propulsion at Sea

A. C. HARDY, in the *Electrician* of October 13, discusses the part that electrically propelled ships are likely to play in the present conflict, and whether this is likely to have a great effect on the future of electrically propelled and Diesel-electric ships. A number of coasters use Diesel generating power not only for propulsion but also largely for winches, windlass and other ancillary purposes. In Amsterdam, turbo-electric vessels are being built and they are now fitting out a pair of 'units' with a special method of propulsion. One of these two ships is the passenger and cargo turbo-electric vessel *Josef Stalin*, designed by the Netherlands Shipbuilding Co. for the Soviet Government, in accordance with the requirements of the U.S.S.R. Shipping Register. This vessel and her sister ship have accommodation for 48 first-class, 164 second, and 296 third-class passengers and also a crew of 102. They have a length of about 133 metres overall with a beam of 18·5 metres, a depth of 9·65 metres and a gross tonnage of about 7,500. It is stated that their turbo-generators deliver about 14,000 S.H.P., to the two shafts. In this respect, on two screws the new ship will develop within 1,000 h.p. of the maximum output of the big German liner *Patria*, the largest Diesel-electric ship afloat. The *Josef Stalin* and her sister ship are expected to have a speed of about 20 knots and they will be among the fastest electric ships in existence. Three large turbo-electric all-welded vessels which were launched recently in the United States have made a great step in advance by using very high pressure and very high temperature steam. If the future should show that there will be a demand for Diesel engines applied to ships having even higher powers than they have at present, it looks as if the struggle for supremacy would lie between Diesel-electric A.C. drive and Diesel-geared drive.

Recent Earthquakes

DR. G. VAN DIJK of the De Bilt (Holland) seism logical observatory recorded fifteen large eart quakes during August and fourteen during Septemb 1939. One of the largest recorded at De Bilt w that of August 3, which probably had an epicent 2,350 km. from De Bilt in an approximately easte direction. Preliminary determinations of epicentr have been made by the United States Coast a Geodetic Survey in co-operation with Science Servi and the Jesuit Seismological Association showi the earthquake of August 12 to have been in t north Pacific Ocean off Japan, that of August 24 the Pacific Ocean near Central America, and that August 26 in the Pacific Ocean near the New Hebride The somewhat deep focus (60 km.) earthquake September 8 had an epicentre in lat. 51° N., lon 175° E., just south of the Andrean Islands, which a part of the Aleutian Islands. This was near t epicentre of the very strong 'missing earthquake' November 10, 1938. The shock of September had its epicentre near the island of San Luis in t Gulf of California in a region which is liable to sm earthquake shocks. Kew reported that six stro earthquakes were registered on the seismograp during September, the latest to be record being on October 10, with a possible epicentr distance of 88° and rather deep focus (75 km.).

Forestry Abstracts

THE Imperial Forestry Bureau at Oxford h commenced the issue of a publication entitl *Forestry Abstracts*. The lines upon which this quarter journal, as it is designated, are based, follow those the well-known *Experiment Station Record* of t United States Department of Agriculture, which now in its eightieth volume. This latter publicati is not, however, confined to forestry. *Forest Abstracts* is intended to record in the Engli language brief reviews and précis of the curre forestry literature of the world. The general idea that each issue will include short reviews of literatu in different branches of forestry, with notes annual forestry reports, and abstracts classified subjects. "In the abstracts the aim is to epitomi the contents of each paper so as to enable the read to judge of its value as a contribution to knowledg The subject headings are as follow : General Forestr Fundamental Natural Laws of the Forest ; Tr Species ; Forest Botany ; Forest Zoology ; Syl culture ; Utilization ; Technology ; Protectio Increment, Yield ; Management, Working Pla Surveys ; Economics ; Administration ; Policy.

Indian Journal of Entomology

WE have received a copy of the first issue of new zoological periodical entitled the *Indian Jour of Entomology* (vol. 1, pts. 1 and 2. June 1939). Th journal is to be published twice a year by the En mological Society of India and the subscription pr abroad for non-members of that Society is Rs. per annum. All communications should be addres to the General Secretary, Entomological Society dia, Agricultural Research Institute, New Delhi, dia. It is intended to publish papers on both pure d applied entomology, besides short notices about w. books and reviews of recent research, etc. The ief editor is Dr. Hem Singh Pruthi who, with five her Indian entomologists, forms the editorial ard. The present number is well produced; it ntains eight scientific articles and runs to 137 pp. gether with illustrations. We wish this new journal ery success, and if it results in the 'localization' of uch future Indian entomological work within its ges, instead of the present diversity of sources for publication, it will prove a definite boon to orkers all over the world.

bliography of Drosophila

Students of genetics have for a long time past eded a guide to the immense amount of genetical rk done on Drosophila. This need has been pplied by the publication of a "Bibliography the Genetics of Drosophila" by the Imperial ureau of Animal Breeding and Genetics. Dr. H. J. uller has compiled not only papers of special terest to workers on Drosophila, but also those ore general papers which shed light on problems hich affect both Drosophila and genetical thought. e bibliography is particularly valuable in that it ovides cross references where several authors are volved in one paper, and in the adequate reference Russian literature.

emical Club

The Chemical Club is continuing to function at its use at 2 Whitehall Court, London, there being od air raid shelters in the premises. There is a eling that the Club will be used more and more ring time of war, since enlarged acquaintanceship d cheerful association are definite factors in the esent national effort. The annual general meeting ll be held at the Club on Tuesday, November 14, 2 o'clock. The popularity of lunchtime meetings nce the war started is expected to result in a good tendance. The report of the executive committee r the year 1938–39 speaks of a year of successful cial and other activities. The Committee has nom- ated for the ensuing year Mr. F. Arnold Green as esident, Dr. H. E. Cox as chairman of the executive mmittee, and the continuation in office of the norary treasurer and honorary secretary, Dr. S. I. vy and Mr. F. J. Bullen respectively. The Com- ittee will recommend to the annual general meeting at in view of the number of clubs which are offering mporary membership to uniformed members of .M. Forces, the Chemical Club should provide rallel concessions by offering facilities, at a nominal bscription, to those who, although not in uniform, e engaged in London on Government work. This mporary measure is one likely to be highly prized chemists and others so situated.

orld Power Conference

Ir. G. J. T. Bakker, chairman of the Netherlands ational Committee of the World Power Conference, as agreed to become acting chairman of the International Executive Council of the Conference during the War. Correspondence intended for the International Executive Council should be addressed to the Secretariat, International Executive Council, World Power Conference, Vereeniging voor Congressen op Electrotechnisch en Aanverwant Gebied, Utrechtscheweg 210, Arnhem, Holland. Correspondence for the British National Committee should, as at present, be addressed to 36 Kingsway, London, W.C.2. Orders for any World Power Conference *Transactions* should be sent to Messrs. Percy Lund, Humphries and Co., Ltd., Country Press, Bradford. Orders for the publications of the Central Office of the World Power Conference, including the Statistical Year-book of the World Power Conference, should be directed to the British National Committee. Special arrangements have, however, been made with respect to "Technical Data on Fuel", orders for which will be dealt with by the Secretary, Society of British Gas Industries, Uplands, Epsom Road, Guildford, Surrey.

Announcements

Prof. E. Schrödinger is now in Dublin, and is delivering a course of lectures which began on November 3 at University College, Dublin, under the title "An Elementary Introduction to Wave Mechanics".

Dr. Icie Macy-Hoobler, director of the research laboratory of the Children's Fund of Michigan, Detroit, has been awarded the 1939 gold medal and the thousand dollars prize of the Borden Company for outstanding research achievement in applied nutrition.

In view of the importance of chemical engineering at the present juncture, the Ramsay Laboratory of Chemical Engineering at University College, London, has reopened, and students will be accepted for training in chemical engineering and research forthwith.

Meetings of the Quekett Microscopical Club are taking place on the third Saturday afternoon of each month at 2.30 p.m. in the Club's rooms at 11 Chandos Street, Cavendish Square, London, W.1.

The general discussion on "The Properties and Testing of Heat Insulating Materials" organized by the Joint Committee on Materials and their Testing in conjunction with the Institution of Gas Engineers arranged for November 23, has been postponed.

Of the two million babies born annually in the United States seventy-five thousand are stillborn, and thirty-nine thousand die during the first month of life. Approximately twelve thousand mothers die from causes directly related to child-bearing, many of which are preventable through combined individual and community action.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 788.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Intensity of Mesotrons in the Upper Atmosphere

IN view of the well-established decay of the mesotron and of the magnitude of the sea-level latitude effect, it is now certain that all mesotrons found have been produced in the atmosphere. It is therefore of great interest to measure their intensities at different heights, particularly at levels where they may be expected to have been produced.

Balloon flights have been made near Edinburgh during the past summer with this object. Triple coincidence counters, shielded with 10 cm. of lead disposed equally between them, have been used. The counters were coupled to a radio transmitter, which was a modified form of that used by Carmichael and Dymond[1]. The thickness of lead was sufficient to absorb completely all electrons. In order to reduce the weight of absorber it was necessary to employ small counters, so that the ground rate of counting was only 0·4 per minute. Because of this small number, the statistical fluctuations in counting during the flights were high, and consequently a large number of flights would be required to obtain an accurate picture of the variation of intensity with height. As the work has now to be broken off, it seems desirable to record the results so far obtained.

Three flights have been made, which indicate that the intensity of vertically directed mesotrons rises to a maximum at a pressure of about 80 mm. mercury (16 km. height), the same point where the maximum for all particles (unshielded counters) occurs, and that its value at this height is approximately nine times the ground value. This should be compared with the increase of about forty times found by Pfotzer[2] and by Carmichael and Dymond[1] with unshielded counters. It is probable that the true increase is even less than this, as the counters, being only shielded in the vertical direction, can record showers coming in laterally. Soft showers of this nature are likely to be numerous at these altitudes, but at present there is no means of finding what correction must be made for them. At heights greater than that corresponding to a pressure of 80 mm. mercury, the intensity appears to decrease rapidly, but the rate of decrease is uncertain, due to the statistical errors mentioned.

These results are of particular interest when viewed in conjunction with Euler and Heisenberg's theory[3] of the intensity variation of mesotrons in the atmosphere. Their assumption that the maximum production of mesotrons occurs at the maximum of the normal transition curve in the atmosphere is shown to be correct.

Also, from the observed ratio of intensities at the ground and at the maximum, some conclusions as to the energy distribution of the particles at their formation can be made. Euler and Heisenberg have assumed that the number of mesotrons with energies greater than E is given by $J(E_0/E)^{\gamma}$, where $\gamma = 1 \cdot 87$. This is the same distribution as that of the primary particles as shown by the latitude effect, and th show that it leads to the correct energy distributi at sea-level. If we exclude all particles of energy le than $1 \cdot 2 \times 10^8$ ev., which will be unable to traver the lead between the counters, their results lead the total intensity at 80 mm. mercury pressure, bei 390 times that at the ground, compared with t observed value of nine.

The discrepancy can be removed, however, if assume that there is a minimum energy with whi mesotrons are produced of about 8×10^8 ev. If t energy distribution is cut off at this value, Eu and Heisenberg's expression leads to the right val of the intensity ratio at the two heights.

The method of formation of the mesotrons is st unknown, although there is some evidence that th are produced by protons and not by shower partic It should be noted, however, that the minim energy of primary electrons in the latitude of Edi burgh is 2×10^9 ev., which is degraded by show formation to from 5 to 7×10^8 ev. at 80 m pressure, the same order of magnitude as the mi mum energy of the mesotrons.

In conclusion, I must thank many of my colleag in the Department for their assistance with t balloon flights, and in particular Dr. C. B. Chil and Mr. A. Cowie.

E. G. DYMOND

Department of Physics,
University of Edinburgh.
Oct. 2.

---

[1] Carmichael and Dymond, *Proc. Roy. Soc.*, A, 171, 321 (1939).

[2] Pfotzer, *Z. Phys.*, 102, 23, 41 (1936).

[3] Euler and Heisenberg, *Ergebn. exact. Naturwiss.*, 17 (1938).

Absolute Measurement of Electrical Resistance

IN recent years, at Birkbeck College, attention h been given to various methods of measuring electric resistance absolutely. On the eve of war, this seri of researches has been brought to a conclusion. the development of a method in which the potent difference across a resistor is balanced by the avera E.M.F. of a commutating generator. Although Ros so far back as 1909, suggested such a method a proposed a form of apparatus, difficulties we encountered and no experimental data derived fro any form of this method have been published. T method is attractive in requiring only the measureme of a frequency and a maximum mutual inductance.

By a new method, the rotor is made to have su an extremely flat maximum of mutual inductan with the field coils that, over a range of some 1 in the neighbourhood of commutation, no E.M.F. generated. Further, over an adjustable portion this range, covering the actual commutations, t rotor together with additional resistance is sho circuited, thus enabling the E.M.F. across the resist to suffer no interruption but to supply instead t extra quantity of electricity absorbed by the rot virtue of its self-inductance, on establishment of current through it at each commutation. In this y the two main errors associated with break and f-inductance are set against one another, and utralization is readily effected by experimental test der conditions in which these errors are magnified. The apparatus is designed for the accurate and pid measurement of resistances of approximately e ohm. The rotor has a constant speed of 12·5 volutions per second, and the maximum mutual luctance of some 20,000 μH permits of fine justment within ± 1 per cent. An accuracy of a w parts in one hundred thousand has been attained. It is hoped to publish complete details of this vestigation elsewhere.

H. R. NETTLETON.

Birkbeck College,
London, E.C.4. Sept. 30.

---

oss, *Bull. Bur. Standards*, 5, 499 (1909). Cf. "Dictionary of Applied Physics", vol. 2, p. 226.

Interfacial Activity of Short-Chain Isomers

IT is well known that when two long-chain com-unds, stereoisomeric with one another around a uble bond, are adsorbed at a surface, they influence tension there to extents which differ according the effective chain length. Recent experiments me have shown that although the thermal agita-n of short-chain adsorbate molecules at a water – air erface prevents any appreciable fall in the surface sion of the solvent, orientation of many small lecules does occur at a water – oil interface. In ny cases this is sufficiently marked to reveal eresting differences in interfacial activity between rt-chain isomeric compounds, of classes not usually arded as surface active. Further, these differences be reproduced with an accuracy which enables h measurements to be used as a means of tinguishing between the isomers.

Experiments have been carried out on two stereo-meric thio-ether compounds of quadricovalent tinum (kindly supplied by Prof. W. Wardlaw). e results shown in Table 1 were obtained by thods previously described[1], and indicate that ile the *trans*-compound has no surface activity, attraction of the benzene phase for the ethyl ups is sufficient to cause appreciable orientation the *cis*-molecules at the interface.

Further evidence for the surface adsorption of rt-chain molecules is furnished by the dibasic ds. The results in Table 2 show that, although leic and fumaric acids are not sufficiently amphi-thic to be surface active, the additional methyl up in mesaconic and citraconic acids separates the drophobic and hydrophilic centres of the *cis*-mole-e sufficiently for orientation at the interface to ur. Similar well-defined differences can be observed der suitable conditions between *cis* and *trans* forms of benzaldoxime, and are to be expected with the isomeric diazotates.

TABLE 1.

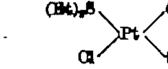
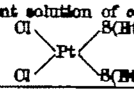
Interface Pure water and :	Interfacial tension (dynes per cm.)
re benzene	35 41
1 per cent solution of *trans* compound : 	35·30
1 per cent solution of *cis* compound : 	28·62

TABLE 2.

Interface Benzene and :	Interfacial tension (dynes per cm.)
Pure water	35·41
1 per cent solution of maleic acid	35·41
1 " " " fumaric "	
1 per cent solution of mesaconic acid (*trans*)	35·41
1 " " " citraconic acid (*cis*)	28·51

Differences in interfacial activity also existing between short-chain *structural* isomers such as the toluic acids, cresols, phthalic acids and butyl alcohols are regarded as additional evidence that interfacial orientation does, in fact, occur in many cases where the adsorbate molecules have been previously considered too small to display any marked amphipathy.

C. C. ADDISON.

Chemistry Department,
Harris Institute Technical College,
Preston, Lancs.

---

[1] Powney and Addison, *Trans. Faraday Soc.*, 33, 1243 (1937); 34, 356 (1938).

Fibre-Follicle Terminology in the Mammalia

A CONSIDERATION of recent investigations[1-4] into the early development of the coats and fibres of various breeds of sheep and also of other mammalian types suggests the need for a standard follicle nomenclature. It has been found that the types within the follicle population and their group arrangement in the skin of the fœtus and lamb are among the chief factors which determine what type of staple and fleece will be produced. It is obviously necessary, therefore, to agree upon a consistent terminology if research in this field is to be intelligibly co-ordinated. The accompanying table indicates the present confusion and incorporates our suggestion for a terminology which is simple and, on the basis of our present knowledge, adequate enough to cover all the important follicle types in the mammalian coat.

It is now well established that the basis of the follicle bundle is usually the trio group, that is, a group of three follicles which in the sheep has a special significance in that it produces certain special types of fibres. Other and smaller follicles develop later in association with each trio to complete the follicle bundle. First, then, there are these two clearly defined growth stages, namely: (1) the phase leading to the formation of the trio group; (2) the succeeding or post-trio phase.

In order to make the distinction clear, we suggest that those follicles which are differentiated during the first phase should be termed *primary follicles*, and those comprising the second phase, *secondary follicles*.

All the trio follicles are therefore primary, but in some types it is possible to subdivide the central members of the trios into two categories, namely: (1) those which are differentiated early in the first phase; (2) those which are differentiated later in the first phase.

The earlier and therefore more advanced series of central trio follicles we now term *primary X follicles* and those which belong to the later stages of the first phase, *primary Y follicles*. It is important to add, however, that, at least in the Merino breed, not all primary *X*- or *Y*-follicles become the central members of a trio. Occasionally one remains separate

FOLLICLE TERMINOLOGY, NEW AND OLD

Proposed New Terminology	Duerden (1939)	Gibbs (1938)	Galpin (1935)	Wildman (1932)	Toldt (1911) and Hofer (1914)	Spottel and Tanner (192
PRIMARY FOLLICLES	— TRIO FOLLICLES					
(a) Central trio follicles — *primary X* *primary Y*	— (a) central trio follicles	— primary follicles secondary follicles	— X follicles Y follicles	primary follicles secondary follicles	—Mittelhaar follicles	Leithaar follicles
(b) Lateral trio follicles — *primary x* *primary y*	— (b) lateral trio follicles	— tertiary follicles	— x follicles y follicles	lateral trio follicles	Stammhaar follicles	
(c) Couplet follicles — *primary X + x* *primary Y + y*						
(d) Solitary follicles — *primary X or Y*						
SECONDARY FOLLICLES	POST-TRIO FOLLICLES	Quaternary follicles			Beihaar follicles	Gruppenhaa follicles

and distinct throughout the whole period and may be termed a 'solitary' follicle. A few may become associated during the first phase with only one lateral follicle, and these have been termed 'couplets'.

We are of the opinion that this terminology, whilst it recognizes the follicle types described by other workers, eliminates confusion by clearly distinguishing the follicles characteristic of the two main growth phases which are so important in any consideration of the basis of fleece structure.

A. B. WILDMAN.

Wool Industries Research
Association,
Headingley, Leeds.

H. B. CARTER.

McMaster Animal Health
Laboratory,
Glebe, Sydney. Oct. 11.

---

[1] Duerden, J. E., (posthumous paper), *Trans. Roy. Soc. Edin.*, 59, Pt. 3, No. 23 (1938–39).

[2] Galpin, N., *J. Agric. Sci.*, 25 (1935).

[3] Gibbs, H. F., *Proc. Zool. Soc. Lond.*, B, 108, Pt. 3 (1938).

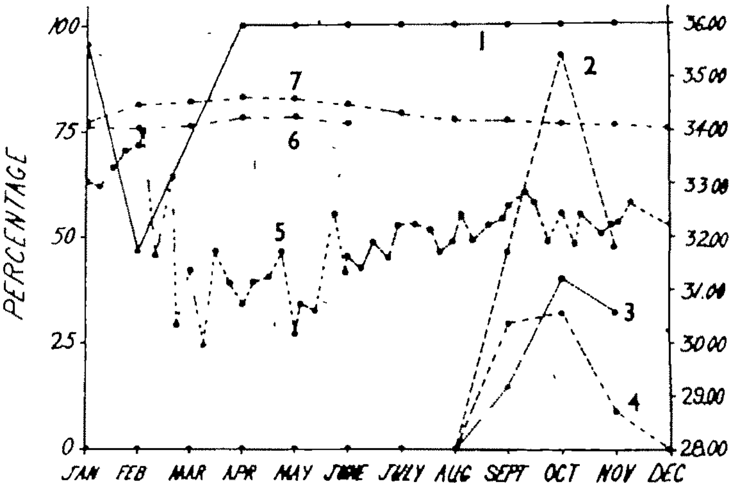
[4] Wildman, A. B., *Proc. Zool. Soc., Lond.*, Pt. 2 (1932).

[5] Carter, H. B., (unpublished), (1939).

Sagitta as an Indicator of Water Movements in the Irish Sea

IN a recent study[1] on the occurrence of the planktonic genus Sagitta in weekly collections at Port Erin 1928–37 (excepting 1935) and the Mersey Channel, Morecambe Bay, Anglesey coast 1937, interesting facts have emerged. It seems desirable to give some of the results here pending publication of the whole. Two species are found: *S. elegans* Verrill, the oceanic form[2], is predominant at Port Erin; *S. setosa* J. Muller, the coastal form, is predominant in Liverpool Bay and is recorded here for the first time. *S. elegans* is absent from the Liverpool district until February–March, when an influx occurs correlated with the appearance of high salinities (see graph). *S. setosa* is absent from Port Erin until September–December with a maximum in October (see graph). These interchanges of species occur at about the periods of the equinoctial tides and indicate (*a*) extensive mixing of inshore and offshore waters in the greater volume and movements of the equinoctial tides, and (*b*) the occurrence of relatively stable bodies of water in Liverpool Bay in periods between the equinoxes. The occurrence of relatively stable bodies of water oscillating in estuaries l long been known, but stability in an open bay su as Liverpool Bay is of great interest and worthy further investigation.

S. elegans appears to have one main spawni period, January to May, while *S. setosa* appears have at least two, namely, April to June and Augu. The winter brood of *S. setosa* attains a larger aver size than the summer brood.



PERCENTAGE *S. setosa* IN TOW-NETTINGS IN THE LIVERPOOL DISTRICT 1937 AND AT PORT ERIN 1928–37 (EXCEPT 1935) ARE GIVEN WITH SALINITY READINGS ‰ AT THE BAR LIGHTSHIP (1937) AND MEAN MONTHLY SALINITIES AT PORT ERIN FOR 1936 AND 1937.

S. setosa		Salinity	
1. Liverpool District 1937	3. Port Erin 1936	5. Bar Lightship 1937	7 Port Erin 19
2. Port Erin 1937	4. do. 1928–34	6. Port Erin 1937	

Data on the rates of growth, time of sexual matur and relative abundance of the two species at differ seasons of the year, with a discussion on sexual cycles, will, it is hoped, be given by one of (E. L. P.) later.

We are indebted to the Oceanography Depa ment at the University of Liverpool and the staff the Port Erin Biological Station for the data salinity.

E. LOWE PIERCE
J. H. ORTON.

Department of Zoology,
University of Liverpool.
Sept. 8.

---

[1] Pierce, E. Lowe, Thesis, Cohen Library, University of Liver (1938).

[2] Russell, F. S., *J. Mar. Biol. Assoc.*, 20 (2), 309 (1935).

Sponge Mortality at British Honduras

A HEAVY mortality among commercial sponges, similar to the Bahamas mortality reported by Galtsoff, Brown, Smith and Smith[1], has appeared among sponges off the coast of British Honduras. The disease appeared first in the Bahamas in December 1938, on the north coast of Cuba in February 1939, and at Key West, Florida, in March. Losses were first reported from British Honduras in June and continued to appear during July and August.

Investigations were carried out in British Honduras by me during August and have yielded the following results.

The sponges, for the most part under cultivation, grow upon grounds within Turneffe lagoon, which is enclosed by islands and communicates with the sea by small creeks and larger channels. The sequence of infection, as recorded by Government and private sponge planters, has followed the general trend of water movements within the lagoon. Originating near a large opening from the sea, the mortality spread first to the more open waters to leeward and only later appeared in more deeply embayed areas, and in areas broken up by small cays.

During the months of April, May and June rainfall was less than 25 per cent of the amount recorded in previous years and water temperatures were generally higher. There is evidence that the salinity during June reached very high values, but unfortunately accurate figures are not available. In July and August the conditions of drought, high temperature and salinity were replaced by normal conditions, and in August accurate determinations placed temperature and salinity within the range of observation for previous years, although the mortality remained unchecked.

Examination of plankton collected with 120 mesh per inch silk townet during August showed no unusual constituents or abnormal quantities of the species normally present. In accordance with previous examinations, a general paucity of life was disclosed.

The microplankton was also poor, except for the presence of bacteria, considered to be the food of the sponges. Bacterial examination showed 2,000–30,000 organisms per c.c. in various parts of the lagoon during August. This compared with 2,000–25,000 observed during May.

No unusual mortality was observed among other forms of life in the lagoon. Non-commercial sponges remained unaffected by the disaster.

Microscopic investigation disclosed the presence of fungus-like filaments in the great majority of dying sponges examined. In appearance, spread of infection through the individual sponge, and greater abundance in the transition zone between dead and living tissues, the organism was indistinguishable from that held probably responsible for the Bahamas disease. Apart from the fungal filaments no organisms have been observed other than those characteristically appearing after the onset of decay.

The successive appearance of the mortality at Key West and at Turneffe and the local progress of the mortality along the path of water currents renders it probable that the disease organism was transmitted from Key West to Turneffe by an ocean current. The strong current running counter to the Gulf Stream along the shores of the Gulf of Mexico and the Gulf of Campeche has a velocity varying from 0·5 to 2 knots. The time elapsed between the appearance of sponge damage at Key West and at Turneffe is ample for transmission of the organism by this current.

At the time of writing no further damage has been reported from Turneffe since the middle of August.

F. G. WALTON SMITH.

Sponge Fishery Investigations,
Nassau, N.P., Bahamas.
Sept. 11.

---

[1] NATURE, 143, 807 (1939).

Transplants of Sea-Island Cotton

WITH regard to the statement made by Prof. Macbride in NATURE of February 4, p. 205, that "the effort to transplant sea-island cotton from islets off the coast of Carolina to other parts of the world has resulted in failure. In a few years the transplanted cotton reverts to the native stock", the following facts, which do not quite support this view, may be of interest.

Sea-island cotton has been grown at the Government Agricultural Farm, Sakrand, Sind, for at least ten years, and the samples raised at this Farm have been regularly tested at this Laboratory since 1929–30. It has been found that in the second year of tests (1930–31) the mean fibre-length dropped from 1·44 in. to 1·25 in., but since then it has remained more or less the same with the exception of 1936–37 when it declined temporarily to 1·18 in. The mean fibre-weight per inch has remained remarkably steady at about $0{\cdot}117 \times 10^{-6}$ oz. From the Farm the cotton spread to the cultivators' fields, and in 1935–36 the area under its cultivation stood at 1,400 acres, giving a crop of about seven hundred bales. Since then the area has decreased sharply, not because of any deterioration in its fibre-properties, but because of its poor yield, which prevented the cultivators from getting adequate monetary return for their labour.

It will thus be seen that at least during the last ten years it has not reverted, when grown in Sind, to the native stock, which is a *neglectum* type having a mean fibre-length of about 0·70 in. and a fibre-weight per inch of about $0{\cdot}300 \times 10^{-6}$ oz., that is, nearly half as long and three times as coarse in staple as the Sind sea-island cotton. Its yield, however, has not been satisfactory, and it may be said to have failed on that account.

NAZIR AHMAD.

Cotton Technological Laboratory,
Matunga, Bombay.
Sept. 1.

Myzus ornatus a Vector of Potato Viruses

TOWARDS the end of 1932, aphids later identified as *Myzus ornatus*[1] were found feeding on clover plants in a glasshouse at the Agricultural College, Glasnevin. The species has since been recorded on a wide host range which includes potatoes, a fact which prompted the carrying out of tests to ascertain the efficiency of this species as a vector of potato viruses.

It was used in three separate trials as a vector of leaf roll, and the results showed that out of sixteen healthy potato plants colonized with *Myzus ornatus* from a leaf roll source, ten developed leaf roll. In two trials as a vector of virus Y, five out of sixteen healthy potato plants became infected with this virus. Negative results have so far been obtained in trials with viruses X and A.

Myzus ornatus has been found to only a very slight extent feeding on field crops of potatoes in Eire, consequently it is probable that it is not important as a vector of potato viruses under field conditions. In view of its wide host range and of the above results, and on analogy with *Myzus persicae*, it is probable that *Myzus ornatus* may act as a vector of viruses of crops other than the potato.

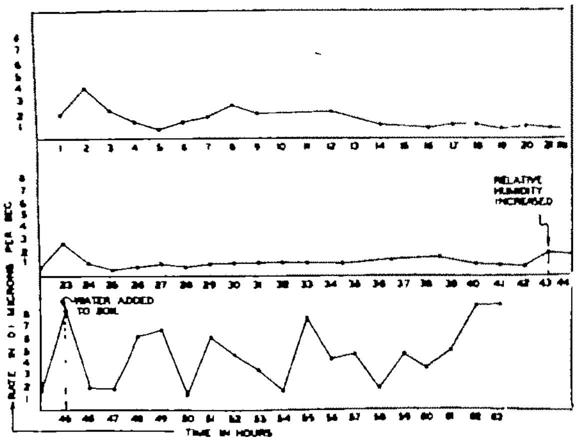
James B. Loughnane.
Albert Agricultural College,
Glasnevin,
Dublin.

---

[1] Laing, F., "A new Aphid-Pest of Violets", *Ent. Mon. Mag.*, 68, 52-53 (1932).

Determination of Growth-Rates by the Optical Lever Method

Rhythm was suspected to occur in the growth-rates of seedlings but it could not be detected with the ordinary microscopic methods. The method described here is promising and proved to be accurate and practical.



Rhythm in cell proliferation is habitually retained in spite of certain variations in the periodicity which are induced by changes in the environmental factors. This kind of rhythm cannot be detected directly, but only by means of histological methods. Growth by cell enlargement increases the bulk considerably in a short time, which makes it probable that a sufficiently sensitive method should make it possible to detect rhythm by direct measurement of growth rates, if it exists at all.

There is good reason for thinking that the elaboration of phytohormones of the bios group and that of the phytohormones of the auxin group are correlated. Since the bios factors regulate the process of cell proliferation and the auxin factors regulate cell enlargement, it is probable that rhythm in cell enlargement must exist and that it is correlated to the rhythm observed in cell proliferation. The optical lever method should yield satisfactory evidence of rhythm if it exists.

The optical lever method offers several advantages over the microscopic methods. It is not necessary to mark the seedling; the seedling need not be disturbed during the period of observation; the seedling need not be exposed to light; the factors influencing the growth-rate may be controlled during the observation; the scale reading varies constantly with the growth and may be recorded at any time; the sensitivity may be increased beyond the limits possible in the microscopic method. In the set-up which we employed in recent experiments the direct reading was 0·002 mm.

A galvanometer mirror was mounted on the balance wheel of a watch movement. It reflected a beam of light, coming from a scale, which turned through an angle that was twice as great as the angle through which the wheel turned. The beam was observed through a telescope, where the scale was read with the aid of a reticule. A light glass arm was mounted on the wheel and had a small bead on the distal end. The movement of the growing point turned the wheel. Friction at the point of contact was slight, and in the jewel bearings of the wheel, negligible. The moment of inertia of the system was small. A force of 5 mgm. applied at the bead was sufficient to raise the lever arm. If the wheel was turned through an angle that was greater than was permitted to obtain accurate results, the scale reading was automatically thrown out of view. The elevation of the arm produced by growth was easily compensated by means of a rack and pinion adjustment mounted on the standard which carried the system. Without this arrangement the optical lever method would not be practical.

The displacement of the bead is determined from the formula:

$$E = \frac{pp'}{2D} \times L,$$

in which E is the displacement; pp' the difference in consecutive scale readings; L the length of the lever arm and D the distance from the scale to the mirror.

D was determined directly and found to be 4456·0 mm. L was determined approximately with callipers at first and then precisely by using the formula, but determining E with a measuring microscope. It was found to be 20·50 mm. By actual trials the probable error for our set-up was found to be less than 0·2 microns.

The seedling was placed on an adjustable stand which made it possible to bring the growing point into contact with the bead without disturbing the set-up, which was adjusted so that readings could be taken immediately after contact was made. This feature is of practical importance in the method.

The seedling was kept in a chamber which had an adjustable side. This side had a small aperture through which the beam of light could go to and from the mirror. The chamber made it possible to control the light, the temperature and the relative humidity.

One example will suffice to illustrate the method. The seedling grew in a substratum of peat and sand. It was watered with standard Knop solution at the time of planting and not again except forty-five hours after recording had begun. Seventy-two hours after planting, when the hypocotyl was just emerging from the soil, contact was made between the hypocotyl and the bead. The temperature was 72° F. throughout the period of the experiment; the relative humidity was 90 per cent before the recording began, 70 per cent for the first forty-three hours of recording and 95 per cent for the remaining hours.

The growth-rate is given graphically in the accompanying figure. It increased somewhat with the relative humidity and the increment could be noted after six minutes. The addition of water to the soil increased the rate very much, which was noted one nd one half minutes after watering, and made the eriodicity much more pronounced.

The plant never ceased growing. The periodicity as evident before and after the changes in the nvironmental conditions. The average value of the rowth-rate was calculated for each hour of the three ycles. From the values obtained, the general verage rate of growth was obtained and found to e 1·092 mm. per hour. Employing this value the alculated final height was 6·8 cm. By actual easurement it was found to be 6·4 cm. The evidence ustifies the conclusion that the method is accurate nd practical.

William A. Beck.

Institutum Divi Thomae,
Athenaeum of Ohio,
Mount Washington,
Cincinnati.
Sept. 7.

lavin-Adenine-Dinucleotide in Tissues of Rats on Diet Deficient in Flavin

Ochoa and Peters[1] found cocarboxylase decreased n tissues of pigeons fed on a diet deficient in vitamin B_1. Axelrod and Elvehjem[2] reported a diminution f cozymase in tissues of animals on a nicotinic acid ree diet. We now find a similar diminution in the lavin-adenine-dinucleotide content of boiled extracts f tissues from rats fed on a diet deficient in flavin. he rats (average weight 35 gm.) were fed a ynthetic diet of rice starch, casein (alcohol extracted), alt mixture, supplemented by cod liver oil, crystalline itamin B_1 hydrochloride, a 50 per cent alcohol east concentrate[3], and a liver filtrate from a revious fuller's earth and franconite adsorption. hese supplements were flavin-free.

Mean flavin-adenine-dinucleotide content of rat tissues (expressed in μ gm./gm. fresh tissue).

Group	Diet	No. of animals	Mean weight increase (gm. ± 2 × S.E. mean)	Tissue	Mean nucleotide (± 2 × S.E. mean)
A	Flavin deficient	6	14·9±4·0	Brain	10·5±0·6
				Heart	38·0±5·0
				Kidney	72·4±11·0
				Liver	40·7±10·0
B	Flavin deficient plus 50 μ gm. flavin per day	6	79·8±14·0	Brain	13·0±2·2
				Heart	93·2±17·9
				Kidney	78·6±12·5
				Liver	87·3±22·2

The nucleotide was determined after the method f Warburg and Christian[4], and solutions standardized from a pure specimen kindly sent by Prof. O. Varburg. Group A, fed the above diet for 5 weeks, ncreased in weight but slightly (see table), while roup B, receiving in addition 50 μgm. flavin per day, ad a normal growth rate. Some rats in Group A howed a dermatitis, especially around the eyes, and thers (results not recorded in table) died before the onclusion of the experiment. It is seen that the ean flavin-adenine-dinucleotide values of Group A re all lower than those of Group B. This is especially o in the case of heart and liver tissue. Application of isher's *t* test to the difference of means of the heart nd liver figures gives *t* = 6·1 and 3·81 respectively. or *P* = 0·01, *t* = 3·17. These figures are thus early significant, and afford direct evidence of a urther instance of a deficiency in the vitamin B omplex affecting biological oxidation systems.

These results will be reported in detail elsewhere.

We are indebted to the Nuffield Trustees and the Hildebrand Harmsworth Trustees (Merton College) for financial support.

Note added in proof. In a letter which has just appeared (Nature, 144, 670; 1939) Axelrod, Sober and Elvehjem report a decrease of *d*-amino-acid oxidase in kidney and liver of rats fed on a flavin-deficient diet, suggesting a deficiency of its coenzyme. Our own independent results furnish the direct proof of this.

S. Ochoa.
R. J. Rossiter.

Department of Biochemistry,
Oxford.
Sept. 18.

---

[1] Ochoa and Peters, *Biochem. J.*, 32, 1501 (1938).

[2] Axelrod and Elvehjem, Nature, 143, 281 (1939).

[3] Kinnersley, O'Brien, Peters and Reader, *Biochem. J.*, 27, 225 (1933).

[4] Warburg and Christian, *Biochem. Z.*, 298, 150 (1938).

Mechanism of Decomposition of Hydrogen Peroxide by Catalase

We have recently suggested[1] that the decomposition of hydrogen peroxide by catalase is brought about by the successive reduction of the catalase iron by the peroxide and its re-oxidation by molecular oxygen; the reaction proceeding according to the following equations:

$$\begin{array}{l} 4Fe^{\cdot\cdot\cdot} + 2H_2O_2 = 4H^{\cdot} + 2O_2 \\ 4Fe^{\cdot\cdot} + 4H^{\cdot} + O_2 = 4Fe^{\cdot\cdot\cdot} + 2H_2O \\ \hline 2H_2O_2 = 2H_2O + O_2 \end{array}$$

The evidence supporting this suggestion can be summarized as follows:

(1) It can be shown spectroscopically that the trivalent iron of azide- or hydroxylamine-catalase is rapidly reduced by hydrogen peroxide, although a powerful reducing agent such as sodium hyposulphite reduces neither the free catalase nor its azide or hydroxylamine derivatives.

(2) The reduced azide- or hydroxylamine-catalase is readily re-oxidized by molecular oxygen but not by hydrogen peroxide or potassium ferricyanide[2].

(3) It has been demonstrated manometrically that the complete removal of oxygen inhibits the catalytic activity of the enzyme by at least 88 per cent in acid phosphate solution and only by 40–70 per cent in a more alkaline phosphate buffer solution. The remaining activity of the enzyme in these experiments is due to a slow non-enzymic decomposition of hydrogen peroxide, which increases with the *p*H, and which liberates a sufficient amount of oxygen to promote the catalytic activity of the enzyme[1].

In our oxygen-free manometric experiments, strong or even complete inhibition of catalase was obtained only when the non-enzymic decomposition of hydrogen peroxide was almost completely abolished. The formation of oxygen during the experiments from non-catalytic decomposition must be avoided because, according to the cyclic mechanism of decomposition proposed by us, the slightest trace of oxygen can, by initiating a series of oxidations and reductions, bring about an extensive decomposition of hydrogen peroxide limited only by the stability of the enzyme preparation. The experiments, therefore, had to be carried out in absence of impurities containing other catalytic metals or hæmatin compounds, at a low *p*H, in thoroughly cleaned flasks and using purified reagents. Moreover, the small amount of oxygen evolved from hydrogen peroxide even under these conditions was rapidly eliminated from the solution by shaking it vigorously in a thin layer.

Our results have been challenged, however, by Johnson and Schouvenburg[3], who claim to have been able to demonstrate that the catalytic decomposition of hydrogen peroxide by catalase may take place in the complete absence of molecular oxygen. Their evidence is derived from a qualitative experiment showing that hydrogen peroxide added under strictly anaerobic conditions to luminous bacteria is decomposed by the catalase of these bacteria. The liberation of oxygen is shown by the appearance of luminescence in these bacteria, which was previously extinguished owing to the complete absence of oxygen. These experiments have been carried out with catalase of living and lysed bacteria, naturally in the presence of a great many of other intra- and extra-cellular catalysts and in strong buffer solutions at pH 7·3; in other words, under experimental conditions, which, as we have clearly shown in our paper[1], would reveal only a partial or even no inhibition at all of the activity of catalase.

On the other hand, if we assume that the catalase in their experiments was strongly (90 per cent) inhibited, which is very improbable, the remaining catalytic activity would liberate a sufficient amount of oxygen to induce luminescence in their bacteria. We can say in conclusion that their experiments, far from disproving our results, show only that th qualitative tests with luminescent bacteria are very little use in the study of this problem, for whi reliable and strictly quantitative methods are alrea available.

D. Keilin.
E. F. Hartree.

Molteno Institute,
University,
Cambridge.
Oct. 13.

---

[1] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **124**, 397 (1938).
[2] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **121**, 173 (1936
[3] Johnson, F. H., and van Schouvenburg, Nature, **144**, 634 (1939).

Tables for Statisticians

In my review of "Statistical Tables", by Fish and Yates (Nature, September 23, p. 533), I referre to the "interesting innovation of providing mea differences for half the interval only". Dr. L. Comrie has pointed out to me that this practice followed in E. V. Huntington's "Four Place Tabl of Logarithms and Trigonometric Functions", and gladly take the opportunity of acknowledging th fact.

J. Wishart.

School of Agriculture,
Cambridge.

Points from Foregoing Letters

The intensity of vertically directed mesotrons at different heights in the atmosphere has been measured by E. G. Dymond in a series of balloon flights. It is found that the intensity rises to a maximum of nine times the ground level value at an air pressure of about 80 mm. mercury. In order to bring the theoretical intensity variations, derived by Euler and Heisenberg, into agreement with these experimental results, it is suggested that there is a minimum energy of formation of mesotrons in the upper atmosphere, of about 8 × 10^9 ev.

H. R. Nettleton records the conclusion of a series of researches on the absolute measurement of electrical resistance by the development of a method which utilizes the average E.M.F. of a commutating generator. He describes how difficulties associated with the method have been overcome, and states that resistances of approximately an ohm can be measured rapidly with an accuracy of a few parts in a hundred thousand.

C. C. Addison finds some interesting differences in interfacial activity between short-chain isomeric compounds of classes not previously regarded as surface active. Interfacial tension measurements may be used to differentiate between such structural or stereoisomeric compounds.

A. B. Wildman and H. B. Carter indicate the present confusion in the terminology of fibre-follicles in the Mammalia. They suggest a new terminology which recognizes clearly two main growth phases and which should make possible a more intelligible co-ordination of research on the development of the mammalian coat.

E. Lowe Pierce and J. H. Orton find that *Sagitt elegans* is predominant or exclusively present at Por Erin and *S. setosa* in Liverpool Bay, except durin equinoctial tides when interchange of species occur It is inferred that extensive mixing of inshore and of shore waters occurs at equinoctial tides and that other periods a relatively stable body of water exis in Liverpool Bay.

Mortality among sponges off the coast of Briti Honduras is reported by F. G. Walton Smit Evidence is given to show that the probable cause identical with that of the recent Bahamas mortality the time and place of appearance support the sugge tion that the disease has been transmitted by ocea currents.

The aphid *Myzus ornatus* is found by J. Loughnane to be a vector of certain potato viruse In view of this ability and of its wide host rang it is suggested that this species may act as a vect of viruses of plants other than the potato.

S. Ochoa and R. J. Rossiter report a decrease the flavin-adenine-dinucleotide of Warburg an Christian in the heart and liver of rats fed on flavin-deficient diet, providing another instance of deficiency of the vitamin B complex affecting biological oxidation system.

D. Keilin and E. F. Hartree find that the decomposition of hydrogen peroxide by catalase is broug about by the successive reduction of the catala iron by the peroxide and its reoxidation by th molecular oxygen. This is in contradiction to th view of Johnson and Schouvenberg, which was base on qualitative tests with luminous bacteria.

RESEARCH ITEMS

rmanation'

HERMANATION', Hanns Weltzel explains (*J. Gypsy e Soc.*, Ser. 3, 18, 4; 1939), is derived by the sies of Germany from the German 'harmonieren', the sense of 'getting on well with'. If this is rect, it is remarkable that the *Sinti* should have opted a German term for so characteristic and cient an institution. It is centuries old among rman gypsies or rather among *Sinti* only. It is basic principle in the structure of their unity. is the union of a small group of gypsies, in which number of families is not limited, and the leader not a chief, but a 'dispenser of justice', or 'judge'. e Hermanation also applies to a definite localized up. Most of the gypsies of central Germany ong to one. The 'Kartepoor' is so called m the beautiful tail feather of the moor-cock, ich hunters often wear in their hat. Members one Hermanation would not eat with those onging to another. Sometimes the term is used a synonym for a meeting, when it is equivalent to *llu*, the gathering at which matters concerning psy law are discussed, and marriages, dispensations justice, cases of outlawry, and the like are settled. m this it follows that Hermanation denotes a uping of families which, on the basis of a bond of ationship, subjects itself to its senior member and colleagues in matters of definite custom. The dge', who was in no sense a 'chief' or 'king', had to a person of reputation and unblemished character the gypsy sense), of imposing appearance, and of re gypsy blood. Supplementary information con- ns ceremonial purity, in which taboos relating to men are stressed: for example, the sole of a woman's e renders things unclean, and hence it is never nded; while among the Krauses a woman carrying ug or bucket must hold it away from her body.

nas of Bengal

ON various occasions in 1933–35, Minendra Nath su carried out investigations of the physical, ial and cultural peculiarities of the Buna colonies Bengal (*J. Department of Letters*, Univ. of Calcutta, , 1939). The Bunas are an aboriginal people of ngal, probably immigrants from Chota Nagpur, racted by the demand for 'landless' labour. ma is a name given them as a 'wild' people, ugh there are other interpretations. In the lages they live in separate areas; and the state- nt that they are hated by Hindu and Mahom- dan alike on account of their fondness for fowl d pork is correct; but nevertheless a large amount intermixture with the two communities has taken ce. Anthropometric measurements and observa- ns of 220 subjects show skin colour (unexposed) rying from tawny white to dark; hair wavy, but th 1·5 per cent woolly; in colour, black, dark own or grey. Eye slit horizontal, or straight; eye- our dark brown, 65 per cent, with medium and ht brown as variants. The nose is generally aight, though convex noses occur; no alveolar gnathism, and facial prognathism slight; lips dium, 85 per cent without eversion; the chin is minent; and the body musculature is marked. e following are the percentages for: (1) stature, le, ranging from 130·0 (very short) to 179·9 (tall); the highest percentage is 82·5 in the group 150·0–159·0, the next highest percentage being 9·5 in the group 160·0–169·9; females, range 140 (short) to 152·9 (below medium), 65 per cent being in the group 140·0–149·9; (2) cephalic index, males, dolichocephalic, 41 per cent, mesocephalic, 54 per cent, brachycephalic, 5 per cent; females, 40 per cent, 20 per cent, and 40 per cent respectively; nasal index, males, leptorrhine 26 per cent, mesorrhine 70·5, platyrrhine 3·5; females, 5 per cent, 80 per cent and 15 per cent respectively. On analysis it appears that the Bunas are a highly mixed group, of which the basic stock was probably indigenous to Chota Nagpur, but which afterwards intermixed freely with the peoples of Bengal, Brahmans, Kayasthas, and Namasudras, and lower Hindu castes.

Blood Groups in Africa

DR. R. ELSDEN-DREW has described the results of an investigation into the distribution of blood groups among African natives (*Pub. S. African Inst. Med. Res.*, 44, Johannesburg, 1939). Tribes were examined over a wide area in Southern Rhodesia, Nyasaland, Tanganyika, Kenya and Uganda, and a number of blood specimens were collected and examined in the field. Considerable differences exist between the peoples investigated, for the percentage of the *O*-group varies from 41 in the Lango to 74 in the Ndau; the percentage of the *B*-group ranges from 5 in the Gogo to 31 in the Ankonde, while the *A*-group ranges from 13 in the Ndau to 32 in the Akamba. The significance of the ethnological distribution of the blood groups is discussed, and it is suggested that the Bantu did not descend from the Negro, but are rather a purer example of a common stock, and that the migration on the west coast has been from east to west rather than in the contrary direction. The Bush people are shown to be less 'ancient' than are the Bantu, and an Egyptian origin is suggested for the Hottentot. The technique employed is described, the findings are subjected to statistical examination, and tables are given of the calculated gene frequencies.

Employment Tests for Rayon Factory Hands

Sigemi H. Kirihara and Kazuo Nakamura (Report No. 41. Japan Institute for Science of Labour) carried out a study to see what relation there was between mental characteristics and efficiency in the operatives of a rayon factory. The ages of the workers ranged from 14 to 18 years. An intelligence test and various performance tests were given to the workers on a number of processes, and the results of the tests were correlated both with the quality and quantity of the output. Intelligence apparently plays a negligible part in success in all processes with the exception of 'reeling'; this process gives a positive correlation with all the tests whereas the others give either negative or insignificant correlations. Taking the results at their face value, the use of tests would not give a better selection than the more usual methods. The writers, however, do not give an adequate account of their method, and although they indicate that motion studies were attempted, they do not make it clear whether the results of such studies guided them in their choice of tests.

A Pleistocene Bird's Egg

Eggs are rarely found in fossil deposits, so that the discovery of a bird's egg on the east slope of Lone Mountain, Nevada, in a deposit attributed to Pleistocene times, deserves notice. Alexander Wetmore states that the egg, of which only one half has been preserved, is embedded in dendritic tufa, having apparently been deposited in water beneath a cone of that material in which it afterwards became involved (*Condor*, **41**, 98; 1939). It measures about 63 mm. in length and 38·5 mm. in width; the shell is pale olive buff in colour on the outer surface and its surface bears irregularly scattered pits. Although no identification is claimed, the author states that comparison with modern eggs suggests that the fossil egg comes closest to the egg of a cormorant.

Jungle Yellow Fever and other Diseases

Important studies on jungle yellow fever in Brazil are described in the annual report for 1938 of the International Health Division of the Rockefeller Foundation, recently published. Jungle yellow fever differs from the classical variety of yellow fever in that it is not conveyed by the mosquito, *Ædes ægypti*. As a result of much research, it seems probable that certain monkeys may be reservoirs of jungle yellow fever, infection from which may be transmitted to man by two species of mosquito. Preventive vaccination with a particular strain of virus has been extensively pursued, more than a million persons having been inoculated, but it is too soon to state with what amount of success. Malaria, influenza, tuberculosis, and worm and other diseases have also been the subjects of study. Details are given upon finance, and of grants made to various bodies, schools and individuals.

A Trypanosome in a Tigress

Parasitic trypanosomes are found in the blood and tissues of various kinds of vertebrates, sometimes causing important diseases in animals, for example, in the horse, and the African sleeping sickness in man. They are, however, rarely found in carnivorous animals, and the record of a trypanosome encountered in a tigress by Dr. Z. Mohamed is therefore of considerable interest (Ministry of Agriculture, Egypt. *Veterinary Service Bull.*, No. 200. Cairo, 1939). The animal came from Sumatra to the Zoological Gardens, Giza, in 1926; it had always been healthy, but became ill on October 18, and died on October 21, 1935. Trypanosomes were found in the blood in large numbers; cultures were failures, but inoculations into dogs, rabbits, rats and guinea pigs proved fatal to these animals in periods of from one to four months. The morphology of this tigress trypanosome is described; it closely resembles that of *Tr. evansi*, which causes surra in camels, but differs from it in some points, and is regarded as a new species, for which the name *Tr. kirdanii* is proposed. The source of the infection in the tigress was not discovered.

Toxicity of certain Insecticides

G. R. Cameron and Cecile R. Doniger have carried out toxicity experiments on mice, rats, guinea pigs and rabbits with lauryl thiocyanate and *n*-butylcarbitol-thiocyanate (in the form of lethane 384). These agents are now being employed as contact insecticides in the campaign against the bed-bug. In field-work, they are diluted, usually with kerosen to about 1 : 64 for the first-named, and 1 : 40 f lethane. Methods of exposure included contact miniature houses sprayed with the undiluted a diluted liquids, skin applications, oral administrati and injections. Both compounds cause death of t experimental animals on injection, but in dilutio similar to those used in field work have produced ill effects, and in such dilutions are unlikely to dangerous to human beings. Undiluted lauryl th cyanate causes severe local reaction when applied the skin, lethane only a slight reaction. The sl should, therefore, be protected when handling t undiluted substances (*J. Path. and Bact.*, **49**, 36 1939).

Effect of Temperature on Chromosomes affected by X-r

K. Sax and E. V. Enzmann (*Proc. Nat. Acad. Sc* **25**, 397–405; 1939) have analysed the effect temperature upon aberrations induced by X-rays the chromosomes of Tradescantia microspores. E cept for earliest prophase, it is found that X-ra induce considerably more breaks at 3° C. than 38° C. There is a critical temperature above whi the number of observed breaks is much reduced, b this critical temperature varies with the season. T authors consider that X-rays induce a similar num of breaks at low and at high temperature, but at hi temperatures the reunion of ends is accelerate therefore the reunion of the original breakage poi may take place. Misalignment may occur throu the slowness of reunion at low temperatures. T reverse temperature effect at earliest prophase difficult to explain, but may be due to similar cau to those underlying the phenomena of chias formation, which also occurs at this stage.

Analyses of Commercial Coals

A report on the analysis of commercial grades coal produced in the Nottinghamshire and Der shire area has just been published (Summary of F Research Survey Paper No. 48. London: H. Stationery Office. 3*s*.). The report forms part of general survey of the national coal resources whi is now being carried out, and is the second to d with commercial sampling in this area. It prese the results of the analysis of 277 grades of coal fr seventeen collieries. The work of the survey proce along two parallel lines. The first deals with t seams as they occur below ground. The coal fr the seams, however, is passed through many proces of blending, cleaning and grading before bei marketed. The second line of investigation is the fore to sample and analyse the actual products of t collieries, so that information may be availa regarding the types of coal actually obtainable consumers. The present report is confined to w of the second kind and deals with such types varieties for the manufacture of metallurgical co high-grade house and gas coals, locomotive a bunker fuels, and free-burning coals for ste raising and general industrial purposes. At ea colliery visited, all the grades finding a commerc outlet were sampled and analysed. Against t recognized commercial name of each grade are giv the screen size and description, including the meth of preparation, use and seam of origin. These d are followed by the analyses. The report also inclu a discussion of the variability of the grades a of the methods by which they are prepared.

ound Vibrations near Dynamite Blasts

THIS has been the subject of investigation by L. Don et (*Bull. Seis. Soc. Amer.*, 29, No. 3, 487; July 39), who has examined in detail the records of such arry blasts obtained on a portable three-component smograph. He found that high-frequency vibrans (25–50) of short duration (about 0·5 sec.) were pical of records on rock, whilst lower frequencies -5) and longer duration (max. 23 sec.) were recorded unconsolidated earth fill, particularly if it exceeded out 20 ft. in thickness. Among the chief types of bration, Rayleigh waves, Love waves and a new bservationally) *C*-type wave were generally obrved. The average period of the Rayleigh waves s 0·14 sec., the velocity of the front of the group out 1,000 ft./sec., and the velocity of the centre of ergy about 800 ft./sec. The period of the Love ves was about 0·15 sec., and the beginning of the oup corresponded roughly with the equation $= 0{\cdot}340 + \frac{\Delta}{2180}$, with t in seconds and Δ in feet. The rd type of surface wave, called *C*, was characterized motion on all three components, with maximum splacements in phase, a pull-down-left followed by push-up-right or other similar combination. It st nearly resembled one of the theoretical coupled ves of Uller. The apparent beginning of the *C* ve approximately fitted the travel-time equation $= 0{\cdot}100 + \frac{\Delta}{2960}$ (ft. sec. units). Its period may ve been 0·18 sec., but irregularity of form made e measurement uncertain. Some or all of these types waves could be identified on the records examined Leet, and their separation by velocity differences s undoubtedly a basic factor in the rapid diminun of the initial amplitudes with distance. It was served that the detailed manner in which this curred was unique for every location, depending on al formations and velocities, but the range of plitudes for various distances and sizes of charge uld be predicted within limits which were narrow ough to be of practical engineering value in timating probable effects on structures. Maximum plitudes at distances greater than a few hundred et from the shots reported (typically 60 per cent d 75 per cent quarry gelatin loaded in three holes in. diameter and 140 ft. deep) did not exceed ¼ and re often less than 1/100 those found necessary to use initial damage to plaster in a test house subted to increasingly severe vibrations until damage curred.

eather Periodicities in Turkestan

PERIODICITIES in weather observed in Turkestan d on the eastern shore of the Black Sea (V. A. agoveschensky, *Piroda*, No. 6; 1939) would appear coincide with the 20-day period of variation which s been found to exist in the solar constant (cf. obot, NATURE, 143, 705–709; 1939). While vestigating the periodicities in daily minimum mperatures, Blagoveschensky discovered in them master cycle, lasting, on the average, 18 ± 2 days, th a sharp fall maintained for 3–4 days at the ginning of each period, followed by a gradual crease until a new period is initiated by another ll. The master cycle may be interrupted on the nth or tenth day by a fall, initiating another mperature wave. These waves occur throughout e year, and the summation of minimum temperares within them shows that there is a more or less regular alternation of relatively warm and cold cycles. They appear to be determined by the passages of families of major and secondary cyclones arriving from the north.

Salts of Europium

ALTHOUGH the rare-earth element europium was characterized by Demarçay in 1900, its compounds have been little studied. H. N. McCoy (*J. Amer. Chem. Soc.*, 61, 2455; 1939) has examined some salts with different results from previous workers. The *m*-nitrobenzenesulphonate crystallizes with 6 (not 3) H_2O, the citrate with 4 (not 5) H_2O and the iodate with 4 (not 5½) H_2O. A number of other europic salts with organic acids, mostly with water of crystallization, were analysed. Europous salts are quickly oxidized by air when they are soluble, but the sulphate, $EuSO_4$, was found to be stable and to suffer little change in a year. An improved titration method is described.

Total Solar Eclipse Results of June 8, 1937

IN "Solar Eclipse Series" No. 1 of the publications of the National Geographic Society (Washington) are described by several specialists the observations of the total solar eclipse of June 8, 1937, made from Canton Island, a small atoll in the Phœnix Islands, by the joint expedition of the National Geographic Society and the United States Navy. The observation of this eclipse presented unusual difficulties, because the path of totality was confined almost wholly to the Pacific Ocean, but the duration of totality, which exceeded 7 minutes—the longest since the year 699—was an incentive to the projected expedition, although no land site was near the position of longest totality. The expedition had perfect weather for the eclipse. The corona was of maximum type according to expectation, the maximum of the 11-year solar cycle occurring in that year. Photographs of the corona were obtained with a special rotating sector disk in the optical train in order that the exposures might be more nearly equalized for the inner and outer parts of the corona. A long streamer was recorded up to a distance of 5 million miles from the sun's limb. The total light of the corona was also determined, and as in most previous eclipses was about equal to half the intensity of the full moon, or one millionth that of full sunlight. A study of the polarization of the coronal light was made, and it was found that the percentage of polarization of the corona and its streamers increased outwards from the sun. The inner corona was also photographed by colour processes (giving a beautiful reproduction in the text). To obtain colour separation negatives, each plate carried its own gelatine colour-filter on the opposite face to the photographic emulsion. A colour painting was also made and is a useful record of the full extent of the corona as seen by the eye. In the study of the spectrum of the chromosphere and of the corona, a new emission line at λ 4412 was detected and appears to be a genuine coronal line. Valuable experience was obtained with a Schmidt camera (giving almost perfect definition over a very wide field) and aluminized plane gratings as applied to eclipse problems. The progress of the eclipse was described from the eclipse camp in a radio broadcast arranged by the National Broadcasting Company of the United States, the radio transmitter being installed on the *Avocet*, the ship which brought the expedition from Honolulu to Canton Island.

THE TEACHING OF MECHANICS

AMONG the many functions which had to be cancelled when hostilities broke out between Germany and Poland was a discussion, due to be held by the British Association at Dundee on September 2, on "The Teaching of Mechanics". This subject holds a peculiar position in the curriculum, lying as it does in the region between physics and mathematics, and having the character both of a severely academic subject and of a cultural one.

The opener would have been Prof. E. A. Milne, who proposed to consider the teaching of the subject to schoolboys, undergraduates, and research workers in turn; in the first stage, experiment should be dominant. It is not surprising, in view of Prof. Milne's own work and experience, that he should suggest that in the third stage, the tacit assumptions of the existence of rigid bodies and of the uniform flow of time should be subjected to criticism. He also offers the suggestion that the logical unsatisfactoriness of quantum mechanics may be due to want of interest in the foundations of mechanics among those who work on the subject.

With Prof. Milne's views we may compare those of Prof. R. Peierls, who was to have been the closing speaker, and who remarked to the present writer that he was sufficiently new to the task of teaching mechanics to feel an interest in its problems and technique. He finds it difficult to steer a true course between the Scylla of special examples and the Charybdis of general theorems, and he feels also that 'statics-and-dynamics' takes up too much time, to the exclusion of elasticity, hydrodynamics and even electricity and optics. On detailed points, he would like to see more use made of dimensional arguments, and the asymptotic solutions of problems (a plea which the writer heartily supports), whilst Prof. Milne stresses in particular the value of vectorial methods as developed by S. Chapman.

The two papers to have been given between these were both by teachers in schools. Mr. K. S. Snell, of Harrow, feels that in the general introduction, to be taken by all boys, experiment should be fundamental, and the appeal to phenomena of daily life should be frequent. This introduction would thus satisfy those who demand cultural value in the subject. For the other course, to be taken afterwards by boys who intend to specialize in science subjects, Mr. Snell feels that the order should be reversed, the subject being developed mathematically, and the deductions checked by experiment. This is, of course, the line followed in much of the historical development of the subject, and allows far fewer principles to be used than the alternative method where experiment is made basic at each step.

It was fitting that at a meeting held in Dundee one of the speakers should represent Scottish schools, and this role was filled by Dr. G. P. Tarrant, of Edinburgh, who, in addition to suggesting methods of teaching, had some specific grievances to mention. He points out that the content of Scottish education has failed to adapt itself to the modern world as rapidly as has that of England. Science there is still tolerated rather than encouraged, so that in the Higher Certificate examinations, Latin or geography or history or book-keeping or art is a whole subj but physics or chemistry or biology is a half subj Naturally the school course is designed to meet examination requirements, and it becomes necess to teach 'electricity' without mentioning elect magnetic induction, motors or moving-coil inst ments and thereby deprives the subject of any va to the boy who does not specialize later. In mecha itself, the syllabus omits the laws of momentum any consideration of rotation, and even exclu simple harmonic motion from its consideration kinematics. In fact, the Scottish pupil does ab half the science subjects, and does each of them ab half as thoroughly as the English pupil. Hence p of Dr. Tarrant's address would have been devoted a plea for overhauling the scheme of teaching a examining science subjects in Scotland. The pres writer would, however, remark that Scotch engine are known all over the world as sound and relia men in general, and therefore that it would se desirable to consider (*a*) whether mechanics is l important to engineers than teachers believe, (*b*) whether mechanics can easily be learned later life, in which case the school syllabus is less import to future specialists than we have assumed.

The other part of Dr. Tarrant's address show how, in spite of difficulties, mechanics can be m a 'live' subject. By means of Meccano models roof trusses and the like, problems of moments c be visualized, and the difficulties of three dimensi removed. The same method illustrates the trian of forces clearly and visually. When the stage calculation is reached, the human being makes interesting subject. It requires no difficult mat matics, for example, to show on mechanical princip that the requirements for the high jump are: (1) lo legs; (2) powerful swing with the free leg and w the arms, while the take-off leg is still bent; (3 straightening of the original forward tilt of the bo then a straightening of the take-off leg, and fina a jump with the toe, the whole being so timed th the arms and legs acquire their upward moment before the lift of the centre of gravity commenc and so that they are brought to rest relative to t body at the exact instant that the toe leaves cont with the ground; (4) a style of crossing the l which keeps the centre of gravity very low on t bar and the head above the buttocks. Like Pr Peierls, Dr. Tarrant introduces the dimensio argument, and uses it, for example, to show tha very small animal needs relatively more food th a big one, merely to keep warm, and explains the fore why small animals are not indigenous to t arctic or antarctic regions.

Had the meeting taken place, it was the hope the organizers that the contributions to the f discussion following these papers would have be not the least valuable part, but it is hoped that t slight outline here given of the contents of some the papers may at least stimulate those who wo have discussed the matter, to consider it again themselves and perhaps to try out different metho of teaching, the results of which can be reported a more suitable time. J. H. AWBERY.

CRITICAL AND CO-OPERATIVE PHENOMENA

N 1937, Prof. J. E. Lennard-Jones and Dr. A. F. Devonshire published two important papers on ritical Phenomena in Gases" in which they re-rded each atom of a dense assembly, irrespective physical state, as moving in the field of force of neighbours and confined by them to a small gion of space equal to the mean available volume r atom. The methods and theory of these papers ve now been extended in two further papers.

The first[1] deals with a theory of melting and the ructure of liquids. From X-ray evidence on liquids is concluded that there exist regions of order proximating crystallinity, particularly just above e melting point, and from X-ray evidence on alloys is known that certain types of disorder can occur. is therefore difficult to differentiate the crystalline id and liquid states satisfactorily, and this is cessary before any theory of melting can be veloped. Assemblies of atoms with spherically mmetrical fields of force probably form 'normal' uids. In a solid the cell in which an atom moves localized, whereas in a liquid the motion of an om must be represented as a vibration about a int which is itself undergoing displacement. Solids assumed to be alloys of atoms and 'holes'. At low temperatures the atoms occupy all the available sites on a perfect lattice and the 'holes' all the available sites on a similar lattice which interpenetrates the first. The number of atoms occupying abnormal sites gives a measure of the disorder of the assembly. The energy required for the interchange of an atom and a 'hole' is assumed to be a function of the volume of the whole assembly. From these concepts a theory of melting is developed. An equation of state of solid and liquid is also derived which gives values in good agreement with observed values for change in volume on melting, and for the thermal expansions of solid and liquid.

The subject-matter of the second paper[2] is very similar. The method in the former paper is simplified by assuming that the environment of any one atom is governed by the average state of order throughout the assembly, instead of, as in the former paper, taking account only of immediate neighbours of any atom. The equation of state of a disordered assembly, the melting temperature in terms of interatomic forces, and the various phenomena associated with melting are discussed.

---

[1] *Proc. Roy. Soc.*, A, 169, 317 (1939).

[2] *Proc. Roy. Soc.*, A, 170, 464 (1939).

THE ENGINEER AND THE STEELMAKER

T is of great importance that the steelmaker should know all about his products, so that he may e advice to the engineer as to any of the alloy els that he manufactures.

Mr. D. Taylor, in the *Journal of the Junior stitution of Engineers* of October, in a paper on teel and the Engineer", lays stress on the impor-nce that the steelmaker attaches to providing the st suitable quality of steel for the work which e engineer has in hand. The common sphere of tivity linking together the work of engineers and tallurgists is the main subject of the paper.

The author gives some typical examples of a tallurgical and mechanical nature and of wrong ndling which leads to failure. He traces what ppens to a 'cast' of steel from its initial stages its final release. The first important stage is ecting the raw materials, the next the method of lting, which governs the cost, and finally the mputation of the 'mixes' employed. Five methods melting are used. The first method is the crucible thod, in which the furnace is of simple design and ily controlled. The second is the Siemens open arth furnace, which produces either acid or basic el. In the case of acid steel, the bath of metal is rked under an acid slag and so the sulphur and osphorus are not thereby eliminated and purer terials must be used. In the case of the basic thod, the sulphur and phosphorus may be removed nost entirely, while the carbon and manganese ntent are practically unchanged. The third method the arc furnace run with a basic hearth. The duct is low in sulphur and phosphorus, and this is good from the mechanical point of view. The fourth method is the coreless high-frequency induction furnace. The advantages of this furnace are that there is no contamination of the metal bath, due to fuel; the bath is in constant motion during melting; the melting temperature can be controlled within certain limits and the bath can be refined. Another method used is to employ an open hearth furnace to do the heavy melting, and then to refine the metal in the electric furnace.

The product of the furnace is required either in the form of castings or as ingots. The ingot is a casting of a particular type which is later mechanically worked. It is important that the ingot should be as perfect as possible, otherwise defects will arise at a later date. If it is to be sound, careful control of the casting temperatures must be taken. To produce a perfect ingot the surfaces should be smooth planes with correctly rounded corners. Prior to use, the inner surfaces of the mould are prepared by painting with a special compound. After the metal has been poured into the mould, it commences to freeze in planes parallel to the ingot mould surfaces. During the freezing, any non-metallic matter will, as crystallization proceeds, be rejected and conveyed to the centre of the ingot, which is the last portion to freeze, and is thus trapped. When the steel has solidified and cooled, it can be stripped from the ingot mould. It is immediately marked up with its cast number, which identity it carries throughout the works. Many months after casting, relevant data, such as casting temperature, nature of the ingot skins, etc., of the cast can be readily found by reference. In this way the steelmaker builds up a personal knowledge and experience of the casting made by various alloys.

If the product of the furnace is required in the form of castings, the casting temperature must have its definite value. In this case its contours are good, the shrinkage is a minimum, the structure is reasonably strong and free from blow holes. The author gives lists of the common defects associated with castings and also defects rising from incorrect treatment or application.

The engineer sometimes produces components which need to be heat-treated. The hardening sho has a great deal of responsibility, as it is the la stage of the work. The steelmaker goes to a grea deal of trouble in determining the critical points c his alloys, which can be found from the heating an cooling curves, and from these he computes the be temperatures for hardening. These temperatur must always be used. The pyrometer must b periodically inspected and calibrated. Useful inform tion can often be obtained from the microstructu as seen by microscopic examination of a represent tive sample by means of a metallurgical microscop

---

NUCLEOLI, SATELLITES AND SEX CHROMOSOMES

By Prof. R. Ruggles Gates, F.R.S.

In recent years striking discoveries have been made regarding the origin and history of the nucleolus. It has come to be recognized that in every cell of a plant or animal species there is at least one pair of chromosomes which is specially concerned in producing this body. This pair of chromosomes may have either a satellite or a secondary constriction. In a satellited chromosome the exact point of origin of the nucleolus appears to be the end of the chromosome proper, where the delicate thread or filament arises which attaches the satellite (a tiny globule of chromatin) to the body of the chromosome. This locus has been called the nucleolar organizing body. In the telophase of mitosis each satellited chromosome gives rise to a nucleolus, while in a chromosome with a secondary constriction the nucleolus arises at the constriction.

There are thus in the early telophase of mitosis as many nucleoli as there are chromosomes with satellites or secondary constrictions (the primary constriction being at the spindle fibre attachment). Some chromosomes with a secondary constriction, however, do not produce a nucleolus. By the following prophase the nucleoli have frequently all fused into one. By means of a new stain[1], Feulgen and Light Green, which stains the chromatin (including the thread or filament) red and the nucleoli green, the exact nature of the attachment of nucleolar chromosomes, whether at a satellite thread or a secondary constriction, can easily be determined. The number of chromosomes attached to the nucleolus in prophase is thus the same as the number which produce nucleoli in telophase. This relationship can generally be confirmed by an examination of the chromosomes in metaphase, when the number which have satellites or secondary constrictions can be determined, except in the very smallest chromosomes.

In an ordinary diploid plant or animal species there is thus one pair of chromosomes with satellites, or sometimes with secondary constrictions instead. This difference seems to depend merely on whether the thin portion (thread) of the chromosome is near the end, to produce a satellite, or nearer the middle of the chromosome. In polyploid species the number of *SAT*-chromosomes and telophase nucleoli is correspondingly increased. Thus a tetraploid will have four, and a hexaploid species such as the bread wheats will have six.

Some species, however, which have hitherto be regarded as ordinary diploids, have two pairs nucleolar chromosomes. Sometimes one of the pairs has satellites and the other pair seconda constrictions. Some of these cases are clearly seco dary tetraploids in which a new species or perhaps new genus has arisen through a change in the ba number of chromosomes. Many such cases have be observed in connexion with recent cytological wo The study of the nucleoli in a species has thus beco a method of tracing changes in chromosome numb and how they have taken place, in other wor nuclear phylogeny.

As an example, rice may be cited. Cultivated ri *Oryza sativa*, has twelve pairs of chromosomes. B many varieties have two pairs of nucleolar chrom somes, indicating that it is a secondary tetraploid or amphidiploid. Further evidence is afforded by t secondary pairing of the chromosomes in the poll mother cells. Such a pairing of chromosome pairs bivalents with each other indicates a specific attra tion, which is the result of homology.

The bivalent chromosomes arrange themselves in r so that the maximum association is into two grou of three bivalents and three groups of two bivalen 2(3) + 3(2) or *AAABBBCCDDEE*, thus making fi groups of chromosomes having different homologi That five is the basic number of chromosomes, fro which the twelve in rice has been derived, w confirmed by showing (Ramanujam[2]) that in certa genera related to Oryza, such as Zizania a Lygaeum, the chromosomes were in high multiples five, while in other genera, such as Hygroryza, th were in multiples of twelve.

Many varieties of rice still have two pairs *SAT*-chromosomes, and so produce four nucle confirming that they are secondary tetraploids. B it appears that it is only necessary for an organi to have one pair of *SAT*-chromosomes in or for the cells to function. In many varieties of r only one pair is present. The other pair has be lost, probably by a mutational loss of a satellite fr one of the four *SAT*-chromosomes and subseque inbreeding. Several other wild species of Oryza, bo in India and Africa, have doubled their chromoso and have 24 pairs. They are thus secondary oc ploids. This is an example of the way in which t origin and history of a genus can be traced vestigation of the behaviour of the chromosomes and pecially of those which produce nucleoli. There is uch other evidence that five is the fundamental romosome number in the grasses, the family to hich rice belongs.

Another recent example may be taken from the guminous genus Cicer (Iyengar[3]). *C. arietinum* has chromosomes. In prophase four chromosomes are tached to the nucleolus and at meiosis the maximum sociation is one group of three bivalent chromo mes, two groups of two and a single bivalent, 3) + 2(2) + 1 or *AAABBCCD*. This indicates at four different (non-homologous) chromosomes as the original basic number. These observations nfirm much other evidence (some of it unpublished) at four is the basic or original number of chromo mes in the family of Leguminosæ, from which all her numbers in this family have been derived.

It is now well known that in groups of organisms as dely separated as insects and liverworts there are nerally sex chromosomes, typically a large *X*- and small *Y*-chromosome. Moreover, these bodies or rtions of them are heteropycnotic, that is, they are ndensed in prophase when the other chromosomes e still in a diffuse condition. The heteropycnotic rtions are believed to be genetically inert.

While the *XY* combination in insects, mammals d some other animals produces a male, in liverworts d mosses the *XY* pair are present in the sporophyte, e male gametophyte having a *Y* and the female metophyte an *X*, in addition to the remainder of e haploid set of chromosomes.

Recent observations show that in many cases, both insects and bryophytes, the *X*- and *Y*-chromosomes e attached to the nucleolus, that is, they have a tellite or secondary constriction and are concerned producing the nucleolus to which they are attached. e possible significance of this widespread condition pears to have been overlooked. Kaufmann[4] has own that in somatic cells of male *Drosophila lanogaster* the *X* (with a secondary constriction) d the *Y* (with a satellite) are attached in prophase the nucleolus which they produce. Heitz[5] indicates e same situation not only in *D. melanogaster* but o in *D. funebris*, *D. simulans*, *D. virilis* and *D. ydei*. By its heteropycnotic condition Heitz identi s the *X*-chromosome as attached to the nucleolus o in *Scatophila unicornis* and in two other genera insects.

Thus it appears that in these insects the *X*- and -chromosomes are generally nucleolar chromosomes, e former with a constriction and the latter with a tellite. An exception was found, however, by ufmann[6] (1937) in *Drosophila ananassae*, in which e *X* is not nucleolar, but a pair of autosomes dinary chromosomes) with satellites are attached the nucleolus in the female. In the male, however, ere are three chromosomes attached to the nucleolus, e *SAT*-pair and the *Y*, which also has a satellite. ufmann suggests that this departure from the ual condition has been produced in this species by translocation between the *X*-chromosome and an tosome.

From a study of the salivary gland nuclei of Droso ila, Frolova[7] finds the nucleolus attached by a anched chromatic thread to the chromo-centre, to ich the ends of all the chromosomes are in turn ached. It seems probable that the sex chromo mes have here become detached from the nucleolus ich they presumably produced, as in less specialized ds.

In liverworts, Lorbeer[8] (1934) figures a large *X*-chromosome, evidently with a secondary constriction, attached to the nucleolus in *Sphaerocarpus Donnellii*, in the cells of the female thallus. In the cells of the male thallus there is a very small *Y*-chromosome and also an autosome with a satellite. In the spore mother cell there are seven pairs of autosomes together with a large heteropycnotic *X*-chromosome attached to the nucleolus and the very small *Y*, also no doubt attached to the nucleolus when in its natural position. In *S. europaeus* the cells of the male thallus contain a *Y*- and a *SAT*-chromosome, while in the female gametophyte an *X*- and a *SAT*-chromosome are present. In Marchantia, both the *X* and the *Y* are figured attached to the nucleolus. Thus it appears that the sex chromosomes of the liverworts are nucleolus-producing, as in insects, but there are in some species also a pair of autosomes which produce nucleoli.

Allen[9] figures in *Sphaerocarpus cristatus* a heteropycnotic body which is part of the *X*-chromosome, attached to the nucleolus. In the liverworts *Pallavicinia longispina* and *Calobryum rotundifolium*, Tatuno[10] figures a large *X*-chromosome with a secondary constriction and a smaller *V*-shaped *Y*, both being shown attached to the nucleolus in the spore mother cell of Pallavicinia. In *Makinoa crispata*, on the other hand, there are no heteropycnotic (sex) chromosomes, but the cells of the sporophyte show a pair of *SAT*-chromosomes. Tatuno[11], in a further study, shows a large heteropycnotic *X* and a small *Y* in *Pallavicinia Lyelli*, *Riccardia pinguis*, *R. blasioides*, *Pellia Neesiana* and *P. Fabbroniana*. But in both species of Pellia a *SAT*-chromosome is figured during mitosis in both the male spores (which have the *Y*) and the female spores (which have the *X*-chromosome).

In mosses, similar conditions hold. Shimotomai and Koyama[12] (1932) show in the female gametophyte of *Pogonatum inflexum* a large heteropycnotic *X*-chromosome attached to the nucleolus, a small *Y*-chromosome attached in the nucleoli of the male gametophyte, and both attached to the nucleolus in the cells of the seta (sporophyte). Shimotomai and Kimura[13] show similar conditions in Polytrichum and Ceratodon.

Thus it appears that both in insects and bryophytes the sex chromosomes take part, with or without a pair of autosomes, in forming the nucleoli. In diœcious flowering plants the relation of the *X*- and *Y*-chromosomes to nucleolar production is not yet known. By the use of the new staining method already mentioned, it will be possible to trace their history fully in flowering plants and also to throw further light on the behaviour of the sex chromosomes in other organisms.

---

[1] Semmens, C. S., and Bhaduri, P. N., *Stain Tech.*, 14, 1–6 (1939)

[2] Ramanujam, S., *Ann. Bot.*, N.S., 2, 107–125 (1938)

[3] Iyengar, N. K., *Ann. Bot.*, N.S., 3 (1939).

[4] Kaufmann, B. P., *J. Morph.*, 56, 125–164 (1934).

[5] Heitz, E., *Z. Zellforsch. u. Mikr. Anat.*, 20, 237–287 (1933); 19, 720–742 (1933)

[6] Kaufmann, B. P., *Cytologia*, Fujii Jub Vol. 1043–1055 (1937)

[7] Frolova, S. L., *Biol. J.* (Russian), 5, 271–292 (1936)

[8] Lorbeer, G., *Jahrb. wiss. Bot.*, 80, 567–818 (1934).

[9] Allen, C. E., *Bot. Gaz.*, 97, 846–853 (1936).

[10] Tatuno, S., *J. Sci. Hiroshima Univ.*, 1, 165–182 (1933).

[11] Tatuno, S., *J. Sci. Hiroshima Univ.*, 3, 1–9 (1936). See also *Bot Mag. Tokyo.*, 51-53.

[12] Shimotomai, N, and Koyama, *J. Sci. Hiroshima Univ.*, Ser. B, Div. 2, 1, 95–101 (1932).

[13] Shimotomai, N., and Kimura, K., *Z. Abst. u. Vererb*, 72, 307–312 (1936).

SCIENCE NEWS A CENTURY AGO

The Geological Society

At a meeting of the Geological Society, on November 6, 1839, several papers were read, among them being one "On the Relative Ages of the Tertiary and Post-Tertiary Deposits of the Basin of the Clyde" by James Smith; and another paper was "On the Noxious Gases Emitted from the Chalk and Overlying Strata in Sinking Wells near London", by Dr. Mitchell.

The most abundant deleterious gas in the chalk, said Dr. Mitchell, is the carbonic acid, and it is said to occur in greater quantities in the lower than the upper division of the formation. The distribution of it, however, in that portion of the series is very unequal, it having been found to issue in considerable quantities from one stratum, while from those immediately above and beneath none was emitted. Sulphuretted hydrogen and carburetted hydrogen gases sometimes occur where the chalk is covered with sand, and London clay, as well as in other situations. In making the Thames Tunnel they have been both occasionally given out, and some inconvenience has been experienced by the workmen: but in no instance have the effects been fatal. In the districts where sulphuretted hydrogen gas occurs, the discharge increases considerably after long-continued rain, the water forcing it out from the cavities in which it had accumulated. Dr. Mitchell cited several cases of well-diggers having been suffocated from not using proper precautions.

Difference of Longitude between Greenwich and New York

At the Birmingham meeting of the British Association in August, 1839, Edward John Dent (1790–1853), the well-known chronometer maker, gave an account of observations made with four chronometers sent to the United States and back in the S.S. *British Queen* on her first trans-Atlantic passages.

Referring to the use of chronometers, Dent said that "The rapid transmission of chronometers now practicable by means of steam vessels from one meridian to another offers great facilities for the determination of the differences of longitude". On November 8, 1839, he wrote from No. 84, Strand, to the Editor of the *Athenæum* giving particulars of observations made during the second voyage of the ship with a second set of chronometers. By the second experiment the difference of longitude between the observatory at Greenwich and the City Hall, New York, was found to be 4h. 56m. 0·24s. west. "The great rapidity and accuracy," said Dent, "with which this important branch of nautical inquiry may be pursued over the whole surface of the globe, as the agency of steam shall be extended, is now, I think, demonstrated. . . . Within the space of ninety-nine days, we have seen the *British Queen* carry chronometers *four* times across the Atlantic, and give ample time during each of her visits to New York for the necessary observations of rates, etc.

"All objections founded on the idea that the motion of a steam vessel would affect injuriously the more delicate movement of the chronometer and taint the results must now fall to the ground. In the two voyages out and home of the *British Queen*, no derangement occurred, and the determination of the longitude of the far-distant ports she sailed between is, probably, settled for ever, within a fraction of a second of the truth."

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned:

Municipal Engineer to the Municipality of George Town, Pena —Petroe and Williams, 1 Victoria Street, S.W.1 (November 7).

International Senior Fellowship in Science—The H Secretary, British Federation of University Women, Ltd., 16 K Street, Reading, Berks (November 10).

Borough Electrical Engineer and Manager to the Com Borough of Halifax—The Town Clerk, Town Hall, Halifax (Nov ber 14).

Research Professor of Medical Psychology in the Univer of Queensland—The Agent-General for Queensland, 409 Strand, W. or the Universities Bureau of the British Empire, 88a Gower Str W.C.1.

Senior Technical Officers (Ref. 875/Y) and Technical Offic (Ref. 875/Z) by the Air Ministry—The Under-Secretary of St S.2.A., Department Z.A., Air Ministry, Adastral House, Kingsw W.C.2.

Part-time Lecturer in Physics—Head of the Department Mathematics and Physics, The Polytechnic, Regent Street, W.1.

Temporary Meteorological Assistants (Male) in the Meteo logical Office—The Under-Secretary of State, S.2.B (Met.), Departm Q.J., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Amgueddfa Genedlaethol Cymru: National Museum of Wa Guide to the Collection of British Aculeate Hymenoptera. By How M. Hallett. Pp. 28. (Cardiff: National Museum of Wales.) 4d. [1

London Shellac Research Bureau. Technical Paper No. 18: Fibr Lac. By Dr. R. Bhattacharya and G. D. Heath. Pp. 14. (Lond London Shellac Research Bureau.) [1

Imperial Agricultural Bureaux. Herbage Publication Series, Bull 26: Research on Grassland, Forage Crops and the Conservation Vegetation in the United States of America. Compiled by R. Whyte. Pp. 113. (Aberystwyth Imperial Bureau of Pastures Forage Crops.) 5s. [1

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, for the Year 1938- Pp. 44. (Newcastle-upon-Tyne: Hancock Museum.) [1

Other Countries

Journal of the Indian Institute of Science. Vol. 22A, Part The Stereo-Chemistry of Pinane and its Derivatives. By K. Ganapa Pp. 155–169. (Bangalore. Indian Institute of Science.) rupees. [1

Catalogue of Indian Insects. Part 24: Evaniidae. By M. S. M Pp. ii+14+ii. (Delhi: Manager of Publications.) 7 annas; 8d. [1

Imperial College of Tropical Agriculture. Eighth Annual Re on Cacao Research, 1938. Pp. 42+2 plates. (Port-of-Spain: Gove ment Printing Office.) 5s. [1

U.S. Department of Agriculture. Circular No. 523: Toxicity Certain Organic Insecticides to Codling Moth Larvae in Labora Tests. By E. H. Siegler, F. Munger and L. E. Smith. Pp. 10. (W ington, D.C.: Government Printing Office.) 5 cents. [1

U.S. Department of the Interior: Office of Education. Bulle 1938, No. 17: Hospital Schools in the United States. By Clele Matheson Pp. vii+79. (Washington, D.C: Government Print Office.) 15 cents. [1

Smithsonian Institution: Bureau of American Ethnology. Bull 125: Ethnography of the Fox Indians. By William Jones. Edited Margaret Welpley Fisher. Pp. ix+156. (Washington, D.C.: Gove ment Printing Office.) 25 cents. [1

Proceedings of the United States National Museum. Vol. 87, 3071: A New Trematode from the Loon, *Gavia immer*, and its Relat ship to *Haematotrephus fodiens* Linton, 1928. By W. Carl Gower. 139–144. (Washington, D.C.: Government Printing Office.) [1

Smithsonian Miscellaneous Collections. Vol. 98, No. 23: Stim tive Effect of Short Wave Lengths of the Ultraviolet on the A *Stichococcus bacillaris*. By Florence E. Meier. (Publication 3549) ii+20+4 plates. (Washington, D.C.: Smithsonian Institution.) [1

Trinidad and Tobago: Forest Department. Administration Re of the Conservator of Forests for the Year 1938 Pp. 16. (Trinid Government Printer) 18 cents. [1

Palaeontologia Sinica. New Series C, No. 5 (Whole Series No. 11 The Fossils from Locality 12 of Choukoutien By P. Teilhard Chardin. Pp. ii+47+1 plate. (Nanking and Peking: Geolog Survey Library) [1

Commonwealth of Australia: Council for Scientific and Indust Research. Bulletin No. 127: Radio Research Board Report No. Pp. 30. Bulletin No. 128: An Investigation of the Problems of Accumulation on a Mallee Soil in the Murray Valley Irrigation A By J. K. Thomas. Pp. 88+2 plates. Pamphlet No. 88: The Orien- Peach Moth (*Cydia molesta* Busck) Investigations in the Goulb Valley, Victoria; Progress Report for the Seasons 1935–38. G. A. H. Helson Pp. 23. (Melbourne: Government Printer.) [1

Editorial & Publishing Offices:
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

Telegraphic Address:
Phusis, Lesquare, London

Telephone Number:
Whitehall 8831

Vol. 144 SATURDAY, NOVEMBER 11, 1939 No. 3654

PHYSICAL ANTHROPOLOGY AND PROBLEMS OF MODERN SOCIETY

WHEN it became necessary during the European War of 1914–18 to assess the ysical development and capacities of every man military age in the British Isles, certain facts ierged which caused no little consternation hen they were revealed at a later date. An duly and unexpectedly large proportion of rolled men were found to be physically unfit r the more strenuous forms of active service, d many, indeed too many, incapable of any rm of military duty abroad. Yet it may be ted that by August 1914, legislation for the edical inspection of school children—the only rge-scale provision for the accumulation of idence relating to the physical condition of the pulation of Great Britain—had been in force r seven years; and more than one medical officer r education had directed attention in his reports whole areas in which a relatively poor physique d under-development pointed to a probability of ironic malnutrition and adverse social and onomic conditions. Had these warnings not en ignored, it would have been unnecessary to int out for the benefit of those who expressed strongest terms their surprise and consternation the results of this, the first, approach to some-ing in the nature of a physical census of a con-derable proportion of the British population, that this instance, if ever, the child might be regarded indeed 'the father of the man'. Study of what e child was known to have been would have counted surprise at the man he had become.

Anthropologists had urged strenuously, but ithout avail, the inclusion of anthropometric servations in the provision for medical inspec-n of school children. They were in consequence rhaps a little less perturbed than some by these revelations of the apparent physical inadequacy of the population. Although recognizing the gravity of the situation, they also realized that in the absence of a norm, a properly adjusted standard of physical development according to type, the crude facts as stated lost half their force in argument. A national standard, or an ideal standard, such as the regulation stature and chest measurement required in the recruitment of a peace-time army of picked men, had been applied to a mixed population without regard to the racial differences, which constitute the most striking feature in the physical characteristics of the British population. The same criticism applies to the statements as to under-development among children, in which a general standard correlating age with development is applied without knowledge of the norm in terms of racial differentiation. Obviously the norm of the tall fair Nordic of East Anglia is inapplicable to the short Mediterranean type of the West, yet the short dark operative of the industrial north of England has been characterized as stunted by generations of factory life, without inquiry or knowledge as to the capacity for development of the type in optimum conditions.

The great enthusiasm for the application of scientific method to the study of social and economic problems, and the application of the results in ameliorative action, in the years following on the War, in great measure seems to have passed the anthropologist by, at least so far as concerns the study of the population of Great Britain. Perhaps the anthropologist himself is to blame, and in default of a clear and concrete statement of the application of his studies addressed to the public as well as to those who control the strings of the purse, but are nevertheless swayed by the trend of public opinion, the study of the racial characters of the population and their distribution must seem academic and remote from reality. Even the arguments of the eugenist, convincing as they may seem to the initiated, lose force when confronted with a demand for a definition of the type towards which eugenic control and conscious selection—for that is what it amounts to—would work, while in the references of its opponents to such approaches to a standard as have been attempted, eugenic studies are frankly twitted with being 'class-conscious'.

Happily it is no longer possible to say that physical anthropology is in default of a re-statement of the possibilities of its aims and methods in relation to the social and economic problems of a modern and—it is unfortunately increasedly apposite to say—post-War society. The due and proper function of the scientific study of these problems, which insistently demand remedy, and will demand it with still more urgency in the social reconstruction which must follow inevitably on the present interruption and disintegration of normal life, is set forth with admirable lucidity in the presidential address delivered before Section H (Anthropology) at the recent Dundee meeting of the British Association, from which extracts are given on another page of this issue of Nature (see p. 804). It is unnecessary to repeat here the list of inquiries in which Prof. Le Gros Clark holds the co-operation of the anthropologist essential; but bearing in mind what has been said of the racial and regional differences in the British population, the need for a survey of the physical characters of the people, in their regional distribution, of which he indicates the purpose, cannot be too strongly urged. It is an essential preliminary to all valid testimony in inquiries related to the assessment of the physical development of the population of Britain in its many phases.

It is remarkable and by no means creditable to Great Britain as a nation, professing to have regard to scientific methods, that for data relating to problems of growth, on almost every point, we must turn to evidence recorded in the United States of America. Yet as was shown by the valuable research by Miss R. M. Fleming among school children in Wales over a period of years, such observation is not only of signal importance in its bearing upon questions of purely scientific interest, for which data are lacking though the raw material is at our doors, but also it is a crucial index to a number of problems fundamental in testing the physical welfare of the communit and in pointing the way to remedial measur Thus in the course of the meeting of the Briti Medical Association in Aberdeen in July last, I Alexander Low submitted an analysis of t anthropometric measurements of more than thousand infants born in the Aberdeen Materni Hospital, of whom also fifty males and fifty fema were re-examined annually up to the age of fi years. From the figures it emerged that these infa were 5–6 ounces heavier at birth than those sho in the published figures for other towns; that af the second year the rate of increase was somewh greater for girls, so that at the fifth year the gi were slightly superior in weight to the boys; th in height at birth both sexes were somewhat und the usually accepted figures, but that at five ye these children were more than an inch taller th Edinburgh and Dundee children.

The regional differences may be noted. Yet default of fuller knowledge, the only suggest bearing on the question of the relative increase height which was put forward was the efficien of the Aberdeen working-class mother, and h appreciation of the educative value of the chil welfare centre. Whether this is the real a only explanation, without the further knowled of the facts, which is not available, it is impossi to say, but it makes all the difference to a attempt at ameliorative measures. If the regio variation is due to heredity and not environme it must be accepted that in all probability a attempt to raise the standard for this one cha acter, provided others show no marked a obvious deficiency, will be largely wasted effo As Prof. H. A. Harris pointed out in the d cussion of Dr. Low's communications, we kn more about the embryology and growth chickens and rats than about humans. At prese Dr. Low's continuous series of measurements unique for Great Britain, yet, as he argued, concerns a period of the highest importance f the welfare of the individual.

Reference may also be made to Dr. H. Bathu Norman's investigation (see Nature of Sept. 1 p. 518) of the figures relating to the developme of adolescents between the ages of thirteen a eighteen years in a public school and in seconda schools in the county of Durham, with the view arriving at a norm of development in optimu conditions. While the secondary school boys we homogeneous in respect of regional origin, an therefore, it may be presumed, predominantly form physical type, it is an equally justifiable umption that the group of public school boys mined constituted a mixed population. The ortance of the distinction is to be seen in the clusion. In every one of the characters investi- ed the advantage lies on the side of the public ool boy, for which superiority in nutrition is d to account. In regard to stature, however, ile some influence is conceded to heredity, that racial history, it is inferred that deficiency in rition and environmental conditions has pre- ded attainment of the full development of ich the organism was constitutionally capable— easonable and probable inference, which cannot tested, nor if correct, can the degree to which individual falls short be measured in the absence of any knowledge of the regional or racial type norm for these ages in either class.

Admirable as is Prof. Le Gros Clark's statement of his case, these investigations by Dr. Low and Dr. Norman should clinch the arguments of the physical anthropologist as to the urgency of the need of an extended knowledge of the physical characters of a population of so mixed a character as that of the British Isles. It is not only of academic interest to the man of science, it is also fundamental to full understanding of the many adverse nfluences which mitigate against the building up of a healthy population, developed to capacity, which will be one of the more pressing needs when we turn to repairing the ravages of war.

STATISTICS IN THEORY AND IN PRACTICE

Principles of the Mathematical Theory of rrelation

A. A. Tschuprow. Translated by Dr. M. ntorowitsch. Pp. x+194. (London, Edin- gh and Glasgow: William Hodge and Co., Ltd., 9.) 12*s*. 6*d*. net.

Methods of Statistical Analysis

C. H. Goulden. Pp. viii+278. (London: pman and Hall, Ltd.; New York: John Wiley Sons, Inc., 1939.) 17*s*. 6*d*. net.

THE original German edition of Tschuprow's book on the theoretical foundations of relation between two variables is probably not well-known among English readers as it might and we are therefore grateful to M. Kantoro- sch for this translation. Tschuprow (Russian tistician, 1874–1926) was interested in corre- on partly from the fashion of his time, and tly from his interest in social science; but his rpretation of the word is a wide one, and many es of stochastic relation are discussed.

'schuprow was roughly contemporary with the glish school of statisticians led by Karl Pearson, acknowledges the close association between own treatment and the results of this school. se familiar with the more recent work of R. A. her and others on small-sample theory will l some of the approximations reached in pter vi superseded by exact methods, a biblio- phical reference (p. 192) to Fisher's work on mal correlation, and a note (p. 183) by the nslator on English statistical literature, helping close this gap.

Formulæ independent of the population sampled are, however, still of more than historical interest, and it is instructive to see how far Tschuprow was able to go with his theoretical methods; note, for example, his correct surmise on p. 112 that the average value of the criterion χ^2 ($N\varphi'^2$ in Tschuprow's notation) is $N(k-1)(l-1)/(N-1)$ for a $k\times l$ contingency table. The mathematics throughout are not advanced; moreover, all details of the derivations are relegated to an appendix.

Before the more technical chapters dealing with population parameters and sample estimates of them (*a priori* coefficients and empirical coefficients) there are some sections on the meaning of correlation, including a careful distinction between correlation and causality. There is much common sense, too, percolating through the concluding chapter on the object of correlation measurement. The final remarks of all are so pertinent that they are worth quoting in full:

> "It is not enough to be familiar with the technical tools; he [the statistician] must be familiar with the subject of the investigation as well, and he must have complete command of his material. He must possess the ability to adapt the technique of his investigation to the end pursued and to the possibilities before him. A routine-like mechanical reliance on ready-made prescriptions leads, even when the most complicated formulæ are employed and the most precise calculations are carried out, to an unproductive waste of time and energy and to the accumulation of numerical values which are but little likely to enrich our essential knowledge."

(2) The second book under review has been written for research workers requiring practical knowledge of statistical methods, and will in particular prove a very useful and comprehensive work for those engaged in agricultural experimentation. There are already other books of similar character, but Goulden has the advantage of being one of the most recent authors in this field, and has been able to incorporate practically the whole of the modern statistician's equipment.

The chapter on the field-plot test contains a summary of the new methods of testing a large number of varieties, developed by F. Yates, and will be welcomed by many workers; it should be noted that the quasi-Latin square design is not mentioned. The rest of the book is fairly standard to one familiar with Fisher's own statistical works, and includes, for example, chapters on goodness of fit, correlation and regression, and analysis of variance and covariance. In the chapter on non-linear regression, where the author uses Fisher's technique in his treatment of orthogonal polynomial fitting, he might have distinguished between the method of orthogonal polynomials in c fitting and the summation method of fin moments. At the end of each chapter are e cises which are a potential source of value to thorough student.

Among minor details, the indiscriminate us p. 80 of both b_{12} and $b_{12\cdot 3}$ for a partial regres coefficient is confusing. The meaning of the on p. 81 is peculiar to this book. The last fi in the first paragraph of p. 72 should be 0· not 0·75. The standard error of a mean does seem too well discussed (p. 12 and p. 115).

Both Tschuprow's and Goulden's books are statistical technique; though one is theoreti the other practical. Their common philoso however, is the intimate relation between us theory and useful practice, so that in spite of difference in the authors' interests, there is recommendation that can be made for either w namely, that it should help its reader to acq a sound grasp of the true function of statistic

M. S. BARTLETT

PHYSIOLOGY OF INSECTS

The Principles of Insect Physiology
By Dr. V. B. Wigglesworth. Pp. viii+434. (London: Methuen and Co., Ltd., 1939.) 30s. net.

THE most significant change of outlook among entomological workers to-day is the increasing appreciation of the importance of the physiological aspects of their subject. These same aspects are also drawing an increasing number of young zoologists in their search for problems upon which to expend their energies. A great literature already exists on insect physiology, and it is appearing in a disconcertingly wide and erratic range of journals. The consequence has been that keeping up to date with this literary growth has already transcended the possibilities of most entomologists, and Dr. Wigglesworth's book has made a timely appearance in consequence. With evident critical powers and acumen he has done the great service of co-ordinating and sifting out this great accumulation of data and facts and welding it as a whole into a really indispensable text-book. At the same time he has incorporated the results of his own researches, which are distinguished for their originality and for the resourcefulness of the technique that has been used. The general anatomy of insects is outside the programme of this book, and is only dealt with in so far as it may be necessary to make the physiological arguments intelligible. Histology the other hand, naturally comes in for fuller tr ment since it is intimately linked up with interpretation of the functions of organs and pa It is coming to be recognized that rational meas for controlling injurious insects are often depen upon a proper acquaintance with the physiolog 'make-up' of the species concerned. As Wig worth remarks, knowledge of the ecology of insect is necessary in order to achieve effec control, while ecology itself can only be prop appreciated in the light of an understandin physiology.

The book is divided into fifteen chapters, e being fully documented with its own bibliogra The relative merits of different chapters are h to assess individually owing to the general stand of excellence of the book as a whole. It is, howe probable that few readers will dispute Chapter iii is a masterly outline of the phenome of growth and that Chapter i, on developm within the egg, is possibly too short and sket to be as useful as it might have been. Errors omissions are pleasingly scarce. A few mispri such as *Menanopus* (p. 327) and *Cioneus* o (p. 319), are trivial faults, while the statem about the effects of change of diet in the after the second day (p. 60) is probably a *la* *calami*.

T. Wigglesworth is to be congratulated upon ing written a work indispensable to all serious dents of entomology. It will also be used a l deal by the general zoologist and by the parative physiologist. Destined to rank as a ndard treatise and become also a working handbook, we look forward to its having a long lease of life, and passing through many editions. It is not likely to have any serious competitors for a long time to come. In the next edition an index of authors would be a great advantage.

A. D. Imms.

THE STORY OF PLAGUE AND OTHER TROPICAL DISEASES

History of Tropical Medicine
ed on the FitzPatrick Lectures delivered before
Royal College of Physicians of London, 1937–8.
H. Harold Scott. Vol. 1. Pp. xix + 648 + 3
tes. Vol. 2. Pp. iv + 649–1165 + plates 4–13.
ndon : Edward Arnold & Co., 1939.) 50s. net.

HESE volumes contain a history of tropical medicine, using that term in its ordinary e sense. Starting with the Navy and Mercantile rine, they tell of the dreadful conditions in ch seamen lived a hundred and fifty years ago, ther in or out of the tropics, and the still se quality of the men haled into the Navy the press gang, so bad indeed that it was not canity but their quality, their cost, and the ct on the nation that brought pressing to an just over a hundred years ago. The steady ance in the Army's health in the last hundred rs comes out strongly, and the same lesson is n in the chapters on the Colonies, Protectorates d Dominions, and on India. The main part of book is taken up with disease caused by anisms and food; and the chapter on plague an excellent example of its scope and outlook. Vhen the Philistines captured the Ark from el, and when thereafter mice began to mar ir land and its people to die of swellings about secret parts, they sent back the Ark with, in golden images of these two things they corted. On the other hand, the great plague of iens in 430 B.C. may, Scott believes, have been lioidosis, since Thucydides, who himself recered from it, mentions no buboes. Again, the nese name for plague, 'shu-yi', meaning 'ratt', has been traced back to A.D. 610. Plague to the establishment of quarantine in Venice 1127, using for segregation the house of St. zarus, so giving rise to the names lazaretto and ar house. It was plague that brought into being ls of Mortality at the end of the seventeenth tury in Great Britain, and from them has wn the science of vital statistics; and about s time, it being announced that none who kept tobacconists' shops suffered from plague, there went out an edict at Eton College the sequel of which was that one of the boys "was never whipped so much in his life as he was one morning for not smoaking". In 1828 came a report from two Frenchmen who held history to show that plague first appeared in Egypt in A.D. 543, about the time when under Christian influence embalming gave place to burial; their conclusion was that the air became heavily tainted with decomposition products and started plague, and they add, "Is there a more conclusive or more notable piece of evidence in any science in which facts are not ascertainable with mathematical certainty?"

The properly controlled scientific certainty, when it came, was very different. Yersin, in 1894, discovered the bacillus in rats and men, and Scott lists fifty-four rodents, other than rats and mice, discovered between 1895 and 1935 to suffer from spontaneous plague. The means of conveyance from rat to man became clear in 1897 when Ogata noted that the plague rat's dead body could safely be handled when cold, that it then had no fleas, and that the emulsion made from a crushed flea, taken off a plague rat, gave plague when injected into a mouse. It was nearly ten years later that the English Plague Commission in Bombay showed that the bacilli, multiplying in the flea's stomach, so fill it and regurgitate into the proventriculus that they readily enter the next mammalian host on which the flea feeds. It is a pertinent comment on the wide interrelationship of biology and human infections that it was some forty years later that Iyengar and O'Connor showed independently that *Microfilaria bancrofti* swallowed by Culex may experience just such regurgitation into the anterior part of the mid-gut before it penetrates the mosquito's tissues.

But to return to plague; there is the pneumonic form with its notable epidemic in Manchuria in 1910; and the occult form in ground squirrels in California, the presence of which is now traced by inoculating into experimental animals the fluid from the bodies of the squirrel's fleas. Knowledge of plague has been used to save human life, as by the rat-proofing of houses and ships, and to destroy it, as in the Pakar murder case in Bombay; and as to the latter use, there is the observation that the bacilli can survive in tear or asphyxiating gas and perhaps could be used to spread infection in warfare.

The mode of dealing with this single disease illustrates the book's aim and scope: there are first empirical observation and uncontrolled conjecture; they give place to controlled observation and reasoning; and finally there is established knowledge used by man for good or ill.

There are chapters on the making of the Suez and Panama Canals, the latter finished only when tropical disease had been successfully controlled. There is one on the slave trade with its half-mill deaths yearly, and to the slaves a water allowa on the voyage of half-a-teacupful every third da and there is the introduction by its means i America, it seems certain, of leprosy, filaria dracontiasis, hookworm infection, yaws, and yell fever.

The last eighty pages of the work are filled fifteen short biographies of men, no longer livi selected because their work on tropical medic has not been limited to one problem, and so h escaped sufficient notice in earlier pages. Bibl graphy and indexes are generous. Resear learning and humour, amply backed by t publishers' enterprise, deserve success.

Clayton Lane

A CRITICAL AND HISTORICAL SURVEY OF THE CALCULUS

The Concepts of the Calculus

A Critical and Historical Discussion of the Derivative and the Integral. By Carl B. Boyer. Pp. vii + 346. (New York: Columbia University Press; London: Oxford University Press, 1939.) 18*s*. 6*d*. net.

In the historical survey of mathematics, as of any branch of science, it is customary to ascribe a great discovery to one or more individuals. Without, however, seeming in any way to detract from the full credit due to such brilliant researchers, it must not be overlooked that behind every great step forward there is, invariably, an evolutionary development of ideas which renders that step possible. There are periods of suggestion and anticipation which lead to a stage where the nebulous begins to take form and ultimately becomes precise. But the process does not stop here. A new discovery is somewhat analogous to a roughly-hewn article specially designed for some particular purpose; it will not function to its fullest extent until subjected to a refining development in which greater definition is brought forth, with a consequent extension of the field of validity and useful application. Thus, in time, by a mental process of evolution, any discovery, great as it may be, tends to become less prominent as a separate entity. In the words of J. W. N. Sullivan: "A history of mathematics is largely a history of discoveries which no longer exist as separate items, but which are merged into some more modern generalisation".

An illuminating example of this truth is furnished by the infinitesimal calculus. The mention of this very important branch of mathematics recalls fluxions of Newton and the differential calculu Leibniz. Yet, according to Chasles, the great mathematician of antiquity, Archimedes of Sy cuse, "gave birth to the calculus of the infi conceived and brought to perfection successiv by Kepler, Cavaliere, Fermat, Leibniz and N ton". Thus were the concepts of the derivat and the integral made possible. Yet the calcu as left by Newton and Leibniz was far from sa factory. There were, for example, no valid crite for testing the convergence of an infinite ser though both these great men realized the necess for convergence. Also, the ideas of continuity a discontinuity were far from being clearly und stood or appreciated. Hence, the eighteenth c tury was characterized by considerable dou concerning the validity of the foundations of calculus.

"Had Newton been more precise in the sta ment of his limit method, and had Leibniz be more explicit in professing that he was develop an instrument of invention and not a logi foundation, the period of indecision might not ha ensued. As it was, it required the work of Cauch Weierstrass and others to impart to the conce of the continuous variable, the limit, the derivat and the integral a precision of formulation wh made them generally acceptable."

Thus does Carl Boyer sum up the deficienc of the calculus of Newton and Leibniz in fascinating book, which is the basis of this b discussion. It seems almost that the eighteen century of indecision which brought forth Berkeley-Jurin controversy, the limit concept

Robins, the "Fluxions" of Maclaurin, the alculus" of the Bernoullis and the various conibutions of Euler, Lagrange and others, was cessary to prepare the way for the period of gorous formulation which followed. But the ll story is told vividly and fearlessly by Carl yer, who traces the development of the basic ncepts upon which the modern calculus is unded, from the earliest times to the present y. The eight chapters are filled with interesting cts welded into a continuous narrative which vets the reader's attention almost like a romantic vel. According to the preface, the author's theme—well described by the sub-title—has not before been satisfactorily dealt with. The book is "not a history of the calculus in all its aspects, but a suggestive outline of the development of the basic concepts"; and a very stimulating outline, too! The author almost makes the infinitesimal, Osgood's "abominable little zeroes", or "the ghosts of departed quantities", the indeterminate ratio 0/0, etc., seem like living characters in a work of fiction.

A comprehensive bibliography is provided at the end and the complete volume is both an important and valuable addition to the literature of mathematics. F. G. W. B.

CHEMICAL ANALYSIS

andard Methods of Chemical Analysis

Manual of Analytical Methods and General
ference for the Analytical Chemist and for the
lvanced Student. By Dr. Wilfred W. Scott.
fth edition, edited by Prof. N. Howell Furman
collaboration with Eminent Specialists. Vol. 1:
e Elements. Pp. xxxi + 1234 + 97. Vol. 2:
ecial Subjects. Pp. xxi + 1301–2618 + 97. (Lon-
n: The Technical Press, Ltd., 1939.) 2 vols..
s. 6d. net.

HE rapid growth of analytical chemistry in modern times necessitates that any textok which hopes effectively to cover the fields both pure and applied analysis shall assume nost encyclopædic proportions. The considerle increase in the size of this fifth edition of ott's well-known manual is at least outward idence that it has attempted to deal adequately th these recent advances, a conclusion which is ıply confirmed by a study of the contents. The o volumes of the present edition now cover me 2,700 pages—an increase of nearly 1,000 ges over the fourth edition.

In the first volume, which deals with schemes the analysis of the more important chemical ments, practically all the chapters have been panded and, in many cases, re-written. In dition, there have been included, for the first ne, methods of analysis for gallium, germanium, drogen, oxygen and rhenium. Of these, the st two are not quite as complete as they might , there being missed from the chapter on gallium o's camphoric acid method, which is quite iable, while no colorimetric procedures are given germanium. Also, in the determination of ygen in organic compounds, it is unfortunate at the method given, although neat, is applicable materials containing carbon, hydrogen and ygen only. Apart from these points, the new chapters cover the ground adequately. The second and third parts of volume 1 are substantially the same as in the previous editions, although it is to be regretted that the tables of gravimetric factors have been omitted.

The second volume has undergone even greater changes and is now divided into two parts. Part 1 deals with sampling and applied analysis, and here all the chapters have been brought up to date, while many of them have received considerable expansion, particularly those on alloys, petroleum products, rubber and soap. The section on paper and paper-making originally found under "Miscellaneous Analyses" has been enlarged and raised to the dignity of a separate chapter.

Part 2 deals with special techniques applicable in diverse cases, and here are to be found the chapters on acidimetry and alkalimetry, gas analysis, metallography and solubility. New material which has been introduced consists of sections on the determination of pH by colorimetric and electrometric methods, potentiometric methods, conductometric methods, chemical microscopy, quantitative microanalysis and spectrographic analysis. All these provide excellent surveys of the various procedures, while in some of the chapters are to be found numerous references regarding the application of the methods to special problems.

The manual is commendably free from errors, although one or two have crept in as a result of rearrangement of the text; also Figs. 25, 243 and 267 do not correspond with the legends beneath them. There has been a typographical change which makes for easier reading, while another welcome change has been the provision of an author index. Altogether, revision has considerably enhanced the value of a work that had long established itself as a necessity to analytical chemists.

SCOPE AND LIMITATIONS OF PHYSICAL ANTHROPOLOGY*

By Prof. W. E. Le Gros Clark, F.R.S.,
University College, London

FOR many years now it has been established beyond doubt that man is one of the terminal products of organic evolution, and that he achieved his humanity at a comparatively recent date in geological time. He was an animal dominated by the primitive instincts of the wild creature before he was a man capable of controlling his own destiny by his intellect. He must be studied as an animal before he can be properly appreciated and appraised as a human being. The subject which is concerned with the study of man from this point of view is physical anthropology, and it may perhaps be claimed that, of all the subdivisions of anthropological science, physical anthropology is the most fundamental, since it concerns itself with the physical nature of man, and the physical nature of man underlies ultimately all those intellectual, æsthetic, and social activities which supply the material for other branches of anthropological study.

Zoological Position of Man

The results of the extensive researches carried out in recent years have served to substantiate in general the views held by most anthropologists, namely, that man has relatively close systematic affinities with the anthropoid apes; in other words, that the human phylum was derived (in the evolutionary sense) from a common ancestral group which also gave rise to the modern anthropoid apes. In a number of details, however, a thorough inquiry into morphological comparisons has led to certain modifications of this generally accepted thesis. The reason for this is that comparative anatomists and palæontologists have come to realize that *parallelism* has played by no means an insignificant part in organic evolution. Now this conception considerably complicates phylogenetic problems, for it makes it necessary to distinguish between morphological similarities betokening real genetic relationship and those which are secondarily acquired as the result of convergence, that is, of evolutionary differentiation which may have occurred in the same direction in different groups independently.

It is interesting to note that, in recent yea detailed and careful comparative anatomic studies have led more and more students to t inevitable conclusion that the evolutionary histo of man and the anthropoid apes has been co plicated by the effects of parallelism. The remains no justification, however, for taking t extreme view that these higher primates are in way related to each other. Such a conclusion do violence not only to all the evidence of co parative anatomy, but also to the availal palæontological evidence. The very fact th parallelism has occurred between man and t apes indicates that they are *ultimately* deriv from a common ancestral stock which endow them with similar evolutionary potentialiti Moreover, even if it be accepted that the rep sentatives of this ancestral stock could scarce have manifested the aberrant specializatio characteristic of the modern anthropoid apes, remains reasonably certain that they must ha shown in the structure of their brain, skull a dentition, anatomical characters which wou demand their inclusion in the zoological catego of Anthropomorpha. In other words, it remai true to say that man had a simian ancestry. Th relationship is well emphasized in a new classi cation of mammals recently put forward by G. Simpson, for he includes man and the anthropo apes in one superfamily, Hominoidea.

Palæontological Evidence of Human Origi

Between the Miocene genera of anthropoid ap and the earliest fossil record of man there remai a large gap in the palæontological sequence. T oldest representatives of the Hominidæ of whi we have any real knowledge are Pithecanthrop from Java, and Sinanthropus from the ea Pleistocene of China. The fact that some anthr pologists have classified the remains of these ea representatives of man as two different genera a good example of the results of the difficult encountered in the study of rare fossils of t type; for, since such fossils usually turn up sing and often at intervals of several years, each c is made the subject of intensive study without t advantage of adequate material for comparis nsequently, the anthropologist tends to exagrate in his own mind the significance of small uctural differences which, after all, may be erely an expression of interspecific or even of dividual variation. This now appears to be rtainly the case with Pithecanthropus and anthropus, for, since the initial discovery of e type specimens, the remains of a number of her individuals have been found which emphasize e wide range of variation in both groups. Indeed, e overlap in variation between the two is quite nsiderable, and it is clearly desirable that they ould both be included, for purposes of classifition, in the one genus, Pithecanthropus.

---

* Based on the presidential address to Section H (Anthropology) of the British Association delivered at Dundee on September 1.

The range of variation among members of this oup may be illustrated by reference to the cranial pacity of adults, which varies from 750 c.c. to 200 c.c. Now such a range of variation in the all number of individuals which has been und is very remarkable, for in so ancient a type man it can scarcely be attributed to the effects extensive intermixture. The knowledge that is variability does occur should therefore guard thropologists against making too hasty assumpons on the basis of the study of isolated specimens.

The variability manifested by these early reprentatives of the Hominidæ serves to emphasize e fact that the range of genetic variation in man quite exceptional in contrast with lower animals. other words, man is distinguished physically om other mammals not only by the possession of rtain general anatomical characters, but also by e degree of variability which they show. The tent to which these genetic characters can be odified by environmental influences is also a istinctive feature of man. This variability ndoubtedly has far-reaching implications in the udy of all branches of anthropological science. seems certain, for example, that it has been important factor in the evolution of human ciety, for it allowed a wide range in the developent of individual abilities, and also provided for e considerable plasticity which is a pre-requisite r the building up of complex types of social rganization.

Future of Physical Anthropology

Apart from palæontology, it may be doubted hether physical anthropology is likely to advance ur knowledge of racial origins and differentiaion very much beyond its present state with he techniques now available. The reasons for his somewhat pessimistic prognosis include the ifficulty of acquiring adequate skeletal material rom which the racial composition of populations the past can be inferred; the frequent imossibility of identifying racial types by the examination of skeletal material only; the fallacy which may be involved in the assumption that certain craniometrical similarities necessarily indicate a true genetic affinity; and the difficulty of eliminating the effects of environmental influences in modifying physical characters which otherwise have a genetic basis.

A valuable aspect of the study of present and past populations from the historical point of view by the rigid application of biometric technique is that it permits the testing of the popular conceptions so commonly held to-day regarding the equivalence of race and nationality. No one will doubt the need for the clarification of such ideas. The physical anthropologist, indeed, has an important duty to fulfil in the discussion of modern social problems, by providing objective evidence to show whether there is any truth at all in the tenet that 'nation' and 'race' in Europe are in any instance comparable terms. Such studies as have been made on this question have hitherto led in general to negative results.

In so far as history can be said to provide a basis for prognostication, physical anthropology as a historical science has a considerable practical significance. The study of the bodily changes which man has undergone in the past gives a clue to the nature and extent of the changes which may be anticipated in the future. *But what is far more important for the same purpose is the study of man as he is to-day.* Sociological problems are becoming more and more forced on our attention and demand for their solution a conscious control of processes which have hitherto been left to chance. The improvement of health and physique and their relation to nutritional and climatic factors, the effects on physical type of the redistribution of the populations of the world, the results of the hybridization of different racial types, the relation of changes in the reproductive rate to human variability and the composition of regional populations, all these are practical problems which can be approached systematically and scientifically only if we have adequate data regarding the physical nature of man in the conditions under which he now lives.

We still lack this essential knowledge. In Great Britain, for example, there are no proper records which show the variability of different sections of the population living under different nutritional conditions and in different environments. Still less is there any real knowledge of the potentialities for growth and development of native populations living under optimal conditions of nutrition and hygiene. Yet a study of the normal variability of man to-day, and of his bodily reactions to environmental influences, must clearly be a necessary basis for any assessment of changes which are to be anticipated in the future. Let us note briefly the lines along which physical anthropologists may most profitably seek for this information.

Human genetics. The study of human genetics offers practical problems of considerable urgency, for no one doubts that the mode of transmission of hereditary defects, which may be manifested in structural abnormalities, metabolic disorders, or susceptibility to diseases of one kind or another, should be elucidated in all possible detail. The problems of human heredity form the basis of the whole science and practice of eugenics, and the eugenist requires to have all the data of human heredity at his disposal if he is to exert any conscious control over the destiny of mankind in the future.

Apart from the practical significance of human genetics in relation to the health and progress of mankind, this study has also a direct relation to the more academic problems of the anthropologist. Physical anthropologists have on several occasions been criticized for employing as criteria in their studies of racial affinities physical characters the genetic basis of which is unknown. No doubt such criticism is often justified, for it is clear that only those characters which are the expression of genic differences have any validity in taxonomic problems. There is evidence that the shape of the head is certainly in part determined by heredity, but there is also evidence that it can be modified by post-natal influences. Similarly, it is well recognized that the height of an individual is closely correlated with nutrition, but it is known that it also depends partly on heredity. The relative importance of genetic and environmental factors must ultimately be determined for all such characters as these.

The question of the possible linkage of phenotypic characters is another problem of human genetics which demands intensive investigation, since this phenomenon may permit the recognition of latent defects in cases where they are linked with a physical trait detectable by superficial observation or appropriate measurement. The possible relation of physique to susceptibility to disease is particularly important. It is commonly supposed that a relation of this kind does in fact exist. Physical types, such as those termed 'asthenic', 'pyknic', and 'athletic', have been defined, each with their particular advantages and weaknesses; but, so far, the evidence in favour of such a sharp classification is equivocal, and the same doubt still applies to the supposition that certain racial types are particularly susceptible to infections of one kind or another. For example, there is a current belief that the Negro, as the result of an inherited predisposition, is specially liable to tuberculosis, and that certain types racial miscegenation likewise lower the resistan to such diseases. Yet in a recent and caref survey by Williams and Applewhite, the conclusi is reached that there is little if any differen between the White and the Negro in resistance tuberculosis (given equal opportunities for medic treatment), nor do miscegenetic types of the Neg really show a greater incidence of tuberculosis.

The possibility of a genetic linkage of characte also raises the question how far inherited physic traits may be related to an inherited mental di position. It is common enough, in text-books anthropology, to find different varieties of tem perament assigned to different racial types. F example, it is stated in a recent comprehensi work on human heredity (by Dr. Lenz, profess of racial hygiene in the University of Munic that the Mediterranean race (of which, in Europ the southern Italians are perhaps the best repr sentatives) is volatile and frivolous in temper ment, has less sense of truth and honour than th Nordic, and, in respect of rational endowme and character, occupies an intermediate positio between the Nordic and the Negro. The Nord race, on the other hand, is supposed to be endowe with creative energy, with a vigorous imaginatio high intelligence, and an unusual degree of sel control.

Physique and nutrition. The problems of huma genetics and the supposed association of ment traits with demonstrable physical characters a complicated by the growing recognition duri recent years that nutrition plays a highly importa part in determining the physical variations seen i different races and in different individuals. It unnecessary to state that a broad relation betwe nutrition and physique has always been accepte by anthropologists. Stature, weight, ches dimensions, and so forth, can all be correlated wit nutrition. But the suggestion is now put forwar by competent dietitians that the effects of mal nutrition may be much more extensive, not onl as causal agents underlying many types of varia tion in physical characters, but also in determinin susceptibility to different types of infection. I this is true (as it undoubtedly appears to be) i clearly demands the serious attention of physic anthropologists.

In Great Britain, indeed, evidence has been pu forward which suggests that malnutrition may b far more extensive in the lower economic levels o society than has hitherto been suspected. Clinica and anthropometric comparisons of the childre of relatively wealthy parents with those of poo parents have demonstrated a marked contrast i physique, general health, and susceptibility t infections. There is evidence, for example, tha e infantile mortality from respiratory infections considerably higher in the poor districts of large wns than in the residential areas of the richer ctions of the population, and there is also idence that the predisposition to respiratory fections is related to under-nourishment. Morever, direct experiments (although of a limited ture) have been carried out on human material which the effects of different diets on growing ildren have been recorded.

It will not be doubted that, if there is indeed idespread malnutrition, it is a matter of national terest that it should be corrected as soon as ossible. But an essential preliminary to any largeale plan of action is to collect precise information garding the extent, distribution, and degree of nder-nourishment. Here is a problem in the lution of which the physical anthropologist ould play a predominant part. He has at least e experience and technique which will enable m to seek an answer to one of the most urgent eliminary questions: By what somatometric ethod, which is both reliable and convenient of plication, is it possible to assess nutritional atus ?

It is perhaps a matter for surprise that in Great ritain we still have no adequate standard of hat may properly be called *normal* physique, as basis for comparison when seeking for evidence f malnutrition. This is partly due to the fact at available anthropometric data apply to ixed populations from different parts of the untry, in which no attempt has been made by reful clinical examination to eliminate those dividuals who may be under-nourished, or otherise unfit physically. It is also a fact that the hysical standard is by no means fixed and nchanging. There is evidence, for example, that e average height of the population, not only in reat Britain but also elsewhere, is rising rather pidly, and it has been recently estimated that this crease may be as much as one centimetre in very 12½ years. It is possible that this increase directly referable to improved nutrition, though here are some reasons for supposing that this xplanation may not be completely adequate. It mains conceivable that it may possibly represent definite orthogenetic trend in human evolution hich is manifesting itself in statistical analysis.

In order to obtain a basic standard of physique r series of standards) for comparative studies, it in the first place necessary to carry out a comlete survey of the country by the systematic xamination of samples of the population from ifferent districts. Such a survey would require he close collaboration of physical anthropologists ith clinicians, medical officers of health, dietitians, nd social workers, in order to attempt a correlation between physical development and the normal healthy condition of body and mind, and, if possible, to relate this also to the social conditions of life. In fact, an attempt should be made to extend the health surveys which have been recently carried out in Great Britain and a number of other countries, the aim of which has been to correlate also the clinical assessment of nutritional status with anthropometric observations.

Observations on the relation of nutrition to physique, capacity for work, and susceptibility to disease are also waiting to be carried out among native peoples in many parts of the world. Some excellent work along these lines has been started in India, Africa, and also in China, where information has been collected regarding the composition of the diet of different sections of the native population. Here the field anthropologist must necessarily give his aid, since he is in the best position to obtain a detailed record of the food elements of the diet which are ordinarily obtainable at different seasons, to study the local customs in the preparation of the food for consumption, and also to collect samples of the various foodstuffs for analytical study by the biochemist. It has already become evident from such observations that in some cases the native diet is hopelessly deficient in certain essential food elements which are necessary for the development of a normal physique and for the maintenance of health. The elucidation of such defects in the diet must surely in the future be a powerful factor for success in colonial administration.

To carry out nutritional surveys in native populations, the physical anthropologist will also require to examine the somatometric indexes which have been worked out by reference to European peoples, for they will probably need modification to adapt them to different types.

The fields of research to which we have directed attention serve once more to emphasize the fact that the physical anthropologist of the future must be essentially a field-worker if he is going to develop his subject along progressive lines. He must also be a man of sound biological training if he is to acquire a real insight into the problems which are set for him. Some of these problems have a very intimate relation to human happiness and human suffering, and their investigation is a matter of urgency.

The science of physical anthropology has contributed much to the study of the past history of the human species. By the study of modern populations it has a still more important function to fulfil : the accumulation of data on the basis of which it will be possible in some measure to control the destiny of mankind in the future.

SOLAR AND TERRESTRIAL RELATIONSHIPS

A DISCUSSION on solar and terrestrial relationships had been arranged to take place on September 5 as part of the programme of Section A (Mathematical and Physical Sciences) of the British Association meeting at Dundee. The meeting was not held, owing to the international situation, and the following account contains the subject-matter of contributions from Dr. E. V. Appleton (radio effects), Mr. H. W. Newton (solar phenomena and terrestrial magnetism), Dr. A. D. Thackeray (solar phenomena), Prof. L. Vegard (auroral phenomena and the physics of the upper atmosphere), Prof. W. M. H. Greaves (the 27-day recurrence tendency of magnetic storms) and Prof. F. J. M. Stratton (general summary).

Many attempts have been made in the past to correlate solar and terrestrial phenomena. Until quite recently, the only one that was found to show a clearly measurable relationship was that between sunspot activity, auroras and magnetic activity. There is no direct meteorological effect of any serious importance, although in some climates tree-rings suggest a connexion of a complex type with the sunspot cycle not shown up by ordinary data. The recent study of the ionosphere has shown a new relation, involving an increase in ionization in the upper atmosphere accompanying increased magnetic activity at times of maximum sunspot activity; this relation appears in a peculiarly clear-cut fashion at times of chromospheric eruptions which closely coincide with short-wave radio fade-outs. The correlations so far found can all be attributed either to a stream of corpuscles ejected radially from the sun's surface or to an increase in ultra-violet solar radiation.

Nearly every type of solar activity is capable of emitting a stream of particles or high-frequency radiation which may ultimately strike the earth's upper atmosphere. In the lowest levels of the sun's atmosphere, direct observation reveals sunspots, faculæ and granulation; with the spectroscope, high-level flocculi and prominences are detected (chiefly in hydrogen or ionized calcium light); still higher, coronal streamers suggest a permanent outward flow of particles. Eruptive prominences, which may ultimately attain velocities of the order of 600 km./sec., form a spectacular example of the sudden expulsion of matter from the sun, presumably through radiation pressure; the motions of prominences, however, as revealed by cinematography, show many characteristics which are difficult to explain even in terms of a complex interaction of radiati pressure, gravitation and electrical forces.

Radiation pressure is insufficient to support t whole mass of chromospheric gases, but the dyna ical concept of turbulence has partially solv this difficulty. A turbulent velocity of 15 km./s in the chromosphere is indicated; in the low layers it is on a much smaller scale. The sho lived granules, with a life-time of only thr minutes, represent permanent activity all over t sun's surface, *independent of the* 11-*year sunsp cycle*, while chromospheric eruptions represe temporary localized activity on a large scale. The eruptions consist of intense brightenings in hydr gen and calcium light which sometimes last only few minutes. Thanks to the spectrohelioscop perfected in 1924 by Hale, a practically continuo watch for these short-lived phenomena is now ke throughout all longitudes by international operation. It has been found that 50 per cent the brightest eruptions are associated with *simu taneous* radio fade-outs; with the fainter eruptio the association is much less direct.

The statistical relationship between sunspo and magnetic storms may be summarized follows: (*a*) there is a general similarity in th frequency curves of the two phenomena in th 11-year cycle; (*b*) the largest sunspots, at the tim of their passage across the central solar meridia are often associated with large magnetic storms (*c*) the most favoured position of the associate sunspot at the time of the magnetic storm is abo one day past the central meridian. The time-la suggests the time of travel of a stream of particl from sun to earth. The relationship becom progressively more obscure when smaller spots a studied.

It is natural to inquire whether this relationshi is due to the presence of chromospheric eruption which are most commonly observed in or ne large active sunspots. A distinct relationship ha been established between eruptions and magneti storms, similar to that with sunspots. Of th twenty-nine greatest eruptions observed since 189 twenty-one were found to be followed withi 4·0 days by a magnetic storm, and half of thes storms were classified as 'great'. Magnetic storm do in fact appear to be more closely associated wit chromospheric eruptions than with sunspots.

The association of chromospheric eruptions wit ionospheric disturbances is of a different character (*a*) there is no time-lag; (*b*) the eruption can b effective wherever it occurs on the solar disk

·) the ionospheric disturbance is practically)nfined to the earth's sunlit hemisphere ; (d) there an accompanying small perturbation of the ırth's magnetic field. These four facts are constent with the suggestion that the solar agency ultra-violet radiation emitted from active egions of the solar surface. The agency responble for magnetic storms, however, is to be looked r in a radially ejected stream of high-velocity articles. The observations favour a common rigin of radiation and particles in an active ortion of the sun's surface, which may also but ot necessarily be marked by a large sunspot. The ssociation of terrestrial phenomena with sunspots ust be regarded as an indirect one ; it is only ecause they are so easily observed that sunspots ave been taken as a convenient index of solar tivity.

A further relationship between sunspots and rrestrial magnetism is shown by the fact, known r many years, that magnetic storms tend to recur t intervals of one synodic solar rotation (about 7 days). A catalogue of 403 storms based on reenwich records for the years 1874–1927 has een used to study this relationship in detail. hese were divided into five groups according to tensity, represented by the mean of the three mponents *D*, *H* and *V*. The history of stormays following each storm was followed up and the ndency to recur after 27 days was found to be nfined to the less intense storms (less than 30 γ) : in the weakest storms (less than 150 γ), ıere is a definite additional tendency to recur at tervals of 54 days.

This result can be expressed in another way : if ttention is confined to storms which tend to recur fter 27 days, it is found that the ratio 'sequence torms' to all storms decreases progressively from ·25 to 0·05 as one passes from weak to great orms. This result does not contradict the conclusion that magnetic storms are due to radial reams of corpuscles from active regions of the un ; it merely suggests that the most intense solar isturbances which eject such streams are comaratively short-lived and will not survive a solar otation. The 27-day recurrence has been found persist throughout spotless periods of minimum ctivity ; thus, as implied previously, the spots hemselves must not be regarded as the origin of he corpuscular streams.

The frequency of auroras has long been known o follow the cycle of solar activity ; there is also slight tendency for intense auroras to occur near he times of the equinoxes, when the earth lies in he plane of the equatorial belt of the sun where ctivity is greatest. The spectrum of auroras onsists of bands (chiefly due to nitrogen) and lines lue to atomic oxygen and nitrogen, neutral and ionized). The wave-lengths of the strong green and red lines have been measured with great accuracy, and, with the help of knowledge of atomic energy levels, attributed to 'forbidden' transitions of neutral oxygen.

The presence of ionized oxygen and nitrogen indicates the action of particles of high energy. The work of Störmer has shown how the streamers may be identified with the paths of electrified particles entering the earth's magnetic field. Analysis of the intensity distribution within auroral bands yields a mean temperature determination of – 44° C. There is no evidence of any increase in temperature with height either from band analysis or from measures of interferometer fringes of atomic lines. Further, the observed light intensity along auroral streamers suggests that the density of atmospheric gases diminishes but slowly within the auroral region from 100 km. to 800 km. It is suggested that matter is driven to these heights by electric forces in an ionized or partially electrified atmosphere.

A theory proposed by Vegard in 1923 accounts for the main facts on the assumption of a stream of photon radiation, the wave-length of which corresponds to soft X-rays, in addition to the ordinary temperature radiation and corpuscular rays emitted by the sun. The incidence of this radiation on the extreme upper atmosphere produces a sort of terrestrial corona. The theory has been very successful in explaining the chief layers of ionization in the upper atmosphere. The soft X-rays will produce two ionization maxima ; the first, formed at a high altitude by high-speed photo-electrons, is identified with the F_2 layer, which surrounds the whole earth, but is higher by night than by day ; the second, at a low altitude where the absorption per unit length is a maximum, is identified with the *E* layer, which is confined to the sunlit hemisphere. The energy of the photons must be about 1000 volts to account for the observed heights of the *E* and F_2 layers. Finally, the absorption coefficient for rays in a large range of wave-length (100–1000 A.) is a maximum, so that these rays will produce an ionization maximum at about the same height—calculated to be 200 km.—which will be confined to the sunlit hemisphere. This maximum is identified by Vegard with the F_1 layer.

The variations in ionization in these three layers may be very efficiently studied by means of the radio sounding method, developed by Appleton and others. The ionosphere may, in fact, be regarded as a solar laboratory in which the effects of high-frequency radiation and particles emitted by the sun may be analysed. By timing echoes of vertically transmitted waves, a relation is obtained between equivalent height of reflection and radio-wave frequency. At a critical frequency, echoes from the ionosphere are lost, and this gives a clue to the maximum electron density in any layer. Layers E and F_1 show comparatively smooth diurnal, seasonal and sunspot-cycle variations, all of which confirm the supposition that these layers are produced by high-frequency solar radiation. The long-scale variations in ionospheric reflectivity do, in fact, give a very perfect reproduction of the 11-year cycle of solar activity. The ionization in layer F_2, however, suffers remarkable irregularities, particularly during magnetic storms, when the ionization maximum is less than normal. The most striking type of ionospheric irregularity is that known as an irruption or fade-out, which is usually associated with a chromospheric eruption. Here the absorption is so great that the echo may be entirely lost, but the height of reflection is not usually greatly affected.

The question of the ultimate character of the short-wave solar radiation associated with these disturbances (for example, its frequency and whether it consists of continuous or line-emission) is still quite unsettled. The spectrum of chromospheric eruptions in the observable range has been found to consist of lines due to H, He and Ca^+. Photometric measures show that during an eru tion, the total Hα radiation from the sun increas by only a few tenths of one per cent; it is qui clear that what the spectrohelioscope observer se is a secondary effect, and that the primary distu bance consists in the leakage of unobservab ultra-violet radiation. As Milne has pointed ou given an increase of radiation, the ejection of stream of high-speed particles is easily accounte for by radiation pressure. Lyman emission hydrogen is insufficient to account for all th observed effects, and it is probable that we hav to deal with a mixture of line and continuou radiation. Continuous emission is not normall observed in the visible region, although a sma increase at wave-length 3220 A. has been detecte in one exceptional eruption.

Further analysis of ionospheric disturbances b radio sounding probably holds out greater hop for the ultimate solution of the problem than th observation of secondary solar effects in the visibl spectrum. Finally, the spectra of 'sunlit aurora recently observed by Störmer promises a fruitf field for research into the uppermost region where the solar rays first strike the earth atmosphere.

OBITUARIES

Sir William Pope, K.B.E., F.R.S.

WILLIAM JACKSON POPE, the great chemist, was the eldest son of William and Alice Pope who at the time of his birth (March 31, 1870) lived in New North Road in the City of London. On leaving the Cowper Street Endowed School, Pope proceeded to the Finsbury Technical College, where he was one of H. E. Armstrong's earliest pupils. He followed Armstrong to the Central Institution (now the City and Guilds' College of the Imperial College of Science and Technology), where the scheme of scientific studies having no reference to outside examining bodies did not lead to a university degree but gave Pope a rigorous training in chemistry, classical crystallography (under H. A. Miers) and in research methods admirably suited to his genius. From that time dated the unique friendship between Armstrong and Pope which was only broken by the former's death in 1937.

While still a student, Pope began his own crystallographic investigations of organic compounds. He also collaborated with F. S. Kipping, then Armstrong's assistant, in important investigations in the chemistry of camphor and on the constitution and characterization of externally compensated compounds.

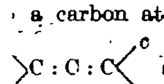
Pope's first appointment (1897) was that of head of the Chemistry Department of the Goldsmiths' Institute at New Cross, and at the same time he was lecturer on crystallography at the "Central". I 1901 he became professor of chemistry and head the Chemistry Department at the newly built Scho of Technology, Manchester, becoming professor chemistry in the University of Manchester in 190 when the School was made the centre of the Facult of Technology, and on that occasion Pope receive his first university degree; he had been elected t the fellowship of the Royal Society in 1902. Pop was elected to the professorship of chemistry in th University of Cambridge in 1908 in succession t J. D. Liveing, who had held the chair for fort seven years, and in the following year he was electe to a professorial fellowship at Sidney Sussex Colleg

Pope's enduring fame will rest chiefly on his wor on molecular dissymmetry. Pasteur had laid th foundations of stereochemistry in 1849, and up t the time of Pope's work at the Goldsmiths' Institut all the optically active compounds studied b Pasteur and his successors contained in the molecul at least one carbon atom having an asymmetri environment. The presence of this 'asymmetri carbon atom'—a carbon atom united to four differen atoms or groups tetrahedrally arranged round it— in the molecule was up to then regarded as bein essential for the particular compound to be capabl of exhibiting optical activity. As Pope has frequentl pointed out, it is probable that the use of thi rticular phrase with its narrow implication tended r many years to delay progress in stereochemistry, ce it became usual to correlate the exhibition of tical activity with the asymmetry of a particular om present rather than with the dissymmetry of e molecule as a whole. By the optical resolution externally compensated compounds in which the oms nitrogen, sulphur, tin and selenium had ymmetric environments, Pope was the first to ow that the presence in the molecule of a carbon om having an asymmetric environment was not sential for the exhibition of optical activity. In s classical work he had as collaborators S. J. achey, A. W. Harvey, E. M. Rich and H. A. D. ville, and its success and that of numerous chemical d stereochemical investigations carried out simulneously depended on Pope's knowledge and use of ystallography and also on his introduction of the e of the camphorsulphonic acids, first adequately scribed by Kipping and himself, for the resolution externally compensated bases.

During the Manchester period, Pope had as sistants C. S. Gibson and John Read. With achey he prepared the first organic compounds of tinum and with Gibson those of gold, and this rk, so novel and simple in its conception, was pical of Pope's knowledge and genius in attacking ndamental problems. Another striking example of is was the elegant work carried out with Read ich resulted in the resolution of externally comnsated chloroiodomethanesulphonic acid, CHClI. $)_3$H. This work showed that it is only necessary r the attachment of four different atoms or groups, ne of which need contain a carbon atom, to a gle carbon atom to condition stable optical activity. is compound is still the simplest substance showing rmanent optical activity. At this time also, Pope d Read began the work which resulted in the troduction of optically active oxymethylenecamphor alternative to the use of the camphorsulphonic ids for the resolution of externally compensated imary and secondary amines.

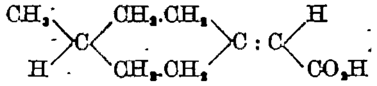
Since his student days, Pope had been profoundly terested in the relation between chemical constituon and crystalline form. For many years he and . Barlow worked on this subject, and beginning in 06 they published a series of long and detailed pers in which the valency volume theory was veloped. After some time it became evident that e fundamental conceptions on which the theory as based were too circumscribed, but the work ey carried out has considerable value in the history the subject which has been so ably developed by r William and W. L. Bragg and other workers.

Following Pasteur, van't Hoff had realized that ganic substances can be formulated which have antiomorphous configurations and yet contain no rbon atom having an asymmetric environment. e showed that on account of the tetrahedral rangement of the atoms or groups attached a carbon atom, allene derivatives of the type



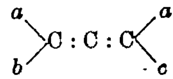
$>C:C:C<\begin{matrix}c\\d\end{matrix}$

should exist in enantiomorphously related forms and therefore be capable of exhibiting optical activity. Pope realized that the compound 1-methyl*cyclo*hexylidene-4-acetic acid,



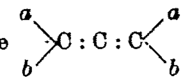
$$\begin{matrix}CH_3\\H\end{matrix}\!>C<\!\begin{matrix}CH_2.CH_2\\CH_2.CH_2\end{matrix}\!>C:C<\!\begin{matrix}H\\CO_2H\end{matrix}$$

which has an enantiomorphous configuration and contains no carbon atom having an asymmetric environment, resembles the above type, and he and W. H. Perkin (then colleagues in Manchester) commenced its synthesis in 1903 and completed it in 1906. Later they were joined by O. Wallach, and adequate quantities of the compound became available for the resolution experiments. In the latter, Read played a leading part, and the successful accomplishment of this difficult piece of work constituted a most important development in stereochemistry. Actually, as Pope also showed, van't Hoff might have stated the case more generally because the above compound is of the type



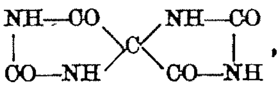
$\begin{matrix}a\\b\end{matrix}\!>C:C:C<\!\begin{matrix}a\\c\end{matrix}$,

and compounds of the type



$\begin{matrix}a\\b\end{matrix}\!>C:C:C<\!\begin{matrix}a\\b\end{matrix}$

are also theoretically capable of exhibiting optical activity. In immediate extension of this work, Pope and his co-workers obtained striking proof that organic compounds can retain their configuration throughout a series of reactions in which the molecular symmetry undergoes profound change. A further example of this is his work with J. B. Whitworth on *spiro*-5 : 5-dihydantoin,



probably the most complete and detailed stereochemical and crystallographic study published in recent years. Pope's work on 1-methyl*cyclo*hexylidene-4-acetic acid has been responsible for almost all the developments in stereochemistry by many workers during the last twenty-five years, owing to the fact that he defined the conditions of mirror-image isomerism, namely, that for mirror-image isomerism the molecular configuration may possess any elements of symmetry excepting a centre of symmetry or a plane of direct symmetry.

Apart from his acknowledged pre-eminence in crystallography and stereochemistry, Pope carried out outstanding work on photographic sensitizers (with W. H. Mills), on the direct synthesis of 'mustard gas' (with C. S. Gibson) and on the extension of Werner's theory of the configuration of complex co-ordination compounds to those containing triamines and tetra-amines (with F. G. Mann).

Pope was president of Section B (Chemistry) of the British Association (1914), president of the Chemical Society (1917–19), president of the Society of Chemical Industry (1920–21), president of the Union internationale de Chimie (1922–25), president of the Federal Council for Chemistry (1918–35), president of the Solvay Chemical Conferences (1922–36) and

Prime Warden of the Goldsmiths' Company (1928–29); he had been chairman of the City and Guilds of London Institute since 1932. He was created Knight Commander of the Order of the British Empire in 1919 and Grand Officier de l'Ordre de Léopold two years ago. He was honorary member of no less than twelve foreign academies and a member of at least ten British scientific societies. He received the Davy Medal (Royal Society), the Longstaff Medal (Chemical Society), Dumas Medal (Société de Chimie industrielle), Lavoisier Medal (Société chimique de France) and Messel Medal (Society of Chemical Industry), besides the honorary doctorate of seven universities.

All who had dealings with Pope, whether as friends, collaborators or pupils, could not fail to be impressed by the true greatness of the man. He was extremely well informed in English and foreign literature and in affairs generally; his judgment and advice were invariably sound. Actually Pope was very shy, but in conversation he was brilliant and witty and few could tell a good story better than he. He was a charming host and loved the company of his friends and life generally. He was a connoisseur and his collections of alchymical pictures, chemists' mortars and drug pots are unique; his library of chemical and general literature has long been the envy of many colleagues. Pope was a most graceful speaker in English as well as in French and German; he could easily translate the spoken word from French directly to German.

For some years Pope had been in poor health, against which he struggled with amazing fortitude, and he continued to carry out his duties and perform extra tasks which must have taxed him greatly. During the last three years he suffered intensely and he bore his sufferings in silence. The end came on October 17 and, after a quietly dignified service taken by his friend, the Master of Sidney Sussex College, his body was cremated in Cambridge.

"Post tenebras lux"

CHARLES S. GIBSON.

Prof. Albert Gilligan

By the death of Albert Gilligan at Storth, near Milnthorpe, on October 14, the science of geology has lost an able exponent. Born on July 26, 1874, he was educated at Wolverhampton Grammar School and at University College, Cardiff. After service as science master at Glossop County School, Gilligan joined the geological staff of the University of Leeds as assistant to Prof. P. F. Kendall. Under the influence of Kendall he became interested in physical geology, particularly that of Yorkshire, and his first published work recorded the denudational effects of a severe storm in that country. This interest remained with him throughout his life.

Gilligan had the ability to lecture in a clear and enthusiastic manner, easily understood by non-geological audiences, and in so doing, perhaps, he rendered his greatest service to the science of geology.
For many years he gave series of lectures througho
Yorkshire, many to the mining community, others
societies of many kinds, and through these ma
many converts to geology. Gilligan also encourage
the work of local geological societies, and his servic
were always at their disposal for a lecture or
description in their journals of a local section.

Later, Gilligan became interested in sedimenta
petrology, a branch of geology then overshadowe
by the igneous side of petrology. He developed
technique of heavy mineral analysis, and turning h
attention to the Millstone Grit, continued the wor
on its sedimentation initiated by Sorby. In 19
he read the results of this pioneer investigation befo
the Geological Society of London, and in 1921
was awarded the Murchison Fund of that Societ
He had in 1920 been made reader in geology in th
University of Leeds and in 1922 he succeeded Kend
in the chair of geology.

His work on the Millstone Grit had led Gilligan
the problems of Middle Carboniferous palæogeograph
and in 1929 he gave, as his presidential address
the Yorkshire Geological Society, an address entitl
"A Contribution to the Geological History of th
North Atlantic Region" in which he summariz
the evidence for a Palæozoic and Pre-Palæozo
'Atlantis'.

From 1922 Gilligan was curator of the Ce
Duncombe Observatory, and he did much to fost
the study of astronomy. He also played his part
the administration of geological societies, serving
the council of the Geological Society. In universit
administration he was closely concerned with studen
activities especially in athletics, and he did much
promote friendly relations between staff and student
He had a sincere understanding of the difficulties
students whose lack of means handicapped the
studies, and many have cause to be gratef
for the ready help which Gilligan so often generousl
gave.

Gilligan was a delightful companion in the fiel
keenly interested in archæology and natural histor
It is the regret of all his friends that he was n
permitted to enjoy, in the foothills of the La
District, his retirement from academic labours.

R. G. S. H.

WE regret to announce the following deaths:

Prof. A. Busi, professor of radiology in t
University of Rome, aged sixty-five years.

Vice-Admiral Sir Percy Douglas, K.C.B., C.M.G
hydrographer of the Navy during 1924–32, o
November 4, aged sixty-three years.

Mr. R. C. Lambert, librarian at the Athenæu
Club during 1922–35, on November 5, aged seventy
one years.

Prof. C. F. Shaw, professor of soil technology i
the University of California, on September 12, age
fifty-eight years.

Dr. J. H. T. Tudsbery, honorary secretary, formerl
secretary, of the Institution of Civil Engineers, o
October 10, aged eighty years.

NATURE

SUPPLEMENT

Vol. 144 SATURDAY, NOVEMBER 11, 1939 No. 3654

THE SEVENTH INTERNATIONAL CONGRESS OF GENETICS

HE Seventh International Congress of Genetics was unique in more than one y. As described by Prof. Crew in NATURE of tember 16, p 496, it was held during a period high political stress, and it accomplished some- ng that perhaps no other international congress l be required to attempt again. The enthusiasm the six hundred men of science present, nbined with a well-thought-out organization, ained the attention and support of all geneticists o were present in Edinburgh during an eventful ek of turmoil. The following pages provide urvey of the proceedings.

The Congress not only achieved success in the rk of the sections, but will also be remembered at least one other direction. The exhibits, ich included charts, diagrams, photographs, gether with dead and living material of plants d animals, occupied the laboratories of the new ological and Engineering Departments of the iversity of Edinburgh. Under at least a hundred d fifty microscopes (probably many more) were les illustrating most of the branches of cytology. ese exhibits enabled one to see for oneself how at was the advance in cytological technique, to perhaps for the first time heterochromatin or omosome splits, and to judge the grounds on ich controversial matters were based. The plant ibit in the laboratory ranged from magnificent nonstrations of the origins of maize, the genetics wheat hybrids, and the cyto-genetics of Datura, the illustration of scientific method in the lysis of the peculiarities of fruit crops and nt pigments. In addition, there were living ibits of genetic characters in a number of plant cies. One laboratory was filled with charts and grams recording the genetics of Drosophila and physiological actions of the genes, while another laboratory contained exhibits on the inheritance of colour in the cocoon of the silkworm, and the diseases to which man is subject. A large exhibit of animal genetics covered the inheritance of characters in rodents, rabbits, and other animals. A notable feature was the organization by Dr. Koller of an exhibit of living plants of Pisum, Lycopersicum, Primula, Antirrhinum, Nicotiana and other genera. These were arranged to illustrate the characters which are controlled by known genes. One of the crops was so well grown that members of the Congress who were specialists on this crop were able to use the plants for observational purposes.

It is obvious that the success of the Congress was due to the excellent organization of Prof. F. A. E. Crew, his committee and staff. Both previous to the Congress and during the Congress in normal times the position of the general secretary is an onerous one. When each day of the Congress brought more news and rumours of war, it was doubtful whether the Congress could continue. By a complete reorganization, only possible by excellent team work, the sections were able to complete their work, the exhibits were received, erected and dispatched in safe custody, and each individual member of the Congress who was directly or indirectly affected by the political upheaval was made to feel that he was being personally looked after by the general secretary and his able staff.

Science will not falter so long as the spirit initially engendered by the staff of the Institute of Animal Genetics at Edinburgh and propagated by the members of the Congress continues among the research workers of the world.

GENE AND CHROMOSOME THEORY*

By Dr. H. J. Muller

THE treatment of gene and chromosome theory was on a far more analytical plane than ever before. Thus, the multiform variations of behaviour of chromosomes at meiosis, and the rules governing these variations, were shown by Darlington to trace back to variations in two primary factors: the region (centric or telic) in which pairing begins, and the time limit set to the pairing process; normally, these must be adapted to each other, so that a mixing of two systems tends to disturb the balance.

Regarding the mechanism whereby structural changes in chromosomes come about, a series of experiments by the present author and co-workers was reported, substantiating and extending, for Drosophila, the earlier conclusions of Stadler, of McClintock and of Sax on plant material, and of Muller and Belgovsky on Drosophila, to the effect that the manifold kinds of structural changes capable of surviving indefinitely are all caused by two distinct primary processes, succeeding one another. These are: (1) breakage of the chromonema at two or more points, followed (2) (though not until after the spermatozoon stage is passed) by two-by-two junction between the adhesive broken ends, giving a new linear order. Distant breakages, giving gross changes, were shown to result from separate individual ionizations, but nearby ones, giving minute rearrangements, to result from one and the same ionization by a spreading of its effect. The reports and demonstrations of a large series of separate investigators—Bauer, Fabergé, Demerec, Camara, Catcheside, Oliver and Belgovsky—in one way or another agreed with or led to one or more of the same conclusions, although some investigators had until then held contrary views. Further light was thrown on chromosome structure and on the changes to which it is subject, in a special evening lecture by Metz, recounting his notable findings in Sciara.

A considerable group of papers analysed t
special, though not absolutely distinctive, p
perties of heterochromatic regions of chromosom
In this connexion, further illustrations were giv
of the high breakability of these regions by Ka
mann, Camara, Prokofyeva and Sidorov, and
their somatic variability (correlated in relat
cells) in respect to manner of chromatin staini
manner of aggregation of chromonemata and ge
functioning. It was noted that all these propert
extend, although to a degree diminishing w
distance, beyond the originally heterochroma
regions into regions lying near to them in
chromonema, by a kind of 'position effect' (Schul
Prokofyeva, Panshin, Khvostova), and the i
portant new point was brought out that the var
tions in staining—which, as proved by Casperss
and Schultz's studies of ultra-violet absorpti
spectra, fairly represent nucleic acid distributio
and the variations in gene activity are correlat
with one another. Evidence was also adduced,
Prokofyeva and by Kaufmann, that small int
stitial regions having some degree of hete
chromaticity are scattered rather widely througho
the chromatin, and often coincide with regions th
apparently originated relatively recently as dupli
tions (which suggests that genes may become hete
chromatic by a kind of denaturizing degeneratio

Analysing the mechanism of gene mutation
the basis of a great series of experiments, Timofée
Ressovsky brought out its causation (1) by
dividual atomic activations, apparently resulti
from the accidental peaks of kinetic energy
thermal origin, as well as (2) by individual ioni
tions, resulting from radiation. The dependen
on single ionizations was further strengthened
Rai-Choudhuri's finding that even radiation of
tensities so low as 0·01 r./min. (a hundred tim
lower than the lowest previously used in su
work) is so effective, ion for ion, as radiation
higher intensities. At the same time, the generali
of the gene mutation effect of radiation w
strengthened in another important way, by
definite extension to mammals (mice). in expe
ments of P Hertwig.

---

* Although the Russian geneticists had withdrawn and most of the Germans had left before the time for their addresses, their abstracts had already been submitted, and in this Section the policy was followed of reading all such papers *in absentia*. They are accordingly included in this report, although only the papers of official members will be printed in the *Proceedings* Also included here are papers given in joint meetings of this and the next Section.

In earlier work, no dependence of the frequency f the gene mutations upon the closeness of spacing f the ions within the radiation-paths could be letected, but newer work by Timoféeff-Ressovsky nd his collaborators, reported at the meeting, uggested that a perceptible influence of this kind night be found by the use of the extremely closely paced ions resulting from some neutron radiation. f so, it should be possible to estimate the 'sensitive olume' for a gene mutation, that is, the amount f contiguous space occupied by material so constituted that one ionization, occurring anywhere vithin it, is capable of producing some one or nore of a given series of alleles. Similar work, tilizing the frequency of chromosome breakage nstead of that of gene mutations, was reported y Marshak. In this connexion, however, it should e noted that if, as seems likely, only a small roportion of the ionizations occurring within the egion in question actually resulted in the effect ooked for, this method would tend to lose its fficacy. Moreover, we have no basis for identifyng the volume or area in question with that of he gene or chromonema itself.

In addition to the seemingly simple thermal ffect of van t'Hoff type, above-mentioned, there vere shown—by Plough, Timoféeff-Ressovsky, Kerkis and Zuitin—to be decided increases in mutaion frequency attending the abnormal physiologcal states of organisms subjected to temperature hanges too rapid or too extreme for the organisms o adjust to them. This makes the search for special hemical influences affecting gene mutations seem nore promising, despite certain negative results eported by Auerbach with carcinogenic subtances. The sensitivity, as well as the intricacy, f the chemical complexes conditioning mutation vas further evidenced by the strong dependence f the general mutation frequency upon the enetic complex present, as reported by Plough nd by Tiniakov, and more especially by observaions of Rhoades and of Harland showing certain normous and highly specific mutational effects on articular genes, not previously known as 'mutable enes', by other particular genes and geneombinations.

The series of papers dealing with the production f mutations by ultra-violet light showed the otable progress made in this field since the last ongress. It was shown by Stadler that the curve epresenting the effectiveness of different wavelengths in producing gene mutations and deficiencies in maize pollen begins at about 313 mμ and rises to a peak at 254 mμ, declining thereafter. This is suggestively similar to the absorption spectrum of nucleic acid and quite different from that of protein. Both Hollaender, working on fungus spores, and Knapp and Schreiber, on spermatozoids of Sphærocarpus, reported results substantially similar to this, although their peaks of mutational effect (as well as of directly lethal effect) were at 265 mμ, which corresponds more exactly to the absorption peak for thymonucleic acid. In Hollaender's work, however, there was also a secondary peak, at 238 mμ; and another peculiarity in his results (one suggesting differential sensitivity of different spore stages) was a falling off in the mutation frequency of surviving individuals at very high doses.

In Stadler's work, a basis was found for drawing qualitative distinctions between several different classes of radiation effects. Thus, the frequency of abortive embryos at different wave-lengths, unlike that of gene mutations and deficiencies, failed to follow the nucleic acid curve, as it showed too high frequencies for the shorter wave-lengths. While these abortive embryos may after all represent some kind of non-genetic effect, the same cannot be said of sectional rearrangements of chromosomes (translocations). Stadler found that the latter were not produced by ultra-violet light, or were produced with a markedly lower frequency than by X-rays of the same gene mutation-producing strength.

This result, which was corroborated for Drosophila sperm by experiments carried out by Muller and Mackenzie, gives some ground for supposing that ultra-violet does not act by breaking the chromosomes, and that therefore gene mutations may not consist merely of linear rearrangements of ultra-small size, involving 'intragenic' breakage and reunion. The latter idea, which is not yet actually refuted, would have tended to make the concept of the segmentation of the chromosomes into discrete 'genes' a mere matter of verbal convenience. Possibly connected with the same series of problems was Stadler's further finding that the gene mutations produced by ultra-violet are far oftener 'fractionals'—that is, confined to one of the chromatids derived from a given treated chromosome—than are those produced by X-rays.

For the first time in the history of genetics congresses a session was included on virus and protein studies in relation to the problem of the gene. A peculiar case of non-chromosomal, probably virus, 'inheritance' in Drosophila, was reported by L'Héritier and Teissier. As was brought out by McKinney, by Gowen and by Kausche, viruses, now known to be crystallizable nucleoproteins, have the distinctive combination of properties characteristic of genes, namely, mutation and (despite mutation) self-duplication, thus substantiating the concept (Muller, 1921, 1926) that viruses represent relatively free genes, and that the gene constitutes the basis of life.

An illuminating account was given by Astbury of his and other modern studies of the chemical structure of viruses and other proteins, with especial consideration of those features which might help to explain the gene's property of mutable self-duplication. He, as well as Caspersson and Schultz (who reported an increase of nucleic acid during periods of growth, both for chromosomes and for cytoplasm), directed attention to the role which nucleic acid may have in this process. The significant fact was reported by Astbury that the nucleic acid spacings are of the same magnitude as those within the protein (polypeptide) chain, a feature which would allow the nucleic acid to unite in parallel with the protein and so perhaps to serve as an intermediary in its synthesis. The paper of Mazia also was of interest in this connexion, since it showed that in salivary chromosomes the framework is not disintegrated by digestion either by pepsin or by nuclease, though it is by trypsin; hence it probably consists of protamine or histone chains, bound together laterally in some other way than by nucleic acid cross-connexions. Other chemical studies nuclear material were reported by Gulick, whic among other things cast doubt on the presence iron in chromosomes, thus bringing their compos tion closer to that of the virus.

Our present knowledge of the internal structu of the tobacco mosaic virus particles, as disclose by the pioneer X-ray diffraction studies of Berna Crowfoot *et al.*, was described by D. Crowfoot a well as by Astbury. It was shown that in thes rods, which are 15 mμ thick and at least ten time as long, the smallest possible chemical unit—tha associated with one nucleotide—must contai about fifty-four amino-acid radicals, althoug there may be a geometrical sub-unit as small a one eighth of this volume (that is, about 1 m each way). But these units (or sub-units) a grouped according to a regular pattern into larg aggregates, about 7 mμ long, and the latter in tur are grouped in a regular way to form the aggregat of high order—the virus rod itself. The globula protein insulin, as well as the fibrous proteins. a show elementary units of about the same size, bu the mode of aggregation varies both with th protein and with the conditions (pH, amount o water, etc.) under which it is being kept. Thu this type of analysis is already bridging the ga between the structures of the chemist and thos of the microbiologist and geneticist.

A series of special conferences were held o problems of the gene, presided over chiefly b J. B. S. Haldane. These were very well attended At these 'gene conferences' many of the report of those unable to attend were read, and many o the above and related questions concerning gen and virus structure and gene mutation were subjected to animated and searching discussion.

CYTOLOGY

By Dr. C. D. Darlington

PERHAPS the most significant feature of the cytological discussions was the difficulty of separating them, except in an arbitrary way, from the discussions of experimental breeding. This was due to three general trends. First there was an increasing use of the direct study of meiosis as a basis of genetic prediction and as a means of testing the reproductive methods of particular species. The work of White and Kolle with sex chromosomes and of Huskins and Newcombe with the relations of chromatids at chiasmata were examples of the one, the studies o Levan on Allium, of Cleland on Œnothera, and o Janaki on Saccharum were examples of th other.

The second trend was the increasing applicatio experimental methods to cytology, both to lve problems that are of immediate cytological terest and to produce results of practical impor- nce in breeding. The different kinds of upset duced in cell-division are of interest in both ays. The diplochromosomes produced by arber's heat treatment represent the mode of ction of colchicine described by several workers giving rise to polyploids. The third trend was he increasing linkage of Drosophila genetics with minute study of salivary chromosomes, so that e found leading geneticists in America and ngland, like Demerec and Muller, offering papers mbodying accounts of the breakage and reunion chromosomes related to the direct observations cytological workers like Kaufmann and Bauer. This last development showed its widest bearings the kind of population study described by obzhansky. The interlocking action of gene hange and chromosome change now discovered field genetics is evidently making it possible bring the scheme of variation in Drosophila to the closest relationship with plant cytology. t gives the whole body of genetics and cytology a unity which is enabling them to be used as a joint tool of evolutionary research.

A word should be said of the technical side of cytology. The great advances of recent years were represented by an extensive microscope demonstration of chromosomes of Drosophila, Zea, Osmunda, Paris, Trillium, of various Orthoptera, and of Mammalia including man. A show of photomicrographic lantern slides brought home these exhibits to a larger audience and made it possible to compare the merits of different new methods of treatment.

A combined gene and chromosome session opened by Dr. W. T. Astbury was devoted to protein and virus studies in relation to the gene. It showed the results of applying new technical methods in protein and virus chemistry. It also showed that these, combined with the study of X-ray mutations on the genetical side and the use of ultra-violet photography and microchemical tests on the cytological side are producing a practical convergence of biology and the physical sciences, a convergence that will probably mark the beginning of a new epoch.

PHYSIOLOGICAL GENETICS

By Dr. C. H. Waddington

ONE of the most active branches of genetics at the present time is the study of the ways in hich genes affect developmental processes, and he section devoted to physiological genetics had a ll and interesting programme. The problem of enic action is so complex and many sided that ery many different methods of approach are ossible, and examples of most of these can be ound in the papers presented at the Congress.

The embryological approach was well exempli- ed in a paper by Landauer, in which he reviewed he correlated effects on different organs which re found both in fortuitous teratological specimens nd also in abnormalities which are known to be ependent on genes. He suggested that many of hese phenomena can be explained by the hypo- hesis of a general deleterious effect, often on the rowth-rate, acting at a period which is critical or a certain set of developmental processes. A eneral embryological approach of a rather different kind was presented by Waddington, who discussed the relation of genes to developmental processes of the kind exemplified by the organizer reaction.

The importance of nuclear factors in particular steps of differentiation was analysed in more detail by Baltzer, who gave a summary of his well-known and important work on bastard merogons, in which an enucleated egg of one species of newt is fertilized by a sperm of a different species. He showed that some tissues are able to develop to late embryonic stages, while others die presumably owing to disharmonies of nucleus and cytoplasm during particular processes of differentiation; still other tissues, such as some of the anterior mesoderm, while able to live, lose their normal power of inducing other organs—in this instance the balancers and gills. Similar studies of the importance of particular elements in the nucleus were reported by Poulson in his studies of the abnormalities produced by total absence of certain genes (homozygous deficiencies) on the early development of Drosophila.

Several reports dealt with gene effects on processes which are chemically more or less defined. Thus we had further chapters in the important and rapidly developing researches of Price, Lawrence and others on flower pigments, and Beadle, Ephrussi and others on Drosophila eye colours. Perhaps the most important new contribution in this field was a fresh study by Sewall Wright of guinea pig coat colours, which he dealt with in a preliminary way many years ago. He was now able to suggest a scheme for the relations of the numerous genes which are known, and to present a mathematical theory of their quantitative interactions.

Quite a different method of approach to the same problem was reported by Schultz and Caspersson, who, by studying the chromosome itself, obtained data which allow of some speculation as to the chemical changes occurring under the immediate influence of genes. Owing to their strong absorption in the middle ultra-violet, the distribution and changes of the substances belonging to the nucleotide group can be followed in the living cell by spectrophotometric methods elaborated by Caspersson. It is found that in the nucleus the nucleic acids seem to be indispensable for the development of chromosomes, and that they are synthesized mainly in earliest prophase just before the chromosomes split. Schultz studied translocations of parts of the heterochromatic regions of the chromosomes, which are rich in nucleic acid, into normal euchromatic regions i Drosophila. In certain of these translocations th adult flies show variegation for characters affecte by genes near the position of the break in th chromosome, as though frequent mutations of th genes had occurred in late stages of development Schultz showed that this variegation is correlate with cytological effects in the salivary chromosome bands corresponding to the variegate genes; these effects ranged from appearance o excess nucleic acid to the assumption of a heterochromatic character and finally apparent disappearance. It is suggested that the appearanc of excess nucleic acid is correlated with an inactivation of the gene as a developmental agent The nucleic acid metabolism can be follow somewhat further, since it is found that th presence of extra heterochromatic material (fo example, supernumerary *Y*-chromosomes) affect both the degree of variegation, the cytologic correlates of variegation mentioned above, an also the nucleic acid content of the cytoplasm. Th different types of nucleic acid occurring in chromosomes, nucleolus and cytoplasm can be determined spectroscopically and suggestions made as t their functional relations with the fundamenta processes of gene action and gene reduplication

It is possible, as Schultz suggests, that we may i this way obtain some insight into the changes o gene activity in different chromosome regions i the different tissues, which may provide mechanism for the primary differentiation of th nuclei in development.

ANIMAL BREEDING IN THE LIGHT OF GENETICS

BY DR. J. E. NICHOLS

THE opening session was devoted to general considerations of animal genetics. H. C. McPhee described the United States Department of Agriculture's long-term inbreeding projects with pigs, sheep, and poultry, and the emphasis now being laid upon measuring the more complex physiological characters; and in reviewing the work at Wiad, Sweden, G. Bonnier mentioned the economy in numbers of experimental animals made possible by the use of monozygotic twins, and the similarity to plant breeding techniques now being obtained with poultry, where th mixed sperm from many males can be used i artificial insemination. W. K. Hirschfeld an G. M. van der Plank struck notes for many succeeding speakers in directing attention to th distinction between frugal and less frugal breed and families relative to production, and to the nee of precise studies on differential demands upo the components of a ration. Their advocacy o the progeny test was pressed further by A. L Hagedoorn, who suggests restricting to *élit* clei' of breeding stock the function to be sole genitors of their kind.

The section got into its stride of discussion on gust 24 in an all-day session on live-stock provement in tropical and relatively low tritional plane conditions. J. H. R. Bisschop ve a comprehensive account of the interesting technical studies on Afrikaner, imported, and de cattle being conducted in South Africa, with objectives of defining a type and performance ted to semi-arid conditions and of assessing the generation of the pure imported types therein. ing the Australian Merino sheep as an example, E. Nichols discussed the practical difficulties of usting type to environment when artificial ection is heaviest in more favoured and natural ection in poorer conditions, where commercial duction is expected. A. O. Rhoad described experimental determination of adaptability of tle to unfavourable conditions in America by ans of body temperature reactions, and revealed etic differences in respect of physiological racters; while Manresa and his collaborators nonstrated significant differences in the hæmobin and other constituents of the blood in tle in relation to atmospheric temperatures d thereby to adaptability to the local environnt) in the Philippines. The economic and ial backgrounds of breeding problems in the imal industries in countries from the Gold Coast Madras were presented in several communicans, and R. B. Kelley lodged a strong claim for importance of ecological and economic studies prerequisite surveys to constructive breeding licies in tropical Australia. Later, G. Pontecorvo essed the influence of agricultural conditions on licies of selection in beef and draft cattle in scany.

The use of artificial insemination as a rational hnique in animal breeding was discussed in a ecial session at which were described the methods ployed, and their accompanying problems, in ly, the United States, Rumania, Kenya, and at row. The necessity of adequate criteria of sperm iciency was strongly stressed by J. Edwards d A. Walton in presenting an account of recent estigations at Cambridge in which the respiran rate of sperm has taken a prominent and omising position.

Statistical safeguards and interpretations in netical experiments with animals and in the analysis of records of performance and progeny tests were discussed notably by F. Yates and J. L. Lush, not only in formal papers, but also in relation to other contributions, especially those on the inheritance of milk yield. This problem, of great practical importance, stimulated one of the most effective discussions of the section, in which particular attention was given to the question of persistency in lactation. The lability of the several phases of a lactation in response to environmental influences of nutrition, management, etc., leads to difficulties in evaluation of records, but emphasizes the need for detailed analysis as well as ultimate resolution in terms of the physiological processes affecting the component parts of the curve.

In other sessions lethal factors and defects in large animals and genetical characters in small animals were discussed; F. W. Dry presented a case of linkage between horns and abundance of halo hairs in New Zealand Romney sheep, and R. C. Bamber an interesting instance of the operation of a time factor in the inheritance of white spotting in cats.

Breed differences and the recognition of the physiological substrata received further prominence in the session on poultry genetics when F. B. Hutt presented evidence of differential reactions and performances, A. W. Greenwood advanced indications of a genetical control of egg-laying persistency, and A. Ghigi's contribution on cerebral hernia in the fowl evoked discussion on the relationships of skull form, 'crest', and hernia.

Again, in the sessions concerned with nutrition and genetics, and with pig breeding, the same fundamental approach was manifested; as in the demonstration by C. P. McMeekan and J. Hammond that the plane of nutrition exerts a profound effect upon not only general form but also the growth components so that the direction, as well as the possibility, of selection is influenced by environmental thresholds. That this aspect of the problem of livestock improvement deserves further scientifically determined discrimination at all stages of growth and in regard to practical breeding policies was emphasized by H. P. Donald and by H. R. Davidson.

It may be said, in fact, that the central theme throughout the proceedings of this section was the evaluation of genetic differences and responses to environmental conditions in relation to the requirements of practical husbandry.

PLANT BREEDING IN THE LIGHT OF GENETICS

BY DR. K. MATHER

THE following conclusions may be drawn from the section of plant breeding in the light of genetics: first, that genetics and cytology can afford valuable assistance to the plant breeder, and secondly, that the geneticist needs a better understanding of the problems of plant breeding, and the breeder of the possibilities of genetical research, before really fruitful collaboration will be achieved.

The breeder requires, for example, detailed information about the mode of reproduction and the cytological behaviour of his material. Cytology and genetics can and do give him such information. But he also needs very detailed knowledge of the inheritance of quantitative characters, and this the geneticist cannot at present supply. It is highly significant that in horticultural breeding, where genetics and cytology have most fully proved their value to breeding programmes, the geneticist is also frequently a breeder. The breeding problems can in such cases be attacked immediately with the full resources of the genetics, and on the other hand, the value of any new genetical technique for breeding work is immediately appreciated. As a case in point, Crane and Thomas have encountered the necessity for determining the mode of reproduction of Rubus species, and have been able to obtain the necessary information by a series of simple genetical and cytological observations. There is also collaboration between breeders and geneticists interested in maize, and for the past fifteen years maize breeding methods have been developed at a rate far exceeding that found in any other cereal crop, as described by Lindstrom, Singleton and Jenkins. The problems of the root-crop breeder closely parallel those encountered in the case of maize, and in overcoming them Rasmusson adopts a similar technique based on like genetical experience.

It is in the field of self-fertilizing cereals that there has been least collaboration, and it is here that opinion is most sharply divided on the question of the practical value of genetical work. Cytology has provided essential information about t causes of sterility in wheat species crosses and Triticum-Agropyron crosses, but it is clear th the real need of the cereal breeder is guidance his varietal crossing and selection programm This guidance can only be given when mo genetical research has been done on inheritan in quantitative characters.

Perhaps the most difficult and least develop aspect of plant breeding is the production of wh are essentially new species of crop plants hybridization and polyploidy. The discovery the action of colchicine in bringing about chrom some doubling has given a stimulus to research this field, as shown by the number of papers the subject. It is, however, too early to ass accurately the practical possibilities of colchici treatment. In this connexion, also, the study the origin of our present cultivated plants is prime importance in indicating how such n forms might be made. Mangelsdorf's analy of the origin of maize materially adds to o knowledge in this direction, besides affordi another example of how genetical analysis c be used in the solution of an evolutiona problem.

All breeding work involves variety trials, a both these and the development and use of t theory of quantitative characters will requi rather complex statistical analysis. The use statistics in plant breeding was the subject of joint meeting of this and the statistics secti opened by Yates. It was apparent that the f benefit of statistics, as of genetics, has not y been realized in plant breeding.

Though the task of organizing genetics, cytolo and statistics in the service of plant breeding unquestionably difficult, the Edinburgh meetin especially that of Frankel's committee of pla breeders, have been of service in showing not on what has been done but also where the difficulti are to be found. Further meetings of the sa kind should be of even greater value.

HUMAN GENETICS

By Prof. R. Ruggles Gates, F.R.S.

HUMAN genetics was well represented at the
Congress. Abstracts of a large number of papers
re prepared, but like other sections their pre-
ntation was somewhat deranged by the approach
war. At different sessions the section discussed
h topics as mental inheritance, feeble-minded-
ss, blood groups, statistical methods in human
netics, selection in human populations, twinning,
rmal and abnormal human characters.

F. Lenz showed that the twin method and the
relation method may give different results as
ards the relative shares of heredity and environ-
nt in the formation of a character. Dr. R. J. A.
rry presented the results of a study of mental
ect in 163 families with parents of normal
ntality and 202 families in which the parents
re mentally defective, insane or of very low
ntality. Mental defectives were twice as
quent in the second group. The problem was
arded as one of the inheritance, not of mental
tes but of normal standards of growth. Dr.
ugger agreed that the majority of mental de-
tives show only retarded mental development,
l concluded from the investigation of 2,380 sibs
t there is a unified recessive inheritance,
ble-mindedness and imbecility generally appear-
together.

Dr. Fraser Roberts pointed out that most
ectives fall at the minus end of the normal
tinuous series and he believes there is multi-
tor inheritance, the low-grade defectives form-
a very heterogeneous group. He concludes
t there are a number of genes, any pair of
ich can determine idiocy or imbecility, abnormal
ceptibility to non-genetic influences frequently
ng present. From a study of 3,400 school
ldren by intelligence tests he concludes that
mal intelligence is also graded and very largely
ermined by multifactor inheritance.

D. K. Henderson recognized a hereditary basis
the manic-depressive and schizophrenic states
l emphasized that a eugenic programme must
largely educational. Helgi Thomasson, on the
er hand, from a nine years study of manic-
ressives in Iceland, was doubtful about the inheritance element. He diagnosed 859 cases of manic-depressive psychosis, only 15 per cent of whom were treated in hospital. Probably his criteria of diagnosis differed from those of others, and perhaps the general climatic conditions in high latitudes may also account for the high incidence. Dr. F. J. Kallmann emphasized that the practical goal of human genetics is the determination of the various physiological, constitutional and dispositional factors governing the phenotypical manifestation of hereditary predispositions and the description of their structural equivalents in proper morphological terms. From a study of 500 pairs of schizophrenic twins and their families, he concludes that the schizophrenic genotype is specific, autosomal and probably single-recessive. Its manifestation is inhibited in about one quarter of the homozygotic taint-carriers by the aid of a strong constitutional resistance or by the lack of furthering dispositional factors.

In a discussion of rare psychological defects in a population, G. Dahlberg concluded that the effect of selection on its incidence is very small, that the effect of prevention of cousin marriage is also small, but that the breaking up of isolates in the population is most important.

Various workers have shown that an injection of cardiazol produces epileptic spasms in animals and man, but a hereditary epileptic will have fits after a smaller dose than a non-hereditary epileptic or a non-epileptic. Hans Nachtsheim finds that a strain of white Vienna rabbits has a gene, X, for leucism and an allele Xe which causes increased liability to spasms, X being dominant over Xe. Among 250 animals given minimal doses of cardiazol, 83 per cent of the homozygous $XeXe$ rabbits but only 3 per cent of normal controls react with spasms.

Pick's disease was studied by J. Sanders in a family with sixteen affected members. The symptoms begin at 40–50 years of age, so that early diagnosis is important. The inheritance is dominant, and it was found that persons who gave queer answers in the ink blot tests developed the disease twelve to eighteen months afterwards.

In a study of twenty-nine families showing tooth deficiency, Barbara Burks found evidence of linkage with hair colour. D. J. Finney also obtained statistical evidence of linkage between allergy and the *ABO* blood groups ; while Munro, Penrose and Taylor, from analysis of twenty-five sibships, found an indication of linkage between the blood groups and phenylketonuria.

As regards disorders, R. C. Robb reported on 100,000 hospital patients, and D. P. Murphy on 935 malformed children studied in relation to birth order, sibs, maternal age, reproductive rate, etc. H. Madissoon cited cases of absence of kidneys (in the fœtus) conditioned by heredity. D. Ferriman found that oxycephaly and acrocephalosyndactyly are dominant conditions, probably allelomorphic, and that a third allele may be acholuric jaundice. Race, Taylor and Vaughan showed that a latent form of the latter disease can be demonstrated investigation of the blood. Dr. I. Lundholm sho that hypochromic anæmia, which is common women in Sweden, is conditioned by a domin gene which prevents the normal absorption of i through the digestive tract.

J. B. S. Haldane pointed out that nat selection in man may act through survival, sex selection or reproductive selection (fertility), that in theory four types of selective process be distinguished, involving slow or rapid selec of genes, selection of heterozygotes or eliminat of rare mutants.

P. J. Waardenburg showed that the *X*-chro somal eye defects, dystrophia retinæ pigment and extraocular nystagmus can be inherited dominant or recessive sex-linked or dominant recessive autosomal characters.

GENETICS IN RELATION TO EVOLUTION AND SYSTEMATICS

By Dr. W. B. Turrill

THE Organizing Committee of the Congress, at the suggestion of the Association for the Study of Systematics in Relation to General Biology, arranged for a special section to be concerned with the wider aspects of genetical research. In spite of the numerous difficulties caused by the international situation both in arranging and carrying out the programme, the results not only justified the attempt but showed the desirability of making a general rule to include in specialist biological congresses a section devoted to overlaps of the special subject with other branches of biology.

The programme of the section was so arranged that papers were grouped under the following general titles : Hybridization, Comparative Genetics and Evolution, Micro-evolution, Experimental and Wild Populations, and Polyploidy and Reproductive Mechanisms. In the plenary session of the section, Th. Dobzhansky dealt with the genetic structure of natural populations. He urged that "according to the genetic theory the pressure of the evolutionary factors, such as mutation, selection, isolation, and migration is constant and unrelenting. A living species can hardly remain static for any length of time. It is a task of investigator to observe evolutionary changes only *post factum* but also in *statu nascendi*, nature as well as under laboratory condition There is a hidden field of variation, detectable through observations on the phenotype but o by genetic and cytological means, and this m engage the attention of students of evolution mechanisms. The main part of his paper de with *Drosophila pseudo-obscura*, and it was sho that this is a dynamic species of local colon which can pursue, within certain limits, indep dent evolutionary courses. Only seconda through migration and selection of superior ge types formed in such colonies can the texture the species as a whole become gradually alter

G. Tischler, under the (translated) title the "R of Chromosomal Race Differences in Systemat and Plant Geography", stated that at least 4 wild cœnospecies of Angiosperms are known whi contain races with chromosomal differences. Ma species become capable of surviving in a climatica unfavourable environment through polyploi but within these species many type plants ha mained diploid. Numerous species have become eeds with a world-wide distribution, but their ploid races have only a local significance. Allolyploids may inhabit wider areas than either rent. Polyploids may develop a perennial habit, pomixis, or seasonal dimorphism.

J. S. Huxley, in a general paper on "Systematics Relation to Genetics", gave a valuable summary f the tendencies of modern taxonomy, illustrated y many examples. He showed that the progress f taxonomy itself, and its contacts with other ranches of biology, are converting it into the asis of the study of evolution in action. In the rst place, cytogenetic analysis is shedding light n particular taxonomic problems; secondly, xonomic advance is suggesting important quesons for experimental analysis; and thirdly, a mbination of all lines of approach is increasing oth the scope and the precision of the general rinciples underlying taxonomy and making it ossible to forecast the course of differentiation nd evolution in different kinds of taxonomic roups. It is not only cytology and classical enetics which are needed to co-operate with xonomy, but also ecology and embryology are qually essential.

W. B. Turrill considered "Taxonomy and Cytoenetics in Plants" and pleaded for close co-operaon between taxonomists and cytogeneticists. He lustrated the most desirable lines for such cooperation by examples of problems of mutual terest under the following headings: classificaons of characters, degree of correlation of charcters, constitution of taxonomic groups, the udy of polymorphic groups, geographical and ological problems, hybridization in Nature and xperiment, problems of apomixis, problems of hylogeny, and general suggestions.

S. C. Harland read a paper under the title "Genetical Studies in the Genus Gossypium and their relation to Evolutionary and Taxonomic Problems". Within the widespread species of this genus in both the Old and New Worlds he traced the consequences of isolation for several millions of years. Species crossing and the study of their cytology in Gossypium has led to the accurate delimitation of the genus, has shown that species may be regarded as systems of modifiers, has revealed the taxonomic position of species in relation to other species, and has proved that species intercrossing results in the disintegration of the coordinated modifier systems possessed by each; it has shown that geographical isolation causes profound genic change, has indicated that genes may become mutable when transferred to the genetical background of other species, and has suggested that the number of alleles at a given locus differing only slightly in their reaction with the genetical background is probably large.

It is impossible in this article to deal with contributions to the ordinary meetings of the section except in a very brief and most generalized manner. The recognition of much more hybridization in the wild amongst animals than has usually been admitted by zoologists was stressed in several papers. The importance of population studies in throwing light upon the actual mechanism in evolution was also emphasized The geographical distribution of 'races' in both animals and plants is obviously receiving increased attention and proving a connexion 'between genes and geography'. The wide occurrence of polyploidy and apomixis in plants is being shown to be one of the causes which make it difficult to accept the species as a clear-cut taxonomic unit.

GENETICAL ASPECTS OF GROWTH, NORMAL AND ABNORMAL

By Dr. A. Haddow

THE fundamentals of this subject were outlined in a paper by E. B. Ford, who demonstrated ow growth may be determined genetically by the ost diverse means. Thus it may be under the ontrol of a single factor-pair, or very numerous genes, approximately equal in effect, may cooperate. Again, while the genetic situation can influence cell-size or cell-division directly, the effect on growth is frequently indirect. For example, genes controlling the endocrine glands will modify total body size in mammals, as in recessive dwarfing in mice due to a factor-pair affecting the development of the anterior pituitary. Dr. Ford further discussed (1) the production by heterosis of increased size in the offspring of a wide cross, and (2) excess or reduction in hybrid size caused by mal-adjustment of the gene-complex. Similar considerations apply to differentiation, as in the case of a sex-linked factor producing dominant black-spotting in Platypoecilus and tumour formation in the hybrid between this and another form (Xiphophorus).

In a discussion of dominance in spontaneous cancer, P. A. Gorer dealt with the genetic basis of the inheritance of lung cancer in mice, mentioning evidence that the appearance of lung tumours is conditioned by three or four genes with additive effect, the degree of dominance thus depending upon the number introduced by the high-cancer parent. In those cases where the onset of tumours is delayed in the heterozygote, he regarded it as probably incorrect to speak of a change of dominance with age (Bernstein), since it is likely that the reactions preceding tumour emergence simply occur more slowly in the heterozygote.

Considerable interest centred round the interplay of genetic and environmental factors in the origin of different cancers. According to N Dobrovolskaia-Zavadskaia, the failure of external carcinogenic agents to produce mammary cancer in mice, even in strains of high susceptibility, indicates that the onset of such tumours is almost entirely dependent on genetic constitution. On the contrary, sarcomata and squamous-cell epitheliomata appear to depend pre-eminently on environmental influences, a view confirmed by W. F. Dunning and M. R. Curtis when they reported that variation in the concentration of a chemical carcinogen is much more effective in influencing the probability of malignant change than is the genetic nature of the host. In another paper on the effect of genetic constitution in determining the response to carcinogenic agents, G. M. Bonser described the gradation of tumou response by male mice to œstrogens as reflecti the ability of the females to develop spontaneo mammary tumours, although when castrat females of high-cancer strains were tested wi œstrogens, their ability to develop mamma cancer was reduced.

In a communication dealing with spontaneo and induced tumours in eight inbred strains mice, H. B. Andervont stressed (1) the correlatio between the susceptibilities to spontaneous an to induced pulmonary tumours, and (2) the absenc of any correlation between susceptibility to th induction of subcutaneous tumours by carcin genic hydrocarbons and susceptibility to spo taneous breast tumours.

Other contributors included G. W. Woolley o reduction in the incidence of mammary tumours i female mice in parabiosis with males, and H. Bagg on his method for early selection in mi and rats, by forced breeding coupled with th prevention of suckling, of those individuals co stitutionally prone to the development of brea cancer. W. Cramer and E. S. Horning describe the association in inbred strains of mice betwee brown degeneration of the adrenal and the inc dence of mammary cancer, although L. Kreyber found no difference in the occurrence of brow degeneration in two homozygous lines, one man festing a high and the other a low yield of spo taneous mammary tumours.

R. J. Ludford discussed somatic mutation i relation to growth, while P. A. Gorer also examine the choice between this concept and "anomalou differentiation" in the origin of tumours. Auerbach reported work on various carcinogeni hydrocarbons in respect of their influence o mutation in *Drosophila melanogaster*. None o the compounds used produced any increase i mutation-rate, a result which could not be ascribe to insufficient substance, although it might con ceivably be attributed to factors such as tim allowed for action or penetration to the tissues.

PRINTED IN GREAT BRITAIN BY FISHER KNIGHT AND CO., LTD., ST ALBANS.

NEWS AND VIEWS

oyal Society Medal Awards

THE following awards of medals have been made y the president and council of the Royal Society : opley Medal to Prof. T. H. Morgan, For.Mem.R.S., irector of the William G. Kerckhoff Laboratories, alifornia Institute of Technology, for his establish- ent of the modern science of genetics, which has volutionized our understanding, not only of eredity, but of the mechanism and nature of volution ; Davy Medal to Prof. J. W. McBain, .R.S., professor of chemistry in Stanford Uni- ersity, for his distinguished work in the study of lloidal electrolytes, for providing the elements of e guiding theory, and for developing the subject ; ughes Medal to Prof. G. P. Thomson, F.R.S., pro- ssor of physics in the Imperial College of Science d Technology, London, for his important dis- veries in connexion with the diffraction of electrons matter.

gineers in War-time

THAT a special degree of responsibility falls on ose called to high office in a professional capacity in me of war was apparent from the presidential ldress of Sir Clement Hindley to the Institution of vil Engineers. Instead of devoting himself, as he d intended, to recounting the cultural history and velopment of the Institution, he found it more ppropriate to put before the members the picture had in mind of the duties now to be taken up by e Institution as a corporate body, and by its embers as individuals. The regular forms of its tivities being very largely curtailed by the exigen- es of war conditions, its first duty lies in the main- nance of high standards, both educational and actical, for the admission of members. This volves an active interest in the education and aining of young engineers and, as a matter of mediate concern, in conjunction with the colleges, e adjustment of curricula to war-time conditions. n the Institution, too, is placed the responsibility seeing that studies are pushed on as far as possible fore military service has to be undertaken, and at those with technical training are employed in itable units. In all this there is the ultimate fact importance that when the period of reconstruction reached, Great Britain will need a well-trained and ell-equipped body of young engineers.

THE second duty of the Institution is that falling individual members to contribute their experience d knowledge to the common stock of the pro- ssion, in which the part of the Institution will be publish in the *Journal* such contributions and the rrespondence to which they give rise. The third d main function to be conserved is that of giving ntinued support to those scientific organizations hich have undertaken research and investigation for the Institution. While certain portions of this work have to be suspended, the Research Committee remains in being in order to deal with problems suggested, and the resources of the Institution are held available for any work the Government may consider can best be carried out by its members. Sir Clement's final remarks may be quoted as a message to all engaged in the pursuit of science and its application : "We may be sure that when we have passed through the present ordeals, and have achieved the victory for freedom for which we are now fighting, there will be unimagined opportunities for applying for the benefit of the human race those advances in science which are even now taking place under the stimulus of war. It is necessary for all engineers to continue to keep abreast of developments in engineering science and practice, and so to fit themselves for this great work of the future."

Fuel Industry in Great Britain

COLONEL W. A. BRISTOW, on his installation as president of the Fuel Luncheon Club, spoke on modern fuel problems. After indicating the cost in foreign exchange of refined oil products and other material such as carbide, silicides, etc., which can be made in Great Britain, he mentioned other products capable of synthesis more or less directly from coal. From the products of the carbonization and gasification of coal he indicated that a great range of chemical products can be made, and, in view of Great Britain's adverse balance of trade, must be made. The obstacle, he said, is not lack of skill, knowledge or courage, but an absence of planning at the centre. Another deterrent is the financial system by which the 'financial whipcrackers' controlling public companies insist on immediate dividends and frown on efforts made in the national interest. He thinks the State should establish a 'Commercial Research Force' not merely for pure research but also to operate plants of capacity and bring processes to fruition. If these ideas are vitally important, it is only logical that the citizen should make his due contribution. There is another reason why an early start should be made in this direction. An effort should be made to prepare for creative work for the young men who return from the war. After the last war, the coal industry passed through tragic years. Moreover, none was more severely hit than the technicians left redundant by the cessation of munition manufacture. This time we should not leave the fate of returning armies to luck, but safeguard the future of the coal, oil and allied industries.

Projected Antarctic Expedition

A NOVEL feature of the new antarctic expedition which Admiral R. E. Byrd proposes to lead from the United States to the Ross Sea area is the snow cruiser which, according to Science Service, has been designed by Dr. T. C. Poulter of the Armour Institute of Technology. This mobile base is to be 55 ft. long and will travel on wheels 10 ft. in diameter. Propelled by petrol, it will have a cruising speed of twelve miles per hour and a top speed, on favourable surfaces, of twenty-five miles. Its range of action should be about five thousand miles. There are quarters for four men, a control cabin, engine room, machine shop, galley and laboratory. Supplies for a year can be carried. The scientific equipment of the snow cruiser includes seismic sounding outfit, gravimeter, and dip circle as well as survey instruments. The builder claims that this mobile base will allow more work to be done in one season than other expeditions have been enabled to do in several years. Its weight is not given but must be considerable, so that its range of movement will clearly depend much on surface conditions, which are always a deciding factor in any form of antarctic travel.

Arrival of the Reincarnated Buddha at Lhasa

THE veil of secrecy which for so long hid the religious life and ceremonial of the sacred city of Lhasa from European eyes may be said to have been lifted finally by the account of an eye-witness, accompanied by photographs, of the arrival in that city of the new Dalai Lama, the four-year-old child in whom, according to Tibetan belief, has been re-incarnated the living Buddha. The story is told in an article which is contributed to *The Times* of November 4 by a special correspondent. Although the essential features of the installation of a living Buddha reincarnated in the person of a small child destined to become a Grand Lama were reported by the Abbé Huc, who travelled in Tibet in 1844–46, it was on hearsay only, as the Dalai Lama of that day had already attained the age of nine years. The present account is fully confirmatory of Huc, but with much added detail. On October 7 the new Dalai Lama was met by the Regent at Rigya, two miles east of Lhasa, where he had rested for two nights, and was escorted in procession to the Peacock tent, which had been erected in the centre of a triple-line, square enclosure. There he was seated on a throne, covered with white silk and fronted with the emblem of the double thunderbolt, to receive the homage and offerings of scarves from the officials, headed by the Regent, and representatives of British, Nepalese, Chinese, and of the Lhasa Moslems, who filed before him, receiving his blessing from either both hands, one hand, or a tassel pendant from a silver rod. At the close of this ceremony, which lasted for about an hour, tea was brought for the Dalai Lama in a golden teapot, of which he partook from a jade cup after it had been tasted by a household official.

ON the following day the Dalai Lama entered Lhasa, the procession passing through the streets of the city to the sacred residence, the route, as on the preceding day, being lined with crowds of reverent spectators, monks and others, holding banners and auspicious emblems. One of the more interesting incidents recorded took place when, as the yellov palanquin in which rode the Dalai Lama, formin the centre of the procession, reached the entrance o a temple, it was met by the Oracle of Nechung in state of possession. A god who acts as the guardia of religion is said to enter into him, and when he i so possessed he dances with convulsive movement bending his body quickly to the ground, forward and backwards. He wore a high headdress of whit plumes over a golden crown, and brandished a swor and a bow. Similar devil-dances are characteristi of Tibetan Buddhism, more especially in the easter parts of the country, where primitive animistic form of belief survive in conjunction with the more orthc dox ritual. On this occasion the Oracle, described a a "terrible figure", rushed to the Dalai Lama' palanquin, and thrust in his head so that the spir within him could do reverence. The young Dal Lama, it is said, was quite unperturbed.

Pacific Entomological Survey

JUDGING from correspondence which has recentl appeared in *Science*, some misunderstanding as t the purpose and position of the Pacific Entomologic Survey has arisen. A brief statement relating to th Survey appeared in NATURE of January 29, 193 p. 196. Mr. E. P. Mumford, director of tl Survey, in connexion with the Hope Departmer of Entomology, University Museum, Oxford, h been for some years working out the collection with the co-operation of specialists in all par of the world. More than two hundred pape have already been submitted for publication i Hawaii and elsewhere. It is important to recogni that the work at Oxford was made possible b grants from the Leverhulme Trustees and the Britis Museum (Natural History); the name "Pacifi Entomological Survey" was used to maintain th continuity of the work, and will not be used in con nexion with the present investigations associate officially with Oxford. The only object in view is t obtain, and make known, facts which will help i elucidating the problems of the Pacific Islands; th Marquesan collections and certain other material no under the charge of Mr. Mumford will be deposite in the Bernice P. Bishop Museum, Honolulu, whe the final results have been obtained. To further thi end the Hope Department of Entomology of th University of Oxford, by means of grants from th University for five years from October 1938, fro the Royal Society and the British Association, an from private benefactors, is obtaining from sundr little-known islands in the Pacific, new collection which it is hoped will aid in elucidating problem revealed by the Marquesan work that Mr. Mumfor has been completing at Oxford.

Ancient Tests for Pregnancy

IN a recent paper (*Proc. Roy. Soc. Med.*, 32, 1527 1939) on this subject, Dr. H. P. Bayon showed th the existing translations of Egyptian papyri reveale directions for the performance of several tests fo pregnancy; some of the tests seemed superstitiou

ers were based on signs and symptoms, and a
could be described in modern terminology as
ormonal germination tests made with pregnancy
ne". Similar tests for pregnancy, fertility and
gnostication of sex are to be found in the Hippo-
tic writings, their survival for more than a thou-
d years indicating that there was some connexion
ween Egyptian and Greek medicine. These tests
also be traced in various medieval authors, such
Moscius, Trotula, Michel Scot, and Albertus
gnus, though they were modified in substance and
thod. At the end of the sixteenth century they
gan to be distrusted, though their practice has
en recommended even in recent popular works.
. Bayon maintains that the original Egyptian
t for pregnancy and its modifications, though
mingly absurd in theory and certainly erroneous
practice, represent the first diagnostic tests on
ord, while their employment throughout the
dle Ages and later indicates a persistent effort to
oly biological experimentation to the needs of
dicine. The Egyptian test was also a striking
mple of instinctive anticipation, which proved
t in the development of medicine, intuition pre-
ed practice, and was followed by understanding,
ich culminated in reasoned and demonstrable
owledge.

ence and Animal Welfare

s was noted under the above heading in NATURE
October 22, 1938, a committee was formed by
F A W (The Universities' Federation for Animal
lfare) in an attempt to bring scientific reasoning
some of the outstanding problems concerned with
welfare of animals, and a short résumé of the
posed functions of the committee was given. It
now possible to review the progress of the first
r, which has been distinctly encouraging. In
nexion with rabbit control, a grant was made
vards the costs of research upon ecological aspects
the problem, which is being carried out at the
reau of Animal Population, Oxford. The Preven-
n of Damage by Rabbits Act was promoted by
F A W. On Skokholm Island, off the Pembroke-
re coast, the Federation has participated in the
empt to carry out a wholesale cyanide fumigation
the warrens, and it is intended, if possible, to com-
te the eradication of the rabbits this winter and so
der the island suitable for farming. Another area
dication experiment is being supported in Corn-
l.

HE problem of anæsthetics for animals has
eived considerable study. It is felt that the
imals Anæsthetics Act of 1919 is in need of careful
ision, and the National Veterinary Medical Associa-
n has agreed to appoint a committee of experts to
iew the whole position of anæsthesia in animals,
l to make recommendations for the drafting of a
bill. Animal euthanasia has also been studied;
suggestion which is being discussed concerns the
sible use of drugs which, although potent narcotics,
e not been marketed for clinical use on account of their high toxicity or narrow therapeutic margin. While the war will almost certainly lead to a great diminution in the trading of pet animals, every effort is being made to provide, by educational means and otherwise, for an improvement in the care of such animals before and after purchase. The use of the electric goad for droving has been considered, and field tests are being carried out at an agricultural college to determine its efficacy. All who are interested in the work of the committee, are asked to communicate with the honorary secretary, A. N. Worden, at the Federation's headquarters, Gordon House, 29 Gordon Square, London, W.C.1.

Communications on Spectrochemical Analysis

OWING to the war, the publication of papers in the English language in *Spectrochemica Acta* is no longer practicable and Mr. F. Twyman, formerly English editor of the journal, has put forward a suggestion that there be an agreed single medium for the publication of such papers in England. Briefly, the proposal is that papers, articles, and notes on spectrochemical analysis should be sent to the *Journal of the Society of Chemical Industry*, and that if the communication deals with some special subject such as an application to botany, soil analysis, mineralogy, etc., the author should at the same time communicate to his own specialist society an abstract or companion paper dealing particularly with the application, while for details of the apparatus and spectrographic method reference would be made to the *Journal of the Society of Chemical Industry*. Should the 'specialist' portion of the paper be of preponderating interest, the main paper would naturally be submitted to the specialist journal, and an abstract or companion paper sent to the *Journal of the Society of Chemical Industry*. Manuscripts for the Society of Chemical Industry, which should in all cases be prefaced by a short introductory statement setting out in simple language the objects of the investigation and a synopsis of the results achieved, should be addressed to: Mr. T. F. Burton, Society of Chemical Industry, Clifton House, Euston Road, London, N.W.1.

A Sensitive Induction Magnetograph

A SENSITIVE induction magnetograph for measuring the time-rate dH/dt of the horizontal component of the earth's magnetic field is described by H. Nagaoka and T. Ikebe in *Scientific Papers of the Institute of Physical and Chemical Research* (Tokyo) of August 1939. The magnetograph embodies a design of a special shape for collecting the lines of force into a permalloy core enclosed in a cylindrical coil. A record is given of complicated magnetic disturbances caused by electric trams. Even at a distance of several hundred kilometres from a great city, the disturbances can be detected as minute ripples on the traces. The selection of an observing station for observing true geophysical phenomena is therefore a difficult problem. The observed effect of weak earthquake shocks is discussed. Apart from the purely mechanical effects of shock, there are probably some true magnetic effects due to the varying magnetic susceptibility of erupting lava (the subject of study being the Asawa volcano). The authors think that it may be possible to predict violent eruptions half an hour before they occur. It is also anticipated that the new magnetograph will provide data to test whether short-period disturbances of a few seconds' duration exist during magnetic storms. Provided that a suitable site can be obtained, the magnetograph has other applications in the study of the characteristics of the E- and F-layers of the ionosphere with respect to the height of origin of the current system producing the diurnal variation of the earth's magnetic field.

Apia Observatory

The annual report for 1935 of the Apia Observatory, issued by the New Zealand Department of Scientific and Industrial Research, bears witness to useful systematic work in several sections of geophysical research carried out at the Apia Observatory. The observations are grouped under terrestrial magnetism, seismology, meteorology, and atmospheric electricity. The meteorological observations include pilot balloon ascents for upper air data and the preparation of daily synoptic charts of the weather in the region of the South Pacific islands. A time service is also maintained. A glance at the meteorological records shows that conditions from the observer's point of view must often be difficult. The mean monthly temperature at 9h. usually exceeds 80° F.; there is much rain in some months, and relative humidity is invariably high. On January 16, 1935, a fall of more than 13 inches of rain was recorded, the total for the month being about 41 inches. Apia Observatory was established in 1902 in connexion with the German South Polar Expedition. The magnetic section of the Observatory was constructed in 1912, the seismograph installed in 1913, while the atmospheric electricity apparatus was housed in 1922–1924 through grants from the Department of Terrestrial Magnetism, Carnegie Institution of Washington. In 1921, the Observatory was formally taken over by the New Zealand Government, which has borne throughout the greater part of the cost of maintenance, although substantial annual grants have been made by the Carnegie Institution of Washington and by the British Admiralty.

The World's Largest Generating Station

Few engineers in Great Britain know much of the progress that is being made in the hydro-electric plant which is being erected at the Samara bend on the Volga by Soviet engineers. The *Electrical Times* of October 26 suggests that a study of the map of Russia will show that the lie of the land at this bend is ideal for the building of a huge hydro-electric plant. Imagine a hairpin bend of the river with the town of Samara containing about 60,000 inhabitants at the top of the bend. The two legs of the hairpin extend west and embrace a ridge of mountains. About thirty miles west of the town is a ravine in these hills, where a small tributary cuts through northward to join the Upper Volga at Stavropol. This would ma an ideal site for a power-house as the pipe lines wou short-circuit something like 75 miles of a falling riv The plant when completed is to have a generati capacity of 3·4 million kilowatts. We know that t six stations at Niagara have a total water power 1·6 million horse-power. Boulder Dam will have ultimate water-power of 1·3 kilowatts but main purpose is for irrigation, and as electric pow is only a side product it would therefore genera much less electricity than the Volga power statio which may therefore claim to be the world's larg power project. This is a case in which electric seems to be shaping the geography of a countr Much of the Samara power will be transmitted a probably, considering the immense distances to whi it will be transmitted, a voltage of 300,000 or mo will be used. Local industries will almost certain group themselves round the power station, as th have done in several places under Soviet control, a large new town will grow up.

Farm Forestry in the United States

A most interesting little booklet entitled "Fa Forestry" by W. A. Ross and W. R. Mattoon h recently been issued by the Office of Educati Department of the Interior, United States (Vo tional Division Bulletin No. 196, Agricultural Ser No. 52, U.S. Govt. Printing Office, Washingt 1939). The material in the bulletin has been p pared to provide teachers of what is termed vo tional agriculture with valuable subject-matt written in a practical fashion to enable them offer more effective systematic instruction on cert forestry work on the farm. The United States, it said, contains some 470,000,000 acres of land whi is classified as forest land. In addition there a several million acres which economists say are excess of what will be required for the production field crops and the raising of live-stock and whi are therefore available for forestry purposes. Timb is now a recognized crop in diversified farming p grammes. Much of the booklet may be read w interest in its application to Great Britain. T United States has, as is well known, some diffic problems to solve owing to excessive lumbering forest and excessive crop-growing on soils not appl able to such treatment. The so-called dust bowls ha shown the direction to which such over-utilizati leads. The hints given in this bulletin are theref of major importance to the farmer.

Land-grant Colleges in the United States

An English farmer remarked that, when he arriv in Honolulu in 1907, he was surprised to find t experts on the spot, ready to advise on forestry a agriculture, supply seeds and lend money on sm holdings. This is one result of the far-flung enterpri of the United States which appears in "The Lan grant Colleges", a paper-covered monograph prepar for the Advisory Committee on Education appoint by the President in 1936 (Washington, D.C.: G.P. 25 cents). The authors trace the rise and broadeni the movement from its beginnings in 1862. They not give instances of the actual working of the eme in any particular case, but its development a whole is clearly indicated with tables of statistics d comments. As the Acts which control the rking of the colleges are no fewer than nine, a rtain amount of friction with the State authorities inevitable. States differ in their resources and eds. But the authors agree that some Federal ntrol of the research to be made is wise. An Act 1935 arranged that Federal funds need not be natched" by the State contributions—a sensible ovision. Agriculture is the main subject. Home onomics appear to languish, from a table of time ent from 1928 until 1936. Experimental stations, in agriculture, can scarcely be arranged. But rrill's initiative in 1862 has certainly proved itful for the farmer, if it has not provided the eral education he contemplated. One difficulty to faced is the duplication of work already being done schools and colleges.

sistant for India at Kew

MR. C. E. C. FISCHER, assistant for India at the yal Botanic Gardens, Kew, is to retire shortly. joined the Herbarium in January 1925, while on lough preparatory to retirement from the Indian rest Service, which had been spent mainly in the dras Presidency. In the same year the death of . J. S. Gamble left the "Flora of the Presidency Madras" unfinished, and Fischer was charged with completion of the work. This involved the rking out of the seven families of Dicotyledons, Coniferae and the whole of the Monocotyledons. assistant for India in the Herbarium he was also ponsible for the identification of material from all rts of the Indian Empire, which during recent ars has been mainly from Burma, the Himalayas luding Southern Tibet, and the Madras Presidency. Mr. Fischer's retirement in December, he will be ceeded by Mr. K. N. Kaul, who has already spent arly six months at Kew. Mr. Kaul is a graduate the University of Lucknow, where he has worked der Prof. B. Sahni.

nouncements

PROF. J. GRAY, professor of zoology in the Univer-y of Cambridge, will deliver the Croonian Lecture the Royal Society on November 16 at 2.30 p.m. e title of Prof. Gray's lecture is "Aspects of Animal comotion".

DR. WILLIAM W. GRAVES, professor and director the Department of Neuro-psychiatry, St. Louis hool of Medicine, has received the Award of Merit St. Louis Medical Society for his studies on erited variations in relation to the problems of human constitution.

AN institute for industrial medicine and particu-ly for the prevention and control of diseases to dust will be opened shortly at Iglesias in rdinia.

THE community education section of the American Dietetic Association has recently published a bibliography of normal nutrition. It can be obtained at the office of the Association, 185 North Wabash Avenue, Chicago, at 10 cents a copy.

THE work of the Eugenics Society will be carried on at 69 Eccleston Square, London, S.W.1, during the war, and an emergency committee has been appointed, with full powers to act on behalf of the council. The quarterly publication of the *Eugenics Review* will be continued under the editorship of Dr. Maurice Newfield.

ACCORDING to a circular recently issued by the International Academy of the History of Sciences, the fifth International Congress of the History of Sciences will be held at Lausanne in September 1940, if the political and social situation of Europe permits. The permanent secretary of the Academy, M. Aldo Mieli, having now settled at Santa Fé in the Argentine Republic as director of the history of science in the University of Santa Fé, M. J. A. Vollgraff of Leyden has been appointed assistant secretary for Europe and the Mediterranean countries. The review *Archeion*, the official organ of the Academy, will henceforth be published at Santa Fé instead of at Rome as hitherto.

THE Finney-Howell Research Foundation, Inc., announces fellowships for 1940. This Foundation was provided for in the will of the late Dr. George Walker of Baltimore for the support of "research work into the cause of causes and the treatment of cancer". Fellowships carrying an annual stipend of 2,000 dollars are awarded for the period of one year, with the possibility of renewal up to three years; when deemed wise by the Board of Directors, special grants of limited sums may be made to support the work carried on under a fellowship. Applications for fellowships for 1940 should be made at the office of Foundation, 1211 Cathedral Street, Baltimore, Maryland, by January 1, 1940.

REFERENCE was made in NATURE of October 21, p. 714, to the British Association Research Committee on Blood Groups among Primitive Peoples; it should have been stated that the work referred to was done by, and under, Prof. R. Ruggles Gates.

UNDER the title "Prehistoric Indian Village, New Mexico" reference was made in NATURE of September 23, p. 542, to the work of an expedition under the leadership of Dr. Paul S. Martin. We are informed that Dr. Martin is, and has been for several years, chief curator of the Department of Anthropology of the Field Museum of Natural History, Chicago, and the expedition referred to is the ninth that Dr. Martin has undertaken for the Museum. The statement that the expedition was sent out by the American Museum of Natural History of New York is incorrect.

LETTERS TO THE EDITORS

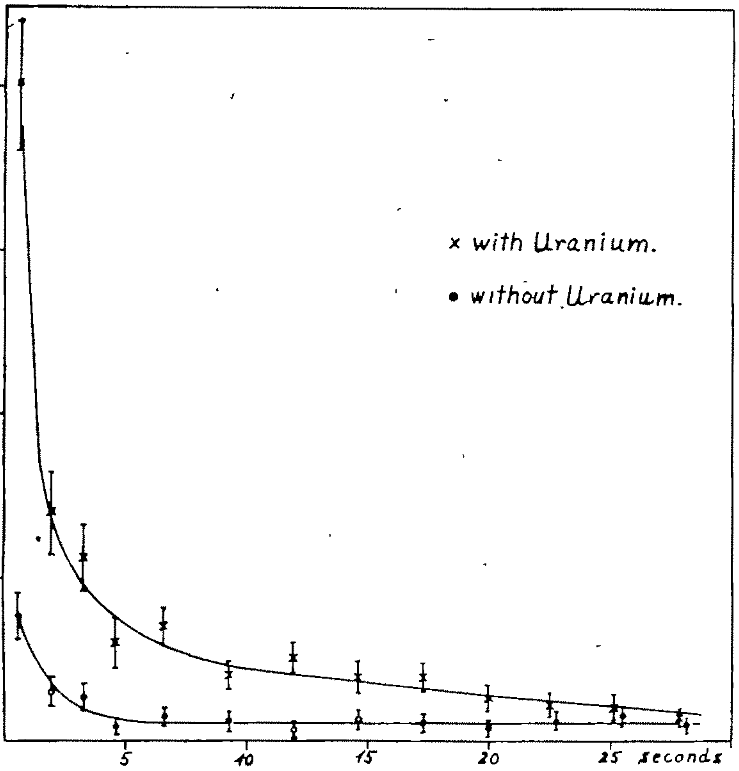
The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 836.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Delayed Neutron Emission accompanying Uranium Fission

As first observed by Roberts, Meyer and Wang[1], the fission of uranium is followed by an emission of neutrons with a delay of about 12 seconds. As this period corresponds roughly to a β-ray period of about 10 seconds previously found by Meitner, Hahn and Strassmann[2] in their study of the uranium neutron reactions, it was suggested that the neutron emission is directly connected with the process of β-ray emission. Further experiments[3] confirmed this conclusion and led to an estimate for the cross-section for the production of such delayed neutrons of about 4×10^{-26} cm.[3]. The subsequent work of Booth, Dunning and Slack[4] established the existence of an additional period of about 45 seconds, which could also be brought into connexion with a known β-ray period of the uranium products.



The theoretical analysis of the problem by Bohr and Wheeler[5] points to a simple explanation of these results, and suggests also the possibility of still shorter periods both for β-ray and neutron emission. The existence of two additional β-ray periods of 0·3–0·9 and 3–4 seconds was, in fact, established the recent experiments of Barschall, Harris, Kann and Turner[6]. Experiments were then initiated this laboratory to ascertain whether the correspondi neutron periods occur.

In these experiments, 1½ kg of uranium nitrate surrounded paraffin were exposed to the ne trons from a lithium target bo barded by a deuteron beam 900 kv. and 20 microamper The beam was intermittently off by means of a switch in t power supply to the ion sour The neutrons emitted from t uranium were detected in a borc lined ionization chamber plac immediately under the urani container. The pulses from t ionization chamber were amplifi and recorded on an oscillogra operated synchronously with t ion source.

The accompanying figure giv the result of measurements ma after irradiation periods of seconds and interspersed with co trol measurements without ura ium. The 12-second period p viously reported is clearly show In addition, a decay of the neutr emission of shorter period is a parent with a starting intensi somewhat larger than that giv for the 12-second period. Besic showing the presence of a period about 3 seconds, the figure giv also some indication of a peri between 0·1 sec. and 0·3 sec. However, the defin establishment of such a short period is render difficult by the large background shown in the cur taken without uranium. This background is due electrical disturbances from the high-tension equ ment occurring when the ion source is turned off, a it is hoped that by more careful shielding of t amplifier the effect may be reduced in continu experiments.

Recently, Gibbs and Thomson[7] have report similar investigations with an intermittent i source of special construction allowing the study periods as short as 10^{-3} sec. Because of the l neutron intensities available to them, they could n detect any definite neutron period in the range fr 10^{-3} to 10 seconds, and were only able to conclu that the total cross-section for the production of su periods was at any rate not much larger than 10^{-25} cm suming that the cross-section for the 12-second riod[3] is 4 × 10^{-24} cm.[2], the total cross-section ven by our experiments for periods down to about 1 sec. is less than 2 × 10^{-24} cm.[2]. The experiments Gibbs and Thomson are, therefore, in no way in sagreement with ours, and indicate further that ere are no intense periods between 10^{-3} sec. and $^{-1}$ sec., in accordance with theoretical expectations[5], nsidering the lack of very hard β-rays accompanying e fission process[6].

We are obliged to Prof. Niels Bohr for suggesting e problem, and to Prof. T. Bjerge and Dr. O. R. isch for valuable advice in the setting up of the periments.

K. J. Boström.
stitute of Theoretical Physics, J. Koch.
University of Copenhagen. T. Lauritsen.
Oct. 7.

---

oberts, R. B., Meyer, R. C., and Wang, P., *Phys. Rev.*, 56, 510 (1939).

eitner, L., Hahn, O., and Strassmann, F., *Z. Phys.*, 106, 249 (1937).

oberts, R. B., Hafstad, L. R., Meyer, R. C., and Wang, P., *Phys Rev.*, 55, 664 (1939).

ooth, E. T., Dunning, J. R., and Slack, F. G., *Phys. Rev.*, 55, 876 (1939).

ohr, N., and Wheeler, J. H., *Phys. Rev.*, 56, 426 (1939).

arschall, H. H., Harris, W. T., Kanner, M. H., and Turner, L. A., *Phys. Rev.*, 55, 980 (1939).

bbs, D. F., and Thomson, G. P., Nature, 144, 202 (1939).

sonance Capture of Slow Neutrons and Emission of Gamma-Rays

The determination of neutron resonance energies nuclei which are made radioactive after neutron pture is possible by utilizing their activities, and veral such cases are known; for example, silver, odium, iodine, indium, gold, etc. But in the cases nuclei which are not made radioactive, it is much re difficult to discover the existence of resonance utron groups and to determine their energies. A. Bethe[1] has suggested several methods for such ses, but no noteworthy results have been obtained cept that of A. E. Dowing and C. D. Ellis[2]. S. Nishikawa and others[3] have pointed out that it possible to detect the resonance groups by an alysis of the activity curve as a function of thickss of paraffin layer interposed between a radon plus beryllium source and a detector which became radioactive by neutron capture. A similar experiment was carried out by Y. Sugiura and O. Minagawa[4] with a D + D neutron source.

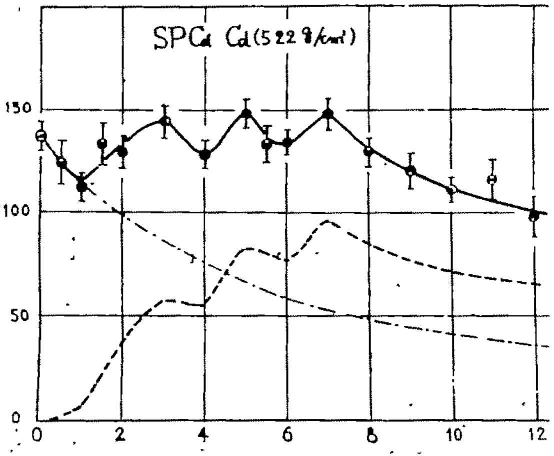


Fig. 1.

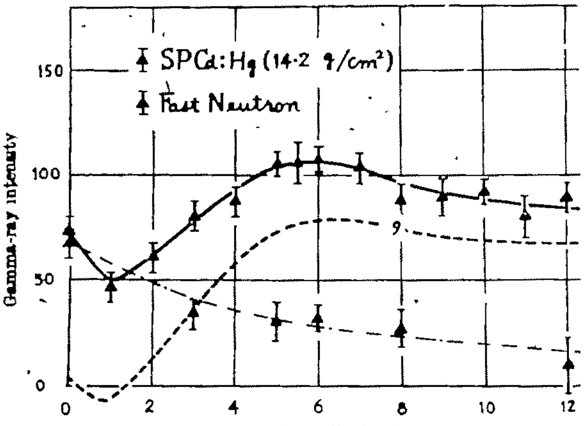


Fig. 2.

In the case of non-active substances, however, it may be possible to utilize the gamma-rays emitted in the capture process itself. Following this idea, the gamma-ray intensity was measured for iron, cadmium, mercury and bismuth by a Geiger-Müller counter as a function of the thickness of paraffin layer interposed between a D + D neutron source and a detector. When thermal neutrons were interrupted by a cadmium filter interposed in an appropriate position, the gamma-ray intensity curve should have one maximum at a certain thickness of paraffin if the detector had one resonance level. The position of the maximum would depend on the energy of the resonance level.

Gamma-ray intensity curves obtained for cadmium and mercury are shown in Figs. 1 and 2. As gamma-rays are excited also by fast neutrons, it is necessary to subtract this part of the gamma-rays in order to get the effect of slow neutrons only. The number of fast neutrons which can excite gamma-rays is calculated as a function of paraffin thickness on the assumption that a fast neutron can excite gamma-rays only when its energy is greater than 1·9 Mev., an average of the values of maximum quantum energies of fast neutron gamma-rays obtained by H. Aoki[5]. The result of the calculations is shown in Fig. 1 or 2 (broken line). An experiment was performed to test this calculated result by absorbing slow neutrons by a thick layer of boric oxide (0·78 gm./cm.[2] of boron). The result is shown in Fig. 2, after being corrected for the residual effect of slow neutrons.

From analyses of gamma-ray intensity curves and measurements of energy by the boron absorption method, it can be shown that mercury has a clear resonance group of about 10 ev. in energy, cadmium has several groups of energies from several tens to a few electron volts, and the mean energy of these groups, plus the residual part of the first resonance group (E_r = 0·17 ev.) not absorbed by the cadmium filter, is about 2 ev. Bismuth has a resonance group giving a flat maximum of gamma-ray intensity at about 5–7 cm. thickness of paraffin. Iron has no distinct groups.

For thermal neutrons the maximum of gamma-ray intensity was found at 9 cm.

In conclusion, I wish to express my thanks to Mr. Masamichi Tanaka for encouragement throughout this work, and also to Mr. O. Minagawa for discussions. A detailed report will be published shortly by the Physico-Mathematical Society of Japan.

Itabu Nokaka.

Research Laboratory, Matsuda Division,
Tokyo-Shibaura Electric Company,
Kawasaki, Kanagawaken. Aug. 29.

---

[1] Bethe, H A., *Rev. Mod. Phys.*, 9, 139 (1937).

[2] Dowing, A. B , and Elbe, C. D., NATURE, 142, 793 (1938).

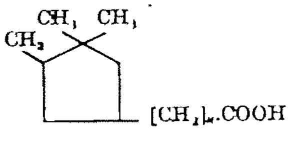
[3] Nishikawa, S., Nakagawa, S , and Sumoto, L, *Proc. Imp Acad Tokyo*, 12, 128 (1936); *Sci. Pap. Inst. Phys. Chem. Res.*, 34, 1, (1937).

[4] Sugiura, Y , and Minagawa, O., *Sci Pap. Inst. Phys. Chem Res.*, 34, 1299 (1938)

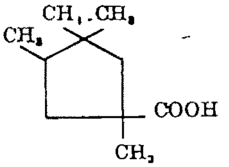
[5] Aoki, H., *Proc. Phys. Math Soc Japan*, 19, 369 (1937).

A Solid Naphthenic Acid from Iranian Petroleum

The importance of the study of the naturally occurring acidic constituents of petroleum, both in the recognition of the individual hydrocarbons from which they are derived and in their application in the domains of medicine and technology, has been stressed by v. Braun[1]. Although, however, the naphthenic acids have been recognized for more than sixty years, owing to the fact that many isomers are possible, it is only comparatively recently that pure individuals have been isolated, many, which had previously been reported as pure, having been proved to be mixtures. v. Braun, Mannes and Reuter[2] are usually considered to have been the first to isolate a homogeneous naphthenic acid by a rather indirect route. Degradation of mixtures, of acids of the general formula $C_{10}H_{18}O_2$ from different sources gave the same 3.3.4–trimethyl*cyclo*pentanone, which was reconverted to 3.3.4–trimethyl*cyclo*pentylacetic acid. All the higher acids $C_n H_{2n-2} O_2$, out of which the above ketone could be obtained by degrading one or more times, therefore correspond to the formula (I) (v. Braun *et alia*, *loc. cit.*)



(I)



(II)

Recently, Nenitzescu, Isacescu and Volrap[3] have isolated and identified *cyclo*pentane, *cyclo*pentyl-acetic and 3–methyl*cyclo*pentylacetic acids from a Rumanian source.

During an investigation of the caustic washing liquors after use in removing traces of acid from a kerosene sulphur dioxide extract derived from Iranian petroleum, the presence of naphthenic acids in an oil from this source was proved for the first time. A subsequent investigation showed that naphthenic acids occurred in the kerosene sulphur dioxide extract to the extent of approximately 0·025 per cent by weight, of which about 10 per cent was removed by the light caustic washing. The spent caustic washing liquors after washing 2,000 gallons of kerosene sulphur dioxide extract were neutralized and the precipitated oil worked up in the usual manner into acidic, phenolic, mercaptan and hydrocarbon fractions. The acidic material was esterified three times by means of methyl alcohol and hydrochloric acid, whereby all the primary and secondary acids could be remov
from the difficultly esterifiable tertiary acids.

The residual tertiary acids on standing for a fe
days yielded a white crystalline solid which aft
many crystallizations from low boiling petrol h
constant m.p. 82° (found, C, 70·90; H, 10·7
$C_{10}H_{18}O_2$ requires C, 70·52; H, 10·66 per cen
molecular weight by titration: 173; $C_{10}H_{18}$
requires 170). The anilide crystallized in colourle
flat needles from aqueous methyl alcohol, m.p. 186–
(found C, 78·32; H, 9·38; N, 5·73; $C_{16}H_{23}O$
requires C, 78·30; H, 9·45; N, 5·71 per cent). I
fractional crystallization of the mother liquors
total yield of 3·3 per cent of the acid was obtain
on the original acid mixture from the caustic washi
liquors. The acid proved to be saturated, and mu
therefore contain a closed carbon ring.

In line with the results of Nenitzescu *et alia* (*l*
cit.) and of v. Braun *et alia* (*loc. cit.*), it is suggest
that the above acid possesses a polymethyl*cyclo*pent
structure, possibly (II). Further information will
published elsewhere when larger amounts are ava
able for study.

I wish to record my thanks to the chairman of t
Anglo-Iranian Oil Company, Limited, for permissi
to publish these results.

Since this work was completed, a publication
Hancock and Lochte has appeared[4] describing the i
lation of a solid tertiary naphthenic acid, m.p. 19
194·5°, from a California straight-run gasoli
distillate which they have shown to be identical w
camphonanic acid (1.2.2–trimethyl-*cyclo*pentanec
boxylic acid).

Thomas Kennedy

Anglo-Iranian Oil Co., Ltd.,
Research Station,
Sunbury-on-Thames. Oct. 4.

---

[1] "Science of Petroleum", 2, 1014 (Oxford).

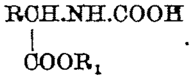
[2] *Ber.*, 66B, 1499 (1933).

[3] *Ber.*, 71B, 2066 (1938).

[4] *J. Amer. Chem. Soc.*, 61, 2448 (1939).

Carbamates of α-Amino-Acid Esters and their Po condensation

On passing a stream of carbon dioxide throu
strongly cooled, pure α-amino acid esters or th
solutions (for example, in ether) with certain p
cautions, new crystalline products have been obtain
After careful purification the products give analyti
data which correspond to the formulæ of carbama
of the α-amino acid esters of the general form



$$\begin{array}{l}\mathrm{RCH.NH.COOH}\\ \quad\ \ |\\ \quad \mathrm{COOR_1}\end{array}$$

A number of them, for example, glycine carbam
ethyl ester, alanine carbamate ethyl ester, phen
glycine carbamate ethyl ester, have now been p
pared and analysed. The new compounds sh
various degrees of stability at low temperature.
room temperature they decompose more or l
rapidly, giving off carbon dioxide; the dissociat
is considerably increased on warming *in vacuo*.

Besides being of interest in itself, this class
amino-acid derivatives is of value in carrying
poly-condensations of amino-acids.

As has been shown in a previous communicati
amino-acid esters exhibit a tendency to condense, fo
ing, *inter alia*, polypeptide esters of varying ch
length. This tendency of the amino-acid esters see
to be enhanced by the introduction into their mole

the readily cleavable COO-group, removal of which bound to leave an NH$_2$-group *in statu nascendi* hind.

According to Curtius and to E. Fischer, the glycine yl ester on standing for several weeks gives as hest condensation product the biuret base, the raglycine ethyl ester. Under similar conditions, cine ethyl ester carbamate yields a mixture which ording to the analytical data seems to contain, *inter ia*, glycine peptide esters of considerably higher chain gth.

From alanine carbamate ethyl ester a product was tained which gave the biuret reaction. From this ixture, tetra-alanine ethyl ester was isolated.

Systematic experiments on the synthesis and operties of carbamates of the various representa-ve amino-acid and peptide esters and on their ndensation are in progress.

Max Frankel.
Otto Neufeld.
Ephraim Katchalski.

The Hebrew University,
Jerusalem.
Sept. 15.

---

rankel, M., and Katchalski, E., Nature, 144, 330 (1939).

An Easily Arranged Periodic Action

Lecturers wishing to demonstrate the existence periodic phenomena may be interested in a scription of a periodic action that can be set up in few minutes.

The surface of a sheet of lead was amalgamated ith mercury and while it still possessed some fluidity drop of concentrated nitric acid was placed on it. reading started immediately, but ceased when the ameter of the area of wetting reached about 1·5 cm. fter an induction period of about a minute, during hich time there was no apparent action, a considerble evolution of gas occurred at the mercury surface, ut this continued only for a fraction of a second. eriods of apparent quiescence and gaseous evolution hen followed regularly, at intervals of about a cond. Pulsations continued for some minutes, until ad nitrate crystallized from the liquid phase.

The presence of mercurous nitrate in the nitric acid cilitated the initial amalgamation, but the surface ad to be dried before the acid was placed upon it, therwise spreading proceeded too far. Some factor ot yet identified caused variations in the period of ne cycle. With some specimens of lead of doubtful urity it was necessary to dilute the acid with up to ne third of its own volume of water in order to get ulsations of sufficiently long period to be readily bserved.

The reaction seems to be that lead (not mercury) issolves, with liberation of nitrogen peroxide or ther oxides of nitrogen.

E. E. Wark.
I. W. Wark.

University of Melbourne,
Carlton, Melbourne, N.3.
Aug. 26.

ffect of Irradiating the Tubercle Bacillus with Radon

Immunity against the tubercle bacillus seems to be due to the presence of living bacteria in the body; t is then of importance to obtain non-virulent but ving bacteria. The virulence of pathogenic bacteria is enerally attributed to their power of multiplication. In actual fact, this is the result of two independent variables:

(1) The toxicity factor T or the mean toxicity potential of the bacteria. This potential for a stable strain is first of all dependent on the host and secondly on the mode of innoculation (excipient, medium, rhythm). Specificity might be connected to this factor.

(2) The numerical factor N_t, or the number of bacteria *in vivo* at a given moment of the infection. Schematically, $V = T.N_t$, N_t being itself a function of N_0, the number of bacteria injected and of their time of generation *in vivo*.

The virulence of a bacterium may then be influenced by acting on either of these factors or on both of them. Calmette acted on the toxicity factor, obtaining B.C.G.; we preferred to act on the numerical factor, inhibiting proliferation without modifying, so far as possible, the other cellular functions. Among the physico-chemical agents available, we selected the ionising radiations, as most suitable for our purpose.

We have irradiated aqueous suspensions of human tubercle bacillus (1 mgm./c.c.) using the whole of the radiation of radon dissolved in the culture. The technique we have elaborated enables us to obtain reproducible results depending exclusively on the doses employed, given in microcurie destroyed per cubic centimetre of the bacterial emulsion. (One microcurie disintegrated (1 μc.) corresponds to the emission of $5 \cdot 5 \times 10^{10}$ α-particles, $3 \cdot 6 \times 10^{10}$ β-particles and to the formation of 10^{16} pairs of ions or 5×10^{6} r. An area of $0 \cdot 5\,\mu^2$ (mean cross-section of a B.K.) is traversed at this dosage by 1·2 α-particle and 33 β-particles. The γ-radiations are negligible.) The following results are observed.

(1) More than 9 μc. radon disintegrated. Proliferation on Löwenstein medium is regularly suppressed. The form of the curve showing the relation between the number of surviving bacteria and the dose employed could not be traced with precision owing to the uncertainty of counts on this medium. If, as it seems, this curve is of exponential form, the effect of 1·5 μc. corresponds to a dilution of 1/10 of the surviving bacteria.

(2) Cultures thus irradiated remain virulent for the guinea pig up to 14 μc. Above 15 μc., guinea pigs which received under the skin of the thigh 5 mgm. of irradiated B.K. remain unaffected.

(3) *Persistence of respiration of irradiated non-virulent B.K.* It was of importance to assure oneself that the bacteria the virulence and proliferation of which were destroyed, still possess vital properties. This has been done in the following way.

An emulsion of living B.K. was divided into three parts: one was irradiated at 20 μc., the second left untouched and the third killed at 120° C. These suspensions, to each of which 5 per cent of buffered glycerine (*p*H 6·8) was added, were placed in the vessels of a Warburg respirometer. The experiment was conducted under sterile conditions, each vessel being separated from its manometer by a piece of sterilized cotton (Rapkine). It has been established that the irradiated bacteria still respire for about five days. The consumption of oxygen during this period is about 20 per cent that of an equal weight of living bacteria. Thus there remains at least 20 per cent of living bacteria in the irradiated suspension.

While we cannot report fully here on the anti-tuberculosis immunity obtained with irradiated bacteria, we may nevertheless enumerate the following facts.

(1) Guinea pigs vaccinated with such bacteria and tested with 1/50 mgm. of virulent B.K. show a survival (250 ± 40 days) double that of controls (133 ± 30 days), the difference being statistically significant.

(2) A regular decrease of temperature and an improvement of the lesions have been observed in most of the cases of tuberculosis, bony, ganglionar, kidney and pulmonary, under treatment (60 cases). The complete harmlessness of the vaccine has been established even in very serious cases; the radio-vaccine never caused recrudescence.

Thus the action of ionizing radiations enables us to obtain living human tubercle bacillus which are non-virulent; this would seem to be of particular interest to immunologists.

P. BONET-MAURY.
H. R. OLIVIER.

Laboratoire Curie,
Institut du Radium,
11 Rue Pierre-Curie,
Paris, 5e.
Sept. 15.

Necessity of Magnesium in the Pyruvate Oxidation System of Brain*

THE necessity of Mg^{++} in enzymic reactions involving transfer of phosphate groups through the adenylic acid system is well known. More recently, Mn^{++} has also been shown to be active in reactions of this type[1]. Further, Auhagen[2] and later Lohmann and Schuster[3] showed that the decarboxylation of pyruvic acid by yeast requires Mg^{++} (or Mn^{++}). This made it likely that these ions are also necessary for the oxidative breakdown of pyruvic acid in animal tissues, the more so as this breakdown is related with reactions involving the adenylic acid system[4].

Stimulation by Mg^{++} of the oxidative decarboxylation of pyruvate by washed muscle preparations was reported by Annau and Erdős[5]. Addition of Mg^{++} has little or no effect on the oxidation of pyruvate by dispersions from pigeon brain[4] after short dialysis periods (2–3 hours), but the effect is more marked if the dialysis is extended for periods of 8 hours. A clearer demonstration has, however, been obtained by adding to the enzyme an excess of sodium pyrophosphate (0·0067 *M.*) to precipitate magnesium. Pyrophosphate is then removed to the extent of 90 per cent by 8 hours dialysis, when its concentration is of the order of 0·0007 *M.* and is, by itself, without effect on the respiration of the brain preparations. The preparations which have, however, been treated as described above give with pyruvate nearly one third of the oxygen uptake which can be obtained by adding Mg^{++}. These facts are illustrated in the table below. Samples contained 1·5 ml. enzyme (dialysed 8 hours), brought to a volume of 2 ml. with additions including phosphate buffer *p*H 7·3 (0·05 *M.*), fumarate (0·005 *M.*), adenylic acid (0·0007 *M.*), and cozymase (0·00007 *M.*).

Treatment	Pyruvate	Mg^{++} (as $MgCl_2$)	Mn^{++} (as $MnCl_2$)	μL. oxygen uptake in 30 min. (air, 38°)
No pyrophosphate	—	—	—	2
	—	100 γ	—	61
	2 mgm	—	—	280
	2 ,,	100 γ	—	432
Pyrophosphate treated	2 ,,	—	—	175
	2 ,,	100 γ	—	400
	2 ,,	150 γ	—	455
	2 ,,	—	100 γ	345

Mg^{++} (or Mn^{++}) is therefore a component of t pyruvate oxidation system.

I am indebted to the Nuffield trustees for gran in aid of this work.

S. OCHOA.

Department of Biochemistry,
Oxford. Sept. 30.

---

* These results are presented here owing to the temporary discontinuance of the meetings of the Biochemical Society.

[1] Ohlmeyer and Ochoa, *Biochem. Z.*, 293, 338 (1937).

[2] *Z. physiol. Chem.*, 209, 20 (1932).

[3] *Biochem. Z.*, 294, 188 (1937).

[4] Banga, Ochoa and Peters, NATURE, 144, 74 (1939).

[5] *Z. physiol. Chem.*, 257, 111 (1939).

Sex Difference in the Response of the Pigeon Crop-Gland to Prolactin

IT has generally been thought[1] that there is detectable sex difference in the response of the pigeo crop-gland to prolactin. Folley and White[2], howeve were able to demonstrate a significantly great response in males than in females, a finding whic has since been confirmed by Bates and Riddle[3] f subcutaneous but not for intramuscular injections.

Preliminary examination of more extensive resul which have accumulated in this laboratory in t course of further experiments on the inhibition oestrogens of the prolactin response[4] appeared at fir sight to indicate no sex difference in response. Sinc however, re-examination of the original records Folley and White revealed that their groups con sisted almost entirely of immature birds, a furth analysis of the above-mentioned data, in which t birds were classified as mature and immature on t basis of gonad size at autopsy, was undertaken Details of the experimental technique are given else where[4], the birds referred to below comprising t prolactin and oil-injected controls together with group of birds used for constructing a dose-respons curve.

The following results relate to two groups of bir receiving the same daily dose of prolactin but differen doses of sesame oil (these were also combined to mak a third group on the reasonable assumption that t sesame oil injections had no effect on the prolacti response) and a fourth group receiving a lower do of prolactin. For groups of 'mature' birds the mea male crop weights exceeded those of females by 0·1 0·06, 0·08 and 0·17 gm. per 100 gm. body weig respectively, the corresponding values of *P* (Fisher '*t*' test[5]) being 0·3–0·4, 0·5–0·6, 0·3 and 0·2–0· For 'immature' birds the mean crop weights of mal were 0·30, 0·31, 0·36 and 0·11 gm. per 100 g body weight greater than those of females. Here th values of *P* were 0·14, 0·076, 0·01–0·02 and 0·1–0·

It will be seen that for 'mature' birds the differenc between the male and female crop weights we small and apparently not significant. On the oth hand, in 'immature' birds receiving the higher do of prolactin the differences were much larger and th significance levels much higher. It therefore appea that this sex difference in response to prolactin most marked in pigeons with undeveloped gonad

S. J. FOLLEY.

National Institute for Research in Dairying,
Shinfield, Reading.
Oct. 1.

---

[1] Rowlands, I. W., *Quart. J. Pharm. and Pharmacol.*, 10, 216 (1937

[2] Folley, S. J., and White, P., NATURE, 140, 505 (1937).

[3] Bates, R. W., and Riddle, O., *J. Biol. Chem.*, 123, *Proc. Ame Soc. Biol. Chemists*, 5 (1939).

[4] Folley, S. J., *Endocrinology*, 24, 814 (1939).

[5] Fisher, R. A., "Statistical Methods for Research Workers" (Edi burgh: Oliver and Boyd, 1934).

Histological Effects of Diabetogenic Anterior Pituitary Extracts

AT the request of Prof. C. H. Best, in whose epartment studies were being made on other aspects f the diabetogenic effects of pituitary extracts, we ade a histological study of the tissues of dogs hich were receiving daily injections of an anterior be extract. The clinical evidences of diabetes as ell as the results of insulin assays on the pancreases f these animals is reported elsewhere (Best, Campbell nd Haist[1]). For our work, pancreas tissue was btained under anaesthesia, other tissues shortly fter death. Tissues were fixed in Zenker-formol and ouin's solution and sectioned in paraffin. Three icron pancreas sections were stained by the Mallory-zan technique, Bowie's stain and other methods iving islet cell differentiation. Hæmatoxylin and osin sections were prepared from all the organs. he histological findings are summarized in the ollowing table.

Number of days injected	2	3 and 4	7	11*
eta cell granules	Slight deplet.	Moderate deplet.	Moderate deplet.	Marked deplet.
lpha cells	No change	No change	No change	No change
itoses in islets	One seen	A few	Several	None seen
ydropic degen.	Not seen	Trace	Trace	Marked
acuoles in duct pithelium	Not seen	Marked	Marked	Marked
itoses in duct pithelium	Not seen	A few	Many	A few
itoses acini	Not seen	A few	Many	None seen
ype of thyroid pithelium	High colum.	High colum.	High colum.	Cuboidal
olloid content hyroid	Slight reduct.	Mod. reduct.	Mod reduct.	Slight reduct.
itoses hyroid	Many	Many	Many	None seen
itoses adrenal Cortex	Many	Many	Many	None seen
itoses parathy-roid	Many	Many	Many	Not exam.
iver degen.	Not seen	About cent. veins	Severe	Not so severe
itoses liver	Not seen	Not seen	Not seen	Many
itoses kidney	Not seen	Not seen	Many in Loop of Henle	None seen

* Two dogs were injected for eleven days. The findings of one were milar to those presented for dogs injected seven days, the findings of e other are presented in this column.

NOTE. (1) The first seven items are concerned with the pancreas;) three- and four-day dogs are grouped together to save space, but e findings in them although similar are not identical; (3) one dog jected only once is not included in the table; it showed no change xcept a heightening of the thyroid epithelium; (4) each dog was acrificed twenty-four hours after its last injection.

Although islet degeneration is pronounced in ermanent pituitary induced diabetes (Richardson nd Young[2], Campbell and Best[3]), our findings uggest that temporary diabetes has a much more omplicated histological basis. In the early stages f the condition we did not find a great deal of islet egeneration; moreover, there were profound changes n many other organs related to carbohydrate etabolism.

The remarkable amount of cell division in the hyroid, parathyroid and adrenal cortex indicates hat the extract contained these glands' respective ropic principles. Cell division in the ducts, acini nd islets of the pancreas likewise indicates a pancreatropic principle in the extract. Anselmino, Ierold and Hoffmann[4] first postulated such an xtract and Richardson and Young[5] have shown hat injections of a crude saline extract of anterior obe causes both the islet and total pancreas tissue f the rat to increase in amount. Our findings confirm the view that there is such a principle and ndicate that its action is by no means limited to islets as is so often assumed, but affects acini as well. This is only to be expected as the pancreas is both an exocrine and an endocrine gland with both elements evolving from the same stem cell. Hence a pancreatropic principle could be expected to produce the effects we observed.

Allen[6], from studies on partially depancreatectomized animals, postulated that beta cells, subjected to excessive functional strain, suffered hydropic degeneration. It therefore does not seem unreasonable to attribute the extensive hydropic degeneration we observed at eleven days to overstimulation by the pancreatropic principle in the extract. Thus we think there is no justification at present for postulating any pituitary principle which is primarily degenerative with regard to islet tissue. The paradox of a diabetogenic effect being produced by an extract containing a pancreatropic principle might be explained (1) by the extract containing many tropic principles which early in the course of the injections affect carbohydrate metabolism by acting on organs other than the pancreas, for example, thyroid and adrenal cortex, and so obscure the effect of the pancreatropic principle, and (2) by the probability that beta cells do not respond to tropic stimulation with such sustained vigour as most cells, but tend to become exhausted and even permanently injured as the injections continue.

A. W. HAM.
R. E. HAIST.

Departments of Anatomy
and Physiology,
University of Toronto.
Sept. 22.

---

[1] Best, C. H., Campbell, J., and Haist, R. E. (In the press).

[2] Richardson, K. C., and Young, F. G., *Lancet*, i, 1098 (1938).

[3] Campbell, J., and Best, C. H., *Lancet*, i, 1444 (1938).

[4] Anselmino, K. J., Herold, L., and Hoffmann, F., *Klin. Wchnschr.*, 12, 1245 (1933).

[5] Richardson, K. C., and Young, F. G., *J. Physiol.*, 91, 352 (1937).

[6] Allen, F. M., *J. Metabolic Research*, 1, 5 (1922).

Occurrence of Wax-like Substances in Peaty Fireclay

ASSOCIATED with the usual type of fireclay in the Ecca Series of the Karroo System in the Witwatersrand area are certain chocolate-coloured, very plastic and fine-grained refractory clays. The colouring matter is organic and mainly colloidal. The clays are difficult to disperse, unless the organic matter is totally destroyed. Owing to the fine state of division of the organic phases, mechanical separation from the inorganic material is impossible. Extraction tests in a Soxhlet apparatus with solvents specified gave the results in the table below.

In general, the extracted substances are waxy, oxidizing rapidly on heating to 110° C. to a dark brown translucent material. The green colouring matter in the alcohol extraction is not due to the presence of vanadium, a fairly commonly occurring element in clays.

Solvent	Extraction time (hr.)	Percentage extracted material	Character of extracted material
Acetone	14	0 12–0·20	Brownish translucent wax
Acetone	4	0 03–0 06	Brownish translucent wax
Ethyl alcohol	28	0·12	Light green transparent wax
Pyridene	14	0·72	Dark brown waxy material with tarry substances

Reilly and others[1] record their results on the extraction of waxy materials from peats, using an azeotropic petroleum mixture. Their yields were much greater, and the peats certainly contain much more organic matter than the fireclays.

It is noteworthy that the fireclays after extraction show no colour change, and all attempts to extract the pigmenting material have failed. Micro-incineration tests show that the organic matter burns off readily at 500–600° C. and leaves a dirty white residue. It chars far below this range. Owing to the rapid oxidation and small amounts of material, accurate melting point and other physical determinations were impossible, but the substance melts at about 90–100° C.

V. L. Bosazza.

University of the Witwatersrand,
Johannesburg.
Sept. 20.

---

[1] Reilly, J., Kelly, D. F., and Duff, J., *Sci. Proc. Roy. Dublin Soc.*, **22**, 149–155 (1939).

A New Record of *Phoronis hippocrepia* Wright

I found many colonies of *Phoronis hippocrepia* on limestone boulders uncovered at low water of the biggest spring tides in July and August 1939. This was on the collecting ground known in our laboratory as Black Rocks, at the eastern end of the Menai Straits. Most of the individuals had embryos attached to the lophophore.

This species must be widely distributed around th west coast of Great Britain and the English Channel for it has been recorded from the Clyde[1], Tenby[2] Ilfracombe[3], Falmouth[4], Plymouth[4] and Sheerness[4] and also from several places on the French coast On the other hand, anyone requiring fresh specimen might have difficulty in obtaining them. Th Plymouth Fauna List does not record it as occurrin on the shore although, according to Cori[5], this is th usual habitat. Mr. D. P. Wilson tells me that it i occasionally dredged at Plymouth to-day, sometime in considerable quantities ; but that it is not alway easy to obtain. As for its occurrence elsewhere w have only the old records. Since the other Britis forms, *P. ovalis* Wright and a form resemblin *P. psammophila* Cori, are probably rarer still, th presence of this species near Bangor appeared worth of note, as it is desirable that material of so interestin an animal as Phoronis should be readily availabl for study.

E. W. Knight Jones.

Department of Zoology,
University College of North Wales,
Bangor.
Oct. 3.

---

[1] Kölliker, *Würzburg Naturw. Z.*, **5** (1864).

[2] Dyster, *Trans. Linn. Soc. Lond.*, **22** (1859).

[3] Wright, *Proc. Roy. Phys. Soc. Edin.*, **1** (1856).

[4] Garstang, *J. Mar. Biol. Assoc.*, **2** (1891).

[5] Cori, "Bronn's Klassen", **4**, Abt. 4, Buch 1, Teil 1, Leipzig (1939

Points from Foregoing Letters

K. J. Bostrem, J. Koch and T. Lauritsen have found short periods for the delayed neutron emission accompanying uranium fission in addition to the two previously known periods of 12 seconds and 45 seconds. The results can be related with the measurements on short β-ray periods from uranium fission, and can be explained by theoretical considerations recently published by Bohr and Wheeler.

An attempt has been made by I. Nonaka to determine the neutron resonance energies of nuclei which are not made radioactive by neutron capture, utilizing the gamma-rays emitted in the capture process itself. The intensity of gamma-rays produced by slow neutrons plotted against thickness of paraffin interposed between source of neutrons and the detector shows maxima representing resonance levels in the cases of mercury, cadmium and iron.

T. Kennedy reports the isolation of a solid naphthenic acid from an Iranian petroleum fraction. The acid has the formula $C_{16}H_{18}O_2$, is saturated, contains a tertiary carboxylic acid group and one closed carbon ring. A *cyclo*pentane structure is tentatively suggested.

It has been found by M. Frankel, O. Neufeld and E. Katchalski that on passing carbon dioxide through pure α-amino-acid esters or their solutions carbamates of the α-amino esters of the general formula

$$\begin{array}{l}\mathrm{RCH.NH.COOH}\\ \ \ |\\ \mathrm{COOR_1}\end{array}$$

are formed. These compounds are also valuable in carrying out poly-condensations of α-amino-acids. They form polypeptide esters of varying chain-length.

P. Bonet-Maury and H. R. Olivier describe method which should be of value to immunologist whereby non-virulent human tubercle bacilli ar produced. The non-virulent bacilli are obtained b irradiating aqueous suspensions of human tubercl bacilli, using the whole of the radiation of rado dissolved in the culture.

S. Ochoa reports that the pyruvate oxidatio system of brain requires the presence of magnesium (or manganese) ions.

A. W. Ham and R. E. Haist have made a histo logical study of the tissues of dogs injected dail with a diabetogenic anterior pituitary extract. complex histological basis for the early phases o temporary diabetes was indicated by a lack of sever islet damage and profound changes in many othe organs related to carbohydrate metabolism. pancreatropic principle in the extract was indicate by mitotic figures in islets, ducts and acini. Th hydropic degeneration which develops later in th course of injections may possibly be explained b the continued action of the pancreatropic principl on beta cells.

The occurrence of wax-like substances from peat fireclays of the Karroo System in South Africa i described by V. L. Bosazza. He was unable to extrac the pigmenting material.

E. W. Knight Jones records the occurrence o *Phoronis hippocrepia* Wright in North Wales, pointin out the paucity of recent records of this form i Great Britain.

RESEARCH ITEMS

Further Concepts of Serbian Gypsies relating to Disease

Bibi, who brings disease to Gadže children, but protects gypsy children from every illness, says Alexander Petrovič (*J. Gypsy Lore Soc.*, Ser. 3, 18, ; 1939), among the gypsies of Golubinci is regarded as a hen. When she flies her chickens fly after her; and they are devils, witches, fever, cholera, diphtheria, and every kind of disease. Some believe that Bibi is in the whirlwind. They are afraid of the whirlwind, and believe that when it gets hold of a man he loses the use of an arm or a leg, or his speech. Bibi is found in dust: we breathe or swallow dust, and disease with it. Illness is caught at the new moon, and waxes and wanes with the moon. Other gypsies believe that cholera is brought to the village by a woman "dressed in black", who carries disease nly to those houses which are unclean. They onclude that a man is saved from cholera who keeps his house clean. The Golubinci gypsies, on the ontrary, with a similar belief as to the origin of the disease, have come to the opposite conclusion. Because Bibi does not like smoke, dust, dirty napkins, dirty clothes and greasy pillow-cases, and these hings stifle her, she will flee. In a house where verything is clean, she enters, touches each inmate, and they die. In the spring when colds, fevers, etc., begin to be prevalent, small dolls are dressed in red, one of which thrown into the well drowns Bibi, the other suspended from a high pole, is Bibi's son, the devil who drives her away. The Golubinci gypsies believe hat every illness comes from fever. This may account for the belief that Bibi is a hen. A man suffering rom malaria trembles violently, just as a hen does, when she beats her wings as if shaking off something. Thus it is not the sick man who shivers and trembles, but the disease itself, the hen that is in him.

North American Indian Music

Miss Frances Densmore, in continuation of her studies of the music of the indigenous peoples of North America, has published songs collected among the Nootka and Quileute of Neah Bay, Washington, on the Strait of Juan de Fuca, near Cape Flattery *Bureau Amer. Ethnol. Bull.*, 124; 1939). These songs of the sea' are here compared with those previously collected among Indians of the prairie, woodland, high plateau and desert. The people are hunters of the whale; they use wooden canoes, and n pursuit of their prey often put far out to sea. Though not of great stature, their physical strength s considerable. They were warriors who cut off the heads of their enemies and displayed them on poles before their village. The potlach was practised with lavish generosity. Among their principal foods were the oil and meat of the whale, the flesh of sea-fowl and other birds, potatoes, fern roots, grasses and water plants and various berries. Climatic conditions are unfavourable to the growth of grain. Their songs, of which 44 per cent have a major tonality as against 38 per cent in Pawnee and 71 per cent in the Ute repertoire, while they show the smallest percentage beginning on the octave above the keynote, are characterized by a small compass; 70 per cent have a compass of six tones or less, compared with 15 per cent in the songs previously analysed. The songs recorded are connected with every department of life and individual and communal activity. They are both ritual or magical in significance as well as purely recreational. One of the most interesting from the cultural aspect is the group associated with whaling in which the skilled whaler was assisted by a strong tumanos (guiding, protecting spirit) acquired as the whaler's first task in the course of prolonged fasting and prayer.

Inheritance of Cyanogenesis

R. D. Williams (*J. Genetics*, 38, 356–366; 1939) shows that some plants of wild white clover (*Trifolium repens*) contain a cyano-glucoside. There is a large variation in the HCN content of the different plants. 1,495 plants resulting from a cross between individuals giving a positive and a negative reaction to the picrate paper test gave positive reactions while 2,473 plants from crosses between acyanogenetic plants gave negative reactions. Further crosses show that the presence of a cyano-glucoside is governed by an almost completely dominant gene *Ac*. Variation in the HCN content between individuals is probably due to modifying factors.

Genetical Analysis of Abnormal Chromosomes

The value of genetics in the analysis of cytological abnormalities is ably demonstrated by B. McClintock (*Proc. Nat. Acad. Sci.*, 25, 405–415; 1939). An abnormal chromosome 9 of *Zea Mays* formed as the result of irradiation with X-rays possessed two centromeres. Therefore the chromosome will break at anaphase I. In order to discover the subsequent history of this chromosome, the behaviour of the genes *Yg C Sh* and *Wx* was studied in plants heterozygous for the abnormal chromosome. It was shown that in embryo and plant tissue the broken ends do not rejoin, but in the embryo sac and endosperm there is a cycle of breakage—fusion of broken ends—bridge formation—breakage at succeeding cell divisions. This phenomena can be followed by the appearance and behaviour of hybrid fruits, which are sometimes variegated as the result of loss of a gene through breakage and refusion of the chromosome.

Position Effect in Œnothera

D. G. Catcheside (*J. Genetics*, 38, 345–352; 1939) has studied X-ray derivatives of the structural homozygote of *Œnothera blandina*. One derivative, *blandina-a* when crossed with *blandina* forms a ring of four chromosomes involving the chromosome 3·4 on which the gene *Ps* is known to be placed. *Ps* normally gives flower buds broadly striped with red separated by narrow green bands. In the heterozygote *blandina-a-blandina*, however, there are narrow ill-defined bands of red. By crossing the F_1 *Ps-blandina-a.Pr blandina* with *Ps blandina*, one *PsPs-blandina* plant in 96 plants occurred. This probably arose as the result of crossing over in the F_1 plant. The author therefore concludes that the activity of the *Ps* gene in *blandina-a* is reduced by its relocation in position relative to the material different from normal blandina.

Genetics of the Garden Nasturtium

EILEEN SUTTON (*J. Genetics*, 38, 161–176; 1939) reports the results of further genetical experiments on the garden nasturtium (*Tropæolum*). The gene *n* reduces the size of plant and of leaves and prevents the anther from dehiscing. The gene *m* gives a sheen to the petals, increases the *p*H value and shortens the flowering season. The effect of *m* on flower colour is to reduce scarlet to biscuit colour, red to mauve or brown, and pink to mauve. The factor *t* partially inhibits anthocyanin production. A gene *g* adversely affects the viability of the pollen-grain and, being linked with *B*, accounts for abnormal ratios of *B*. The genes *B* and *R* are linked with a cross-over value of 0·125. The biochemistry and interaction of characters and chromosome constitution of *Tropæolum* are discussed.

Invertebrates from Manchoukuo

FIVE zoological reports based on material collected by the expedition maintained by the Japanese in Manchoukuo during June–October 1933 under the leadership of Prof. Shigeyasu Tokunaga, of Waseda University, Tokyo, have been published (Rep. 1st Sci. Exp. Manchoukuo. Tokyo: Waseda University). The only earthworm reported is the widespread ***Eisenia foetida***. Four trematodes are described, two of which, *Pneumonoeces jeholensis* and ***Harmostomum momiyami***, are new. The three leeches have all been recorded previously from Japan and China. The two major papers are those on mammals and molluscs: both of them have the text in Japanese and English and both are illustrated by good plates, coloured and plain. Tamezô Mori describes 21 species of mammals, of which three species and two subspecies are regarded as new. Only twelve were actually collected by the expedition; the rest came from the Pest Investigation Institute at Tang-liao. Only four species of molluscs were found, one of which, ***Viviparus*** (*Idiopoma*) ***chengtehensis***, is new. The account occupies 222 pages (137 Japanese and 85 English) and is illustrated by 22 plates. It contains a detailed account of the anatomy of the species, a good deal of information of general interest, and a suggested revision of the Viviparidæ.

Wax Emulsions for Deciduous Fruit

FRUITS are still living organisms when separated from the parent plant, and this fact is responsible for the main difficulties of storage. Citrus fruits have been preserved in good condition for longer periods than normal by the application of a thin coat of wax; indeed, 80–90 per cent of the crops in California and Florida are so treated. Waxing lengthens the effective period of storage apparently by lowering the rate of respiration, and research work on this subject in America is now being directed towards the use of the process on deciduous fruits. Robert M. Smock, of Cornell University, reviews the progress of these investigations in the ***American Fruit Grower*** of August. Research is also in progress in the Universities of California and Maryland in addition to Cornell, and the main problem appears to be to diminish the rate of respiration, and check the evaporation of water from the fruit without stimulating anærobic respiration, with its accompaniment of bad flavour. Bitter pit and storage scald are reduced by waxing, under certain conditions, and the aroma of certain varieties like McIntosh is conserved. Considerable possibilities are revealed the paper, but the exact conditions of treatment a not yet sufficiently standardized for general cor mercial application.

Helium-Neon Content of Sea Water

THE vertical distribution of oxygen in the deep parts of the ocean shows a minimum concentratic (which may be very pronounced) at depths of 20 1,000 metres. In parts of the Pacific there is virtual no oxygen, whilst in the Atlantic the minimum zo is seldom less than 30 per cent saturated and in tl far north and south there is sometimes no minimur Reported analyses of the helium-neon content of s water showed an apparent minimum of the helium neon mixture coinciding with the oxygen minimun N. W. Rakestraw, C. E. Herrick and W. D. Ur (*J. Amer. Chem. Soc.*, 61, 2806; 1939), by a repetitio of this work under more suitable and representati conditions, have shown that specimens of Atlant and Pacific water are practically saturated wi helium and neon at all depths investigated (from to 3,000 metres) with no evidence of a minimu concentration at any depth. There is hence relation to the depth of oxygen minimum. Th result is in general agreement with other ocean graphic evidence.

Magnetic Testing

RECENT developments of alloys for magnet ste which require very high magnetizing forces f magnetizing and testing have led to the productio of high-field permeameters, and R. L. Sanford an E. G. Bennett, of the Bureau of Standards, descril the one adopted at the Bureau, which seems capab of a high degree of accuracy (*J. Res. Bur. Stand* 23, No. 3; September 1939). It is a double-yol apparatus with the adjustable pole pieces place diametrically. The yoke is of laminated silicon stee The pole pieces are channelled, with filler piec fitting closely in the channels and capable of adjus ment so as to grip the specimen to be tested, or the specimen is very short it is made to butt again the pole pieces. The magnetizing coils are woun mainly on the pole pieces with auxiliary coils on th yokes. The induction is determined by reversal the magnetizing current and the magnetizing fiel by coils rotated suddenly through 180°, close t the surfaces of the specimen. Both may be dete mined at various points along the specimen.

Mechanical Force due to an Electron Stream

DR. P. SELÉNYI of the Tungsram Researc Laboratories, Ujpest, Hungary, has sent an accoun of a measurement of the mechanical force exerte on an electrode by a stream of electrons. The electron were accelerated from a filament to a gold-leaf anod suspended as a pendulum. The pressures observe were 5–20 per cent higher than calculated from th accepted value of e/m for electrons, and this differenc is ascribed to radiometer effects. The author considers that this mechanical pressure requires for it explanation a 'true' as distinct from an 'electro magnetic' mass, for he points out that when a singl electron approaches a metallic screen, the electrodynamic repulsion due to induced currents depend on the conductivity of the screen, which is contrar to experience; while with a steady electron beam conditions are stationary and no repulsion due t induced currents is to be expected.

THIRD INTERNATIONAL CANCER CONGRESS

By Prof. F. C. Wood, Institute of Cancer Research,
Columbia University

HE Third International Cancer Congress, held under the auspices of the International Union inst Cancer, met in Atlantic City, New Jersey, A., during September 11–15, 1939, under the sidency of Prof. Francis Carter Wood of Columbia iversity.

nfortunately the onset of war prevented many the European delegates from attending, and ateur Justin Godart, president of the International Union against Cancer, felt that he could not ve France. A few English delegates, among them William Cramer of the Imperial Cancer Research d of London, were able to remain. Considerable gations came from South America and Mexico, Prof. R. Kinosita represented the Japanese ernment. The total attendance was more than hundred, and approximately the same number papers were read.

special feature was a group of evening lectures ch presented general surveys of various aspects the cancer problem and were prepared with the pose of interesting not only the specialist but also entire audience. In these lectures the subject of etic susceptibility to tumour formation in mice surveyed by Dr. C. C. Little of Bar Harbor, ine. Dr. A. Lacassagne of Paris presented the tionship of hormones and mammary adenocinoma in the mouse, and, as he was unable to be sent, his paper was read by the chairman. The er of Profs. Kennaway and Cook, also read in ir absence, dealt with the chemical compounds as cinogenic agents, and Dr. William Cramer of the perial Cancer Research Fund spoke on some phases he etiology of human cancer. Another interesting ning lecture was that on "Cancer and the Public lth" by Surgeon-General Thomas Parran of the ited States Public Health Service. A scheme for organization of a cancer clinic, with the methods recording the facts concerning patients and the hanical sorting of the cards on which records are t so as to obtain the desired statistics within a rt period, was presented by Prof. Fred J. Hodges he University of Michigan. Recent advances in cer surgery were discussed by Dr. Frank H. ey of Boston; and Prof. James Ewing of New k, under the title of "Cancer, Present and Future", marized the main features of the Congress and icated the direction in which research might pro- d in the future. The evening lectures were exceed- y well attended not only by the members of the gress, but also by the local medical fraternity, desired to obtain the latest information on pro- s in the investigation and treatment of cancer.

apers were presented in the following Sections: physics; Surgery; Therapeutic Radiology; Stat- s and Education; Genetics; General Pathology; erimental Pathology; Diagnostic Roentgenology; a General Section for those titles that could be included elsewhere or were received too

The Section on Biophysics included studies on the relation between concentration of ionization and the biological effect; the comparative action of X-rays and neutrons; a comparison of biological and physical measurements of X-rays produced at voltages from 200 to 1,000 kv.; the action of radiation on protoplasm, and the effects of X-rays on different viruses and genes.

In the Section on General Pathology there was an interesting series of papers on the relation between treatment with œstrogenic compounds and the tissue changes produced. Two of the authors believe that the administration of these substances in physiological doses or even in fairly excessive amounts cannot be held responsible for the production of malignant tumours in man, thus differing from the results obtained on animals by Lacassagne, Strong, and others, in which a carcinogenic effect, though perhaps not rigidly proved, is strongly suggested. Important papers were read in this section on tumours of the central nervous system, including one on brain tumours induced in mice by methylcholanthrene. Another communication was that by Martland on the occurrence of cancer in persons who have received considerable quantities of radioactive substances either for therapeutic purposes or accidentally as in various industrial processes. Other papers dealt with tumours of the ovary, pancreas, and parathyroid.

The Section on Experimental Pathology had a very large number of papers and of such variety that every phase of cancer research was included, with a full discussion of the recent studies on leukæmia in animals and the correlations between this disease and human leukæmia, the possible relationship of viruses to cancer, and other questions.

Sessions of great interest to practising physicians and surgeons were the combined symposia of the Sections on Surgery and Therapeutic Radiology, with prolonged discussions on the value of pre- and post-operative radiation in the treatment of cancer of the breast, the proper method of handling node involvements occurring with cancer of the oral cavity, and similar problems which, since they have to be studied statistically on human beings, cannot yet be regarded as settled, because of the lack of extensive statistical records of patients treated in different ways.

The remainder of the programme was devoted to papers on roentgenological diagnosis, genetics, education and statistics, and other clinical and experimental investigations.

Owing to the present situation, it was impossible for the Executive Committee of the International Union against Cancer to make any decision as to the place of meeting for the next Congress. The delegates from South America, however, gave a very cordial invitation to the officers urging the suitability of Buenos Aires for the Fourth International Cancer Congress in 1942.

SAFETY IN MINES RESEARCH BOARD

THE seventeenth annual report of the Safety in Mines Research Board for 1938 has recently been published*. In referring to safety instruction, it is pointed out that teachers, managements and trade union officials are convinced of the value of safety instruction. Safety principles classes for boys are established in every coalfield and similar classes are being formed for adults. Many applications for permission to attend demonstrations at the Research Station, Buxton, have had to be refused on account of lack of accommodation, but during the year there were twenty-two demonstrations which were attended by 5,983 visitors, of whom 3,864 were adults and 2,119 were boys. After demonstrations of coal dust explosions, methods of firing shots and the testing of electrical appliances, discussions were held, usually initiated by some member of the research staff. Many lectures have been given in the coalfields by members of the staff to an estimated total of 16,000 persons.

Cinema Films, Lantern Slides and Exhibits. The Board has prepared cinema films, lantern slides and exhibits, which have been used by teachers and safety officers in connexion with their work. One hundred and twelve loans of cinema films, representing three or four hundred exhibitions in addition to two hundred exhibits, have been made, which indicates the popularity of this branch of the Board's work.

Dispersability of Stone Dusts. An underground gallery at the Station has been used for comparing the dispersabilities of dust deposits during explosions. Various stone dusts have been used separately in thin layers, and as mixtures alone and with coal dust. Work on this problem is being continued, but it can be stated that improvements in the dispersability of dusts is obtained by the addition of light precipitated carbonates. Carbon black causes remarkable improvement. The minimum speed of an air current required to disperse weathered gypsum is 3,400 ft. per minute, whereas with the addition of only 1 per cent of carbon black this speed is reduced to 2,100 ft. per minute. The nature of the action is being studied, but obviously a disadvantage in the use of the mixture is the darkening of the dust, which affects the illumination of roadway.

'Water-proofing' of Colliery Stone Dusts. If ordinary stone dust comes in contact with moisture either in the atmosphere or on the surfaces of roadway in mines, it will not retain its dispersability. Both in Great Britain and in the United States, dusts have been produced which are not readily wetted by water. The dust is ground limestone, with which is incorporated ½ per cent of palmitic or stearic acid. These dusts are highly dispersable and resist damp atmospheres extremely well. Incidentally, the fatty acid protector is readily incorporated during the grinding of the dust, and there appears to be no reason why the process should not be applicable to other dusts.

Gob-fire Experiments. For many years work has been proceeding on gob fires. In the experimental chamber, heatings have taken place when warmed air has been passed through packs consisting of coal and dirt. This state has been reached when the ingoing air has been at temperatures as low as 150° F. The he ings have been within a foot or two of where the entered the pack.

In one experiment the chamber was filled w coal from the roof coal above the Barnsley Bed l than 3 in. in size, of which one third was ground pass through a ¼-in. sieve. After ten weeks a heat occurred. The temperature of the air was raised stages from 160° F. to 212° F. and the rate of f varied between 0·5 and 10 cubic feet per minu A heating developed when the rate of flow v 5 cu. ft. per minute.

A similar experiment was carried out but with fine coal, and a heating developed in four wee When the temperature of the air was raised fr 185° F. to 200° F., the carbon monoxide content the return increased in six days from 0·002 per c to more than 0·024 per cent.

Noise. Another interesting investigation is t concerned with the reduction of noise. It has b found that the proper maintenance of mechan details and attention to the air exhaust is necess to obtain substantial noise abatement. A silen has been designed for use with pneumatic pi which adds 1¼ lb. to the weight of the pick, equival to an increase in weight of 7 per cent. Good res have also been obtained by piping the exhaust from the road rippers on the surface, and whilst t idea cannot be applied to portable machines und ground, it might with advantage be used in connex with stationary engines. The metallic ring can reduced appreciably by drilling a ¼-in. diameter h at a distance of about 12 inches from the shank the pick steel and filling it with molten lead plug with a steel cap.

Experiments are being carried out on sou absorption in connexion with the silencing of elec motors.

Health Researches. Experiments are in prog at the Physiological Laboratory, St. Bartholome Hospital, on dust inhalation and rela problems. Cages of guinea pigs have b placed at selected positions at collieries work anthracite, and a large number of lungs have b examined. It has been noticed that the lungs animals from the screens contain more dust th those of animals kept underground. Much work been done on dust suppression, and with the aid wetting agents it has been possible to design pl using: (*a*) a compressed air mist; (*b*) a mechanica formed mist; (*c*) turbulent passage through wat and (*d*) filtration by means of a compressed me wool mattress. Under practical conditions consid able improvement has been effected by the use these appliances at loading points underground in connexion with screening on the surface.

With regard to poisonous gases it has b shown that a high degree of protection agai carbon monoxide can be obtained with commercial canister. When tested against a 1 cent mixture of carbon monoxide in air satura with water vapour at 17° C. and flowing at a rate 32 litres per minute, each canister had a total leak of carbon monoxide of 960 c.c. in four hours, wh is the limit set in the official tests of the Uni States Bureau of Mines.

J. CROSSLAND

---

* Mines Department. Seventeenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1938. Pp. iv+123+10 plates. (London: H.M. Stationery Office.) 2s. net.

ARCHÆOLOGY IN PERU: RECENT PROGRESS[*]

HE sequence of cultures in Peru was first established on a scientific basis by the excava- ns of Max Uhle at Pachacamac and Moche; and is was in the main confirmed by A. L. Kroeber's d expeditions of 1925–26 and his classification of e Uhle collections in American museums; but the tecedents of the earliest and finest cultures, such the Early Chimu and the Early Nasca, are still known. Dr. J. Tello's intensive field researches ve led him to the conclusion that the Coast cul- res were to some extent derived from the Highlands, sagreeing in this and in other respects with the le-Kroeber scheme. He regards the 'Archaic dean' as the earliest, extending throughout the ghlands. Dr. H. U. Doering has recently found Pacatnamú superimposed burials, of which he gards the oldest as having 'Early Chimu' affinities. In the Highlands, the Tiahuanaco cultures are nerally recognized as being considerably pre-Inca. e cyclopean buildings of the Cuzco region have en supposed by some to belong to a pre-Inca galithic period. A detailed study of the masonry which cyclopean, megalithic, and ashlar styles are ten intimately blended, now makes it difficult to stain this view. H. Bingham's investigations at chu Picchu provide good evidence of this blending styles; but the pottery is typically Inca. In 1933 e Peruvian Government established an Archæological Institute at Cuzco in celebration of the fourth centenary of the foundation of Spanish Cuzco, and inaugurated an extensive programme of clearing, restoring and excavating on the sites of the Cuzco region.

Hitherto unknown buildings have been revealed above the citadel of Sacsahuaman, and much pottery and other artefacts have been excavated. All the architecture is purely Inca; but the Incas used different styles for different purposes, often combining two or more styles in the one building. The pottery is almost without exception of Inca types.

The use of radiophotography in the laboratory of the British Museum recently by Dr. H. J. Plenderleith and Mr. A. Digby has afforded interesting results regarding the technique of handle and spout attachment, which may prove of value in classification, dating, and tracing influences from one region to another.

Air photography has been used in recent years and led to the discovery and plotting of the 'great walls' of Peru flanking the Santa River in 1932.

Dr. Valcarcél has appealed recently for international co-operation in Peruvian archæological excavation, for which local resources are inadequate. It is to be hoped that British field archæologists will give some attention to the Peruvian area in the future, and that the study of American antiquities may be encouraged and placed on a sounder basis by the establishment of special departments for the subject in some of our universities and museums.

---

[*] From the Presidential Address to the Royal Anthropological stitute, by H. J. Braunholtz, delivered on June 27, 1939.

MARINE DEPOSITS OF THE ARABIAN SEA[*]

NVESTIGATING the many samples from 131 stations the author determines the distribution the main types of marine deposits in the Arabian a. The new data confirm the essential facts given Sir John Murray's latest chart. The transitional lobigerina ooze - red clay, however, is indicated parately on the new chart, as this mixed deposit is equently difficult to assign to one or other of the mponent types. In several cases the distribution the pelagic deposits is correlated with water ovement, as in the Zanzibar Area. The Pteropod ze in certain areas is shown to be correlated with e hydrographic conditions which cause a lack of ygen and increased salinity resulting in a high ath-rate in these molluscs. Special attention is ven to the biological remains in all the samples as evious authors have worked mainly from the ineralogical and chemical point of view. The remains organisms in the deposits have been separated out d the percentage remains of each of the common yla determined. The total percentage of remains the deposits is correlated with the depth, being gh in shallow water, low in 500–600 metres, and en rising again in about 1,000 metres. This rise the deep water is mainly due to the accumulation of Globigerina and other Foraminifera. Foraminifera are much the commonest constituents of these deposits, Globigerina being the chief genus which with other Foraminfera forms enormous areas of deep sea oozes. It is found that the green and brown muds have the largest foraminiferal fauna, and more than twice as many species occurred in the green mud deposits than in any other. In two instances only did any one species occur in great numbers—*Rhabdammina abyssorum* from a deposit of mud in the Gulf of Aden where the residue after washing consisted almost entirely of these shells, and *Dendrophrya ramosa* from a station in the Zanzibar area occurred in very large numbers.

The Priestman grab hauls give interesting results in the depth range of the larger animals obtained, and the different types of deposit are reviewed as animal habitats in the light of these hauls. It is found that green muds and the muds and sands from the lagoons are rich in life whilst grey muds and clays and light brown or yellow sands are almost without life. Certain groups are shown to live mainly or exclusively on the coarser deposits.

It is unfortunate that the coloured key to the separate chart of the Zanzibar area is very mixed up, the area of Globigerina ooze reaching out to the deep water and coloured pink being labelled Pteropod ooze, whilst the coral muds and sands are labelled Globigerina ooze and the Pteropod ooze is labelled Coral muds and sands.

---

[*] John Murray Expedition, 1933–34. Scientific Reports, Vol. 3, . 2: The Marine Deposits of the Arabian Sea; an Investigation o their Distribution and Biology. By Dr. H. G. Stubbings. Pp. -158+8 plates. (London: British Museum (Natural History), 39.) 15s.

SCIENCE NEWS A CENTURY AGO

William Murdock (1754-1839)

On November 15, 1839, William Murdock, the colleague of Boulton and Watt, died at his house, Sycamore Hill, Handsworth, at the age of eighty-five. He was buried in Handsworth Church, and his bust by Chantrey was placed there side by side with the memorials to Watt and Boulton. Murdock was born at Lugar, Ayrshire, on August 21, 1754, and after being trained as a millwright by his father, in 1777, at the age of twenty-three, entered the famous Soho works, Birmingham. In 1779 he was sent to Cornwall as an erector of pumping engines, and he remained there until 1798. Much of the success of the firm in the county was due to him. He was a man of fine physique, cool-headed, frugal, ingenious and resourceful. In those days only the principal parts of the engines were made at Soho and much remained to be done at the mine. Boulton spoke of Murdock as the finest erector he ever saw. In Cornwall, too, at Redruth, Murdock made his historic little model steam vehicle, and carried out his pioneering work on gas lighting. The latter formed the subject of a contribution by him to the Royal Society in 1808, for which he was awarded the Rumford Medal.

Returning to Soho in 1798, on the dissolution of the partnership of Boulton and Watt and the assumption of office by the sons of the founders two years later, Murdock became the presiding mechanical genius at the works, and during the next twenty years made notable contributions to mechanical engineering. The manufacture of gas-lighting plant was taken up in earnest and Soho may well be regarded as the cradle of the gas industry. Murdock also furthered the application of compressed air to machinery, constructing air motors and pneumatic lifts. His inventions included the sun and planet motion, cast-iron cement, a rotary engine, an improved boring machine, and the long D slide valve.

The United States Coast Survey

In its column of Weekly Gossip, the *Athenæum* of November 16, 1839, said: "We are glad to learn that at length some progress has been made in the survey of the coast of the United States of America—a subject of great interest to all maritime nations. So far back as 1807, a law was passed on the recommendation of Jefferson, authorizing the President to cause a survey of the coast of the United States . . . owing, however, to the external relations of the country at that period, the survey was, for a time, deferred . . . In 1832, however, it was recommenced with increased vigour. . . . From the report of the Superintendent, it appears that the work is completed throughout that part of the coast and adjacent waters lying between the eastern extremity of Long Island Sound, to the neighbourhood of Long Branch, New Jersey; and the necessary triangulations to pursue the survey have extended southerly to Cape May and northerly to Mount Carmel in Connecticut."

Ferdinand Rudolph Hassler, to whom the project was largely due, was born at Aarau, in Switzerland, in 1770 and, having made his mark as a mathematician, was engaged on a trigonometrical survey of his native country. Removing to America, in 1807 he was made professor of mathematics at West Point, and in the same year he submitted plans for a survey of the American coast. He died while directing the survey on November 20, 1843.

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned:

Director of the Geological Survey—The Secretary, C Service Commission, 45 Upper O'Connell Street, Dublin (November

Assistant in the Department of Physiology—The Secreta University College, Dundee (November 30).

Lecturer (Woman) in Mathematics—The Principal, Train. College, Lincoln.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Experimental Researches and Reports published by the Depa ment of Glass Technology, the University, Sheffield. Vol. 21, 1938. iv+342+27 plates. (Sheffield: The University.) 7s. 6d. [1

National Central Library. 23rd Annual Report of the Exe tive Committee, 1938–39. Pp. 77. (London: National Cent Library.) [1

The Journal of the Institute of Metals. Vol. 64. Edited by S. Guillan. Pp. 428+37 plates. (London: Institute of Metals.) [1

Metallurgical Abstracts (General and Non-Ferrous). Vol. 5, 19 (New Series.) Edited by S. C. Guillan. Pp. viii+1036. (Londo Institute of Metals.) [1

The National Smoke Abatement Society. Tenth Annual Rep. 1939–40. Pp. 12. (Epsom: National Smoke Abatement Society.) [

Other Countries

Berzelius-Porträtt. Illustrerad beskrivning på Kungl. Vete kapsakademiens uppdrag utgiven av Arne Holmberg. Pp. xvi+52+ plates. (Stockholm: Kungl. Vetenskapsakademiens.) [1

Indian Forest Records (New Series). Entomology, Vol. 5, No. On the Biology of *Calopepla leayana* Latr. (Chrysomelidae, Col.) the Possibilities of Control. By P. F. Garthwaite. Pp. v+237–278 plates. (Delhi: Manager of Publications.) 1.12 rupees; 2s. 6d. [1

Osiris, Vol. 7: Lettres inédites de Newton. Par Jean Pelsen Pp. 523–556. (Bruges: St. Catherine Press, Ltd.) [1

Nyasaland Protectorate: Geological Survey Department. Colo Development: Water Supply Investigation. Progress Report (No. for the Year 1938. Pp. 22+4 plates. (Zomba: Governm Printer.) [1

Annual Report of the Public Health Commissioner with Government of India for 1937. Vol. 1, with Appendices. Pp. vii 345. (Delhi: Manager of Publications.) 3 rupees; 5s. [1

U.S. Department of Agriculture. Circular No. 529: Food Hab of Prairie Dogs. By Leon H. Kelso. Pp. 16. 5 cents. Leaflet 186: Domestic Mosquitoes. By F. C. Bishopp. Pp. 8. 5 cen (Washington, D.C.: Government Printing Office.) [1

Proceedings of the United States National Museum. Vol. 87, 3068: The *Hederelloidea*, a Suborder of Paleozoic Cyclostomat Bryozoa. By Ray S. Bassler. Pp. 25–91+16 plates. Vol 87, 3070: New Turritid Mollusks from Florida. By Paul Bartsch Harald A. Rehder. Pp. 127–138+plate 17. (Washington, D. Government Printing Office.) [1

Transactions of the San Diego Society of Natural History. Vol. No. 14: Three New Worm Snakes of the Genus *Leptotyphlops*. Laurence M. Klauber. Pp. 59–66. (San Diego, Calif.: San Di Society of Natural History.) [1

Bulletins of the Zoological Society of San Diego. No. 15: A Furt Study of Pattern Dimorphism in the California Ring Snake. L. M. Klauber. Pp. 24. (San Diego, Calif.: Zoological Society San Diego.) [1

New Zealand: State Forest Service. Annual Report of the Direc of Forestry for the Year ended 31st March 1939. Pp. 37+22 plat (Wellington: Government Printer.) 1s. 3d. [1

Annual Report of the Indian Central Jute Committee for the Y 1938–39. Pp. iii+123. (Calcutta: Indian Central Jute Co mittee.) [2

Journal of the Indian Institute of Science. Vol. 22A, Part Crop Response to Chemical Oxidisers. By C. R. Harihara Iyer a R. Rajagopalan. Pp. 171–178. 12 annas. Vol. 22A, Part 14: Influen of Manganese and Iron Salts on the Oxidation of Organic Matter a Release of Plant Nutrients. By C. R. Harihara Iyer and R. Raja palan. Pp. 179–202. 1.12 rupees. (Bangalore: Indian Institute Science.) [2

Industrial Research Bureau. Bulletins of Indian Industrial Resear No. 14: Indian Refractory Clays. By H. Crookshank. Pp. vii+ (Delhi: Manager of Publications.) 1.6 rupees; 2s. [2

Annual Report for the Year 1938 of the South African Instit for Medical Research. Pp. 96. (Johannesburg: South African Instit for Medical Research.) [2

Catalogues

Association Books, including some from Kelmscott Manor, M cellaneous Recent Purchases also Botany, Gardening. (Catalog No 280.) Pp. 50. (London: Dulau and Co., Ltd.)

Brush-Koela Gas Producers. Pp. 4. (Loughborough: Br Electrical Engineering Co., Ltd.)

ditorial & Publishing Offices :
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

Telegraphic Address :
Phusis, Lesquare, London
Telephone Number :
Whitehall 8831

Vol. 144 SATURDAY, NOVEMBER 18, 1939 No. 3655

MAN-POWER AND THE NEEDS OF YOUTH

'EW features of the opening weeks of the War have received more widespread approbation n the desire manifested in our general policy conserve human life so far as possible. If loss life is inevitable in warfare, strategy and tactics ve been designed to secure objectives with the nimum of loss, and to avoid the appalling wast- which so often characterized offensives in the r of 1914–18. The announcements that the lier age groups will not be among those first led up for service with the armed forces and t the former militiamen are not to be drafted mediately to active service units, the funda- ntal idea in evacuation schemes, and even the lundancy or waste in certain branches of civil fence against air attack which have been the oject of recent criticisms, are all signs that sons of the last war are being taken to heart. is realized that the man-power of Great Britain a most precious national asset, and a serious ort is being made to conserve it.

Welcome as such signs may be, we cannot ume that the lesson has been fully learned. n-power is as precious on the home front as the field, and the uneasiness and criticism re- rding the Ministry of Supply which have found pression are indications that concern exists ether the wisest use is being made of the tion's resources in labour and skill in the bilization of industry, to meet alike the demands the fighting services for munitions and of the riad essential home needs of a nation at war. en more disquieting, however, is the postpone- nt of the raising of the school-leaving age to een years, which was to have been enforced m September 1 last.

That an Act should have been passed repealing sections one to six of the Education Act 1936 cannot be viewed without dismay. A trenchant passage in the paper by Mr. W. O. Lester Smith, director of education for Manchester, which was read before a meeting of Section L (Education) of the British Association at Dundee seems now almost like a prophetic warning :

> "One of the great social tragedies of our time is our blindness to the needs of boys and girls in the adolescent period when schooldays are over. The wanton blow struck at the day-continuation school clauses of the Fisher Act by the Geddes Axe was probably the unkindest cut our educational system has suffered ; it has prevented local authorities from making a decent job of the youth problem."

Mr. Lester Smith goes on to point out that, of our three million young people between the ages of fourteen and eighteen years of age, one third only attend any kind of school, another third belong to some voluntary organization, while the remaining third—probably those who need it most—are completely out of touch with educational or wholesome social influences. Mr. Lester Smith's argument is powerfully supported by Dr. A. E. Morgan's recent report to King George's Jubilee Trust on the needs of youth, where it is maintained that the raising of the school-leaving age to fifteen years is not enough. We cannot afford to let even the boy or girl of sixteen slip out of our care and allow invaluable human capital to run to waste. A system of part-time continued education carried on during the working day up to the age of eighteen years is essential.

We are indeed far as a nation from realizing the difference it would have made if the Fisher

Act had been in force in the post-War years, or how far the shock given to our social life by the disaster of widespread unemployment might have been broken. The exasperating picture drawn by the Unemployment Board of youth going to seed after a flourishing beginning followed by lack of attention need never have been; the boys and girls whose lives were blighted by the effect of those drifting years might have found help and strength in the development of their minds. Nation and Government alike have been lacking in imaginative insight where youth is concerned. So far from recognizing the cruel wrong done by our neglect, the Government is now withdrawing the only big educational gain of this generation, and there are even those whose first reaction to the need for economy in the financial sphere is to press for the further squandering of the most precious form of our human capital. The recent announcement of the President of the Board of Education that a special committee has been set up to deal with juvenile welfare is a welcome sign, however, that the Government is not entirely indifferent to the matter.

It is recognized, of course, that under war conditions administrative arrangements necessary to make beneficial use of the extra year at school would be difficult and that the difficulties have been enhanced by evacuation. To base suspension of the raising of the school-leaving age on financial grounds, however, is reprehensible and dangerous, betraying an indifference to fundamental values that may well cause alarm among all who are concerned to see that our war-time effort is prosecuted as effectively as possible. The contention that the elaborate machinery for exemptions would be unworkable in present circumstances is equally invalid. Recognition of the real value to the nation of raising the standard of education during the formative years would lead us rather to abandon all exemptions, as indeed most educational authorities recommended originally.

It is indeed idle to expect real progress until the nation as a whole is awake to the value of youth as its ultimate capital—the bedrock upon which alone, as Dr. Morgan remarks, we can lay the foundations of real national fitness. Then indeed we might have the courage to repair this evil and not intensify it. To impose compulsory continuation education up to the age of eighteen might indeed put a strain on industry at a time when the war demands all its energy. That, however, is not the whole truth. Even more than the
nation needs munitions, it needs capable a
intelligent human power. So far as the immedi
needs of the war are concerned, it might be t
economy to take all boys and girls out of indus
for some hours every week for education. A
loss in material output would be more th
balanced by the improvement in the men a
women on whose spirit and capacity the nati
must rely for victory.

If we regard, as we must, the permanent nee
of the nation, the argument is more power
still. None can say how many of the difficult
of the last twenty years are due to the destructi
of talent and virtue by the last war itself, to t
loss of constructive minds, imaginatively alive
the fundamental issues. But some of the di
culties are doubtless due to our persistent
difference to the nation's larger needs, our failu
to strengthen the moral and intellectual power
the electorate to meet the demands made by wo
politics on their intelligence and imagination

The discussion on education as a preparati
for industry and on education in industry befo
the British Association at Dundee afforded welco
evidence that, at least in some quarters in industr
the higher standard of education demanded in t
leaders of industry, as well as in the rank and fi
for the successful conduct of industry to-day
now recognized. The wider recognition of t
value of a sound general education is all to t
good, and equally the dependence of progress up
co-operation between industry and education
authorities is gaining recognition.

It is indeed from co-operation in this way, t
development of contacts between the education
and the industrialist,and the fuller understanding
each other's point of view, difficulties and proble
that we may expect an informed opinion to emer
powerful enough to resist short-sighted policies
economies on the part of the Government. Alrea
many industrialists are alive not only to t
importance of part-time continued education, b
also to the importance of provision for the leisu
needs of adolescents. It is for the industrialists
join hands with the educational authorities in repr
sentations against policies likely to undermi
industrial efficiency and dissipate human capit

Dr. A. P. M. Fleming's fine presidential address
Section L of the British Association, a portion of whi
is printed elsewhere in this issue (p. 852), strikes t
right note in this crisis. Industry, he conten
is not concerned with the education of its person
in a narrow sense only. It recognizes increasing

at education for those engaged in industry must characterized by broad aims and linked up-with e outside world. It has proved its willingness co-operate with education and is increasingly sirous of recruiting those well trained in fundaental principles rather than in any special branch the selected science. It is turning its attention the problem of finding suitable personnel trained undertake the increasingly difficult problems of anagement. As this problem is solved, industry ill find itself provided with leaders imbued with e realization that every industry is in fact a national service, although it may be conducted by private enterprise; and as awake to the welfare of its workers as they are to the technical efficiency of the enterprise. Such leaders will ever be vigilant against the betrayal or waste of national resources, whether in materials or in men and women. Meanwhile, it is imperative that the importance of youth as a national asset should be fully recognized, and that every effort should be made to prevent a repetition of the disastrous mistakes of the last war period in the treatment or even exploitation of youth.

PSYCHOLOGY OF WAR AND PEACE

'ar and Peace
ssays in Psychological Analysis. By Dr. William rown. Pp. xvi + 93. (London: Adam and arles Black, Ltd., 1939.) 5s. net.

THIS book left its author's hands a few months before the outbreak of war, and though he s sanguine enough to say that the events at unich in September 1938 "saved the world from r at that time, and possibly for ever", yet his ok does not on that account lose any of its real lue. Dr. Brown is a well-known psychologist of definitely marked type. He writes here as a ychologist on the subject of war and peace, and would have done well if he had adhered idly to the scientific point of view, and avoided en distant references to his political convictions. e book would probably also have gained in eight and influence if greater care had been stowed upon clear and consecutive exposition. The book consists of six chapters, three of them lected from previous publications, together with number of letters contributed to *The Times*. e author's claim that these parts in their subct-matter belong together will not be disputed, t it must be added that if they are to "fall turally into their place as stages in the arguent", the reader must to a great extent make em do so. For the most part, Dr. Brown makes mself quite intelligible to people who are not udents of abnormal psychology, but the reader ould be warned that, after many pages free m technicalities, he is suddenly informed that e may cure or improve the hysteric, the psychourotic, but the psychotic still in the main apes us".

We have said so much because we believe that psychologist has an important message on the bject of war and peace, and because we are anxious that he should be understood by the ordinary intelligent citizen. Dr. Brown holds that unless the world applies psychology to its problems, as it has applied physics and chemistry, physiology and pathology, its pursuit of peace will continue to fail. His difficulty is that the man in the street thinks he knows all about psychology, as he thinks he knows all about economics—for has he not a mind of his own, and has he not much to do with credit balances and deficits? We cannot have a nation of experts, but we ought to have a far wider appreciation of the forces that make for war. Among the most fundamental of those forces are the tendencies to self-preservation, self-assertion or aggressiveness, acquisitiveness, and pugnacity. The activity of the group mind, with partial liberation of repressed mental forces, especially under the influence of a leader, also stands out as an essential factor in leading to the outbreak of war. Such are the main positions taken up and explained in Dr. Brown's book.

If we interpret Dr. Brown aright, he would say that in spite of all that has happened since this book appeared, his views remain unchanged. When the war ends, we must begin again to seek peace and ensue it, never yielding to a belief that war is inevitable. But, he holds, we shall never secure peace by orgies of pacifist sentiment. The more hopeful way is that of understanding human nature, especially those sinister forces which lurk in the unconscious of the best of us. "The tiger is there, and the wolf, and the jackal, and the snake, and we must not forget the donkey."

We conclude by expressing the hope that psychologists of different schools will do much more than has yet been done to throw light on the dark problems of war. Meantime, Dr. Brown has courageously led the way.

THE PLANNING OF LONDON

The Government and Misgovernment of London By Dr. William A. Robson. Pp. 484. (London: George Allen and Unwin, Ltd., 1939.) 15*s*. net.

As soon as the international situation permits, there can be little question that much more time and thought than hitherto will have to be concentrated on urgent problems in home affairs, among which the government of London stands pre-eminent ; and even if international affairs are still pre-eminent, that indeed may be cited as a principal reason why this matter should receive immediate and intelligent consideration, with a view to immediate and intelligent action, for it can easily be shown to be a primary factor in national defence. Dr. Robson emphasizes this aspect with convincing force, and also very appropriately at the beginning of his book insists that the proper government of London is a question of supreme national and not only metropolitan importance.

> "A dim realisation is dawning on the public that the size, growth and development of London have nation-wide effects which are felt ultimately in the remote quarters of Great Britain ; and many people have recently become aware of the sinister military significance of the immense concentration of population, wealth, and power in London ; but so far there is little or no understanding of the connection between these matters and the general administration and planning of London government".

Again, in the last chapter, at page 459, he urges the essential need for clear recognition of the fact that London's government is a national question calling for national leadership and direction ; pointing out that nothing would be more fatal than a complacent delegation of this vital and fundamental problem to the local authorities to settle among themselves.

Dr. Robson has to deplore that for half a century or more no Government has exhibited qualities of leadership, imagination, or determination in regard to this much-needed re-organization. In fact a striking, not to say an amazing, feature of the history of the metropolis during the past hundred years is the vast number of commissions and committees of all kinds that have studied, with great trouble and expense, some aspects or other of London municipal organization—or lack of it—and made excellent and desperately urgent recommendations on overwhelming evidence ; but nothing whatever has been done ! These pages are a record of innumerable lost opportunities, of feeble drifting, of supine indifference, and of a la of courage and imaginative foresight that absolutely appalling. Doubtless the opposition vested interests, municipal or otherwise, has som times been exceptionally powerful and w organized ; and the share of the City Corporati in this respect is not too creditable. But the tr issues and their importance have been clea realized by acute observers from the time of t first emergence of the problem, long before reached its present huge and almost unmanageal shape. Among others it was thoroughly grasp by the Royal Commission on Municipal Corpor tions (second report in 1837), and by the Select Co mittee of 1838. In 1852 Mr. Toulmin Smith sa that "the present condition of this huge metropo exhibits the most extraordinary anomaly in En land. Abounding in wealth and in intelligen by far the greater part of it is yet absolute without any municipal government whateve (page 56).

Of books on London, besides innumerable Bl Books, there is no end ; and several of the mo important are given in the footnotes. Of planni and reform talk there has been likewise a swelli flood, and yet, as Mr. Pick, of the London Pa senger Transport Board has pointed out (quot on page 415): "Town-planning does not rea exist at all in London at present. What goes the name is almost idle and useless so far, and h not yet arrived at a conception of the congeries towns that make up a metropolis." Elsewhere like many others who have seriously studied t matter, fully acknowledges the need for unifi control of an aggregation of people in a sin social, economic, geographical unit. "Aggreg tion", whilst apt enough for the present hete geneous dismembered mass of London humanit is not perhaps the best term for that migh co-ordinated community which, despite politic and local differences which may persist, will breathe as one vast organism, aflame with ci ardour, and united in one common bond of mu cipal loyalty. That dream of the future shou not be long delayed in its realization ; and it m be said at once that it does not mean that local differences and governments will be who sunk and immersed in one dominating form control.

Dr. Robson's main idea, in fact, is the establis ment of a Greater London Council, which shou be the one supreme authority in an administrati area very much greater than that of the prese

C.C., and with far wider powers. It would take le charge of certain important functions where ified control is most essential, and would exercise ly supervisory powers over the local authorities matters which should preferably be left mainly der their control. There would also be a third tegory of activities which could be left wholly local control. The number of authorities, hower, would be much less than the present bewilringly numerous collection, and their respective eas would be correspondingly larger. Certain *hoc* bodies like the London Passenger Transport ard would doubtless have to remain, provided me means were established for the better codination of their functions with the general ntrol; but the county councils on London's rders would probably have to relinquish or dicate their powers which, under the new rangement, would be unnecessary and merely structive.

The book is a very fine piece of work, the result Herculean labours and research of existing terial, with much original and constructive ggestion of its own. It exhibits in a marked gree literary qualities of a high order, and the en analytical powers of a trained legal mind, gether with a sustained interest almost unique studies of this kind. Interest, indeed, is intensid both by the very special and unprecedented ture of the subject-matter and by the method of treatment. There may be differences of opinion in matters of detail, but as to the main recommendations of the author there can surely be little question or quibble among intelligent people.

The difficulties in the way of reform are doubtless formidable, but that is no ground for shirking or further postponing the issue, which presses clamorously and insistently for early action. The historical background as well as the sharply critical treatment of the present muddle and confusion show clearly enough that action of some kind is long overdue.

Among the many valuable features over which one would wish to linger there is only one of which exigencies of space will allow mention: Dr. Robson continually emphasizes the paramount need for awakening the interest of the individual elector; but not content to leave it there, he suggests several ways in which this urgent need may be supplied (pages 67, 171–73, 279, 314, 324–25, 330, 351), or indicates reasons why it is lacking. To the suggestions already made perhaps one may be allowed to add another, namely, that a smaller and cheaper version of Dr. Robson's work would perhaps more effectively reach the teeming millions of London who are most nearly concerned, as well as the general public throughout Great Britain, who also must give some thought to this vital matter of the government of London.

W. G. L. C.

INTRODUCING BIOLOGICAL PRINCIPLES

imals without Backbones
Introduction to the Invertebrates. By
lph Buchsbaum. Pp. x + 371 + 128 plates.
icago: University of Chicago Press; London:
mbridge University Press, 1938.) 25s. net.

WHEN one reads that an attempt is being made to present a zoology text-book in mple, non-technical language", one's first reion is invariably that of suspicion. In the jority of cases the authors of elementary logy text-books fall between two stools. In desire to preserve an easy and popular approach book often takes on a bias towards natural tory, and although serving to describe the bits and characteristics of many animals, is nerally lacking in morphological detail and in oretical principles. On the other hand, in der to present the academic point of view, a ok not infrequently becomes a mere comndium of technical terminology and minute ail in which fundamental issues are obscured. Fortunately (for our introductions to invertebrate zoology are very limited) this book belongs to neither of the above classes. Each group of animals is treated in such a way that it illustrates some general principle of biology or some level in the evolution of animals from simple to complex forms. In this account of the lower group of animals, Dr. Ralph Buchsbaum combines an extensive practical knowledge of the subject with that rare propensity for making the 'wood' apparent without neglecting the individual 'trees'. The sequence of the book is based on the course given to students at the intermediate grade in the University of Chicago, and the author has been fortunate in having the active collaboration of the staff of the Zoology Department there.

A particularly interesting feature of the book is the liberal supply of drawings. These, together with the numerous photographs, immediately command and later compel attention. The photographs, which are intended as a sort of laboratory exhibit and vicarious field experience, are extremely profuse—there are ninety-eight insect photographs alone—and represent a new approach in the production of biological text-books. The drawings are original, are mostly diagrammatic and have been prepared as an adjunct to the author's attempt to expound biological principles rather than to confuse the student with meticulous attention to detail; they are generally designed to convey *ideas* about structure, function, or habit. Much of the attractiveness of the book is due to these unusual diagrams, many of which are 'three-dimensional'; a tribute by the author to his sister, Miss Elizabeth Buchsbaum, for her "skilful and artistic execution of the drawings" is richly merited.

The text contributes to that clarity of outlook which is revealed by the diagrams and photograp emphasis being constantly placed upon principle involved rather than upon the de connected with it. Occasionally, with a revuls for the use of extraneous terminology, the aut carries his simplification too far; this is seen his disinclination to use zoological nomenclat as complementary to the local name. Since book is American, some of these local nar would be quite unfamiliar to British stude There are some inaccuracies, but these are r and one can readily believe that this book soon find its way to many bookshelves. That is already appreciated is borne out by the f that a second impression was printed just t months after the issue of the first.

T. H. Hawkins

MANUFACTURE OF CALCIUM SUPERPHOSPHATE

Calcium Superphosphate and Compound Fertilisers

Their Chemistry and Manufacture. By P. Parrish and A. Ogilvie. Pp. xiv + 322. (London: Hutchinson's Scientific and Technical Publications, 1939.) 35*s*. net.

SUPERPHOSPHATE is one of those chemicals that are almost indispensable to civilized man and never put by him to base uses. It commands our interest for several reasons. Its value for increasing world supplies of food and fibres has been proved on all five continents, and the annual consumption of it now exceeds sixteen million tons. It was the first so-called 'artificial' fertilizer to be manufactured on a large scale, by J. B. Lawes in Great Britain, where also its use as a simple fertilizer and as a base for 'compound' manures was first developed.

Some thirteen years ago the present authors wrote a book on superphosphate to which they gave the too general title of "Artificial Fertilisers: Their Chemistry, Manufacture, and Application", and the present work is a revised and extended version of it with a more accurate title, though even this is somewhat invalidated by the added chapter on basic slag. The subject as treated will appeal to the technician, and especially to that notable example of technical 'hybrid vigour', the chemical engineer; the language, too, is technical, and the authors themselves would not claim to have produced a rigidly scientific or a literary treatise.

The bulk of the book relates to the manufacture of superphosphate, to the plant used and the operations involved in grinding and crushing phosphatic raw material, its treatment w sulphuric acid in various types of 'den', drying, storing, handling and bagging of product. Conveying machinery is well describ and interesting data are given concerning manufacture of sulphuric acid from spent ox and the preparation of 'compounds' by mixi Apart from the omission of several kinds of fi grinding plant used in Britain or abroad, mechanical part of the subject is well done; numerous photographs and line-diagrams particularly good, whilst the sensible treatm of financial outlay and working costs is also be commended.

If the authors had confined themselves to above matters, and had expressed themselves better style, there would be nothing but pra for the book. It is no doubt owing to the l of a clear and succinct style that they se to tread on thin ice when they assert that "me phosphoric acid is a product of overheatin that "pyrophosphoric acid only occurs in s stances which have been subjected to heat", that "the calcium salts of orthophosphoric a are found in all phosphatic fertilizers. . . The same reason can scarcely be advanced for surprising statement that water combines w monocalcium phosphate to form hydrated cryst of calcium sulphate. Recent X-ray analysis shown that only a small proportion of calcium sulphate which is present in sup phosphate is in the hydrated form, so that planations based upon the old view are outmoded.

References to "concentrated fertilizers" are apt confuse the reader unless he understands the ference between those based upon ammonium osphate, like the German 'Nitrophoskas' and e English 'Concentrated Complete Fertilizers' .C.F.'s) that were first marketed in 1926 and 30 respectively, and the projected new con- ntrated fertilizers that are based upon super- osphate. The authors' sweeping statement that n the early trials the concentrated fertilizers re found less efficient than the compound anures, and their use began to decline after a w years" needs correction. Apart from a few lated failures, mainly with the American mmophos' and with 'Nitrophoska' in the United ates about ten years ago, the early trials, conducted on strictly scientific lines, were very successful. Sales of Nitrophoska increased spectacularly until the world depression in 1931, when they fell, but have gone ahead since, whilst sales of C.C.F.'s have increased continuously and markedly from the start.

Few of those who know the requirements of British crops and soils will dispute the authors' opinion that there is still scope for the greater use of fertilizers, but the suggestion that the fertilizer industry, and in particular the superphosphate industry, should be better represented in Parliament opens up, by implication, a vista of trade representation and commercial flag-waving in that august assembly which would be entirely foreign to its honoured traditions.

THE STEAM ENGINE AND ITS DEVELOPMENT

Short History of the Steam Engine
H. W. Dickinson. Pp. xvi + 255 + 11 plates.
ambridge: At the University Press, 1939.) 15s. net.

HIS is the most important work on the history of steam engines published since 1908, when . C. Matschoss's "Die Entwicklung der Dampf- schine" appeared under the auspices of the rein Deutscher Ingenieure. But whereas Dr. tschoss's work ran to two volumes each of re than 700 pages, and dealt with all types of gines, including locomotives and marine engines, . Dickinson's book is on a much smaller scale, d is devoted entirely to stationary engines.

As is well known, Dr. Dickinson spent some rty years as a keeper at the Science Museum, ndon, and the catalogue of stationary engines, ntaining information about more than five ndred exhibits, was prepared by him. But he no dry-as-dust compiler and is as interested in lives of inventors and in industrial progress as is in the machines themselves. In this volume has therefore been able to incorporate the ults of the researches of such as Mr. Rhys nkins into the early history of heat engines, the ults of his own inquiries into the lives of ulton, Watt, Trevithick and others, and a neral review of boilers, engines and turbines ce the steam engine began to revolutionize lustry in all its ramifications.

There are fourteen chapters in the book, of ich five deal with the work done in the seven- nth and eighteenth centuries, four with the gress of boilers and the reciprocating steam gines during the nineteenth century, and four th modern boilers and steam turbines. There is also a chapter on the philosophy of the steam engine. In addition, there is a reproduction of a synopsis of events in the history of the steam engine exhibited at the Science Museum, and a good index.

Though in a brief notice it is not possible to touch upon the many interesting developments in steam machinery set out in the book, many readers, we think, will find entertainment in the excellent account given by Dr. Dickinson of the Newcomen engine, which proved of such outstanding value and importance. Belidor, the celebrated French engineer and architect, said in 1739 of this engine that it was the most marvellous of all engines: "Heat is its principle of movement; in its various pipes it creates a circulation like that of blood in the veins, having valves which open and shut opportunely; it feeds itself; it discharges itself at regulated times and draws from its own work all that it needs to subsist". No less marvellous are the boilers and turbines found in the power houses of to-day, and the end is not yet.

To all the developments of the last 200 years a whole host of ingenious men have contributed, and in his well-balanced, impartial and authoritative review, Dr. Dickinson has endeavoured to do justice to all those who made contributions of outstanding merit. The portraits given in the book are those of Papin, Smeaton, Watt, Evans, Trevithick, de Laval, Rateau, Parsons, Curtis and Ljungström. These were the pioneers of the reciprocating engine and of the turbine; but between these groups of pioneers were scores of notable inventors to whose labours attention is directed in the text. Altogether this history should prove a most useful book.

ONE HUNDRED YEARS OF MICROSCOPY

The Royal Microscopical Society

By Prof. R. Tanner Hewlett

THE Microscopical Society of London, now the Royal Microscopical Society, was founded in 1839, and it was proposed to celebrate its centenary this October with a special meeting. This function has been postponed for the present, but papers on the progress of microscopy during the last hundred years, contributed to celebrate the occasion, will be published in ensuing numbers of the Society's *Journal*.

In the earlier part of last century, microscopy was beginning to attract considerable attention, and not only among men of science, for public exhibitions with the microscope were given in London about 1833. This development owed much to improved instruments and to improvements in the lenses about this time. The first English achromatic lenses for the microscope were made by Tulley, an instrument maker of Islington, in 1825, at the instigation of a Dr. Gurney. Then in 1830, J. Jackson Lister, father of Lord Lister, devised improved formulæ for "working [achromatic] object glasses of short foci and large aperture, with a view to increase the power and ease of manufacture", and his paper did much to stimulate the production of better microscopes and their more extended use.

In 1839, several votaries of this new science of microscopy lived in Wellclose Square, near Tower Hill, including J. S. Bowerbank, authority on sponges, N. B. Ward, of "Wardian glass-case" fame, Edward Newman, the entomologist, and the brothers Edwin and John Quekett, whose name is perpetuated in the Quekett Microscopical Club. These and several others met at Edwin Quekett's house on September 3, 1839, and on a proposal by Bowerbank decided to form a society for "the promotion of microscopical investigation, and for the introduction and the improvement of the microscope as a scientific instrument"—aims which it has always been the endeavour of the Society and its fellows to fulfil. In December of that year, the Society came into being, with Richard Owen as its first president, Ward as treasurer and Dr. Arthur Farre as secretary. J. J. Lister was one of the original members, and Michael Faraday joined in 1841 and remained a member until his death. The Society was incorporated by Royal Charter in 1868, during the presidency of James Glaisher, and the reigning Sovereign has since been its patron.

Owen delivered his presidential address February 1841, on "The Structure of Fossil Tee from the Old Red Sandstone indicative of a n Genus of Fishes (*Dendrodus*)". Of the roll eminent men who followed Owen as presidents the Society may be mentioned John Lindley t botanist, Thomas Bell and George Busk, zoologis W. B. Carpenter, John Quekett the histologi W. Kitchen Parker, H. C. Sorby the spectroscopi Lionel Beale, W. H. Dallinger, E. M. Nelson, C. Hudson, Lord Avebury, Sir Ray Lankester a Sir J. Arthur Thomson.

During the first forty years of its existence, t proceedings of the Society were published succe ively in certain journals, but since 1878 the Socie has issued its own *Journal*, which in addition its proceedings, contains abstracts of the worl literature on microscopy. The Society maintai an extensive library and a cabinet of more th 20,000 representative microscopical specime including many 'type' specimens of diatoms a other forms of minute life. It also possesses unique collection of historical instruments.

The following brief survey of communicatio appearing in the Society's *Journal* will serve give some idea of the contributions made fellows to microscopy, though representing but fraction of the matter contained therein. Referen to articles by living fellows, which have appear during the last few years, is also omitted, wi one or two exceptions.

Dealing first with the microscope and its acc sories, an outstanding achievement was t formulation in 1858, with subsequent revisio of a standard screw-thread for objectives, n universally adopted by makers all over the worl As a result, an objective by any maker will fit t nose-piece of any microscope. The Society h likewise drafted specifications for the sizes of ey pieces and sub-stage fittings which have be generally adopted.

In 1854, F. H. Wenham contributed a paper "The Application of Binocular Vision to t Microscope", and described his binocular mic scope, and J. W. Stephenson described his "ere ing" binocular microscope in 1870. T. Maltwo in 1858 designed his "finder" for registering t position of objects mounted on a slide, and t description of the construction of an iris diaphrag was given by J. H. Brown in 1867. A malachit reen cell for monochromatic illumination was escribed by J. W. Gifford in 1894, and the glass-d illuminator by J. W. Gordon in 1907, and eith Lucas in 1904 designed a stand in which eometric slides replaced the usual planed nes.

Numbers of papers are to be found on microopical optics, to which E. M. Nelson made otable contributions, and about 1879 the question f lens-aperture and of microscopical resolution ccupied much attention, and numerous papers ere devoted to these subjects. In that year, bbe defined "numerical aperture" as we now nderstand it, and stated that for immersion puroses cedar-wood oil had proved the most suitable uid.

In 1865, Huggins and Browning first dealt with e application of the spectroscope to microscopy, d later H. C. Sorby contributed much to microectroscopy, incidentally, in his presidential ddress to the Society in 1870 surmising the ssible existence of "invisible germs", thus ticipating by some thirty years any positive nowledge on ultra-microscopic organisms.

There are naturally many contributions on hoto-micrography, commencing with a paper On the Application of Photography to the Reprentation of Microscopic Objects" by Joseph elves in 1853.

As in the "brass and glass" department, as we reverently call it, so a vast amount of material as been contributed on the biological side. iatoms, presenting as they do problems in the terpretation of the microscopical image, and as eing a most interesting group, both fossil and ving, have always been a favourite subject of udy, and are dealt with in numerous papers by allich, Greville, Kitton, Petit, Flögel and others. he Foraminifera have also been much studied; arly papers on the group were contributed by . Rupert Jones, and more recently by H. B. rady and F. Chapman, together with the notable apers by F. M. Millett on Malay forms, and by eron-Allen and Earland on the Selsey, North ornwall, North Sea and other species. Rotifers re likewise the subject of numerous papers by . T. Hudson, P. H. Gosse, V. Gunson Thorpe, ames Murray, C. F. Rousselet and others. T. H. uxley contributed a study of the rotifer *Lacunuria socialis* in 1853.

The Infusoria are dealt with by Saville Kent, . T. Hudson, Dallinger and Drysdale and Dallinger. The latter, in 1880, determined the thermal eath-point of monads in natural surroundings o be for the mature forms about 140° F. Dallinger n 1887 also worked on the gradual acclimatization f certain monads to increasing temperatures, and as able finally to maintain them without harm at a temperature of 155° F. E. M. Crookshank and H. G. Plimmer dealt with parasitic flagellated Protozoa. The mites are the subject of a number of papers by A. D. Michael, which deal with their structure and taxonomy and with new species, and Rupert Jones wrote on the Entomostraca and Saville Kent on siliceous sponges.

Parasitology is represented by several communications, commencing in 1849 with one by George Busk on the guinea-worm parasite of man. He remarked that infection is derived from water and that the worm is always female in its attributes; statements that stand to-day, for even now the male is almost unknown.

On the botanical side, contributions on the Bacteria are relatively scanty, probably because microscopy is rather subsidiary to culture methods for their study. There are, however, papers by R. L. Maddox on bacteria in the air and in rain-water and hail, and on lactic ferments, by E. M. Crookshank on Actinomyces and by Cheshire and Cheyne describing *B. alvei*, supposed to cause foul brood of the honey bee. In 1884 Lionel Beale described the microscopical examination of twenty-five samples of Thames mud, taken between Gravesend and Chelsea, for the presence of bacteria, determining their relative numbers at the various localities, and he remarked that if only the vast quantities of water in the upper Thames in time of flood could be husbanded for times of scarcity, there would be ample water to flush London's sewers and to keep the lower Thames from being fouled—surely a presage of the later work of the Metropolitan Water Board.

Many new micro-fungi were described by G. Massee, and other papers on this group were contributed by Miss Lorrain Smith and A. Chaston Chapman. Freshwater algæ are dealt with in many papers by A. W. Bennett and W. and G. S. West, and the bog mosses by R. Braithwaite. There are also many papers on vegetable structure, pollens, cytology and chromosome structure, and W. Carruthers and D. H. Scott dealt with the microscopical anatomy of fossil plants.

There are a goodly number of papers on animal histology, notably by John Quekett, Lionel Beale and C. da Fano, and W. Kitchen Parker contributed several studies on the development of the skull in birds, etc. In 1849, R. Warington described a new medium for mounting organic substances as permanent microscopical objects; this was glycerin, and he outlined the method of sealing the mounts with various varnishes. R. J. Farrants, president in 1861–62, devised the well-known Farrants' mounting medium.

There is no space to record many other important contributions, particularly those on the technical applications of microscopy to iron and steel, clays, petroleum, fabrics and fibres, and others, and to medical science. Many of the subjects referred to in this account are discussed more fully in the papers contributed in honour of the Society's centenary, which, as mentioned, are to be published in the Society's *Journal*.

In conclusion, we may express the belief that the Royal Microscopical Society has throughou its history sedulously pursued studies associate with problems of microscopic structure an function, and has contributed in no small measur to the development of the microscope as a scientifi instrument, and to its applications in science an industry.

EDUCATION FOR INDUSTRY*

By Dr. A. P. M. Fleming, C.B.E.,

Metropolitan-Vickers Electrical Co., Ltd.

THE evolution of industry involves a continual change in the character of the knowledge that must be applied by those engaged in it, if they are to achieve a continually increasing efficiency of production. How important this question of efficiency is to the whole community of an industrial nation may not always be appreciated. The material progress of civilization demands an increasing supply of manufactured products of all kinds. If they are manufactured at home, employment is increased and money is available for circulation. This affects eventually all the community and not merely those workers directly engaged in industry. It is therefore of vital importance that the transformation we speak of as industry shall be conducted with the utmost efficiency, and to achieve this the personnel engaged in it must be most effectively trained; which in its broadest sense means most effectively educated.

Industrial personnel can be divided into two main groups: manual and non-manual workers. The first requirement of the manual worker is practical handicraft skill, and of the non-manual worker specialized knowledge applicable to the function he performs in the particular branch of industry concerned. To satisfy these requirements well-organized schemes of theoretical and practical training must be made available to all those fitted to take full advantage of them.

There are four main classes of entrants into industry, namely, those who enter at the school-leaving age from elementary, junior technical, central and secondary schools; those from secondary schools who have attained School Certificate or Higher School Certificate standard; those who have had university training; and those adults who enter at any age and from any educational level. Of the first three classes, the university group contains the smallest proportion of misfit At the lowest entry level, economic need an local conditions of employment may, and usuall do, determine the choice of vocation. In additio there is still considerable social prejudice in favo of the so-called 'black-coated' occupations. Th importance of vocational guidance in the earl years cannot be too highly stressed, and althoug good work is being done in this direction muc more is needed; it should in fact be accepted as responsibility by every competent teacher. Su acceptance implies, of course, familiarity wit local conditions and opportunities. One usef adjunct might be the keeping, from school ent age onwards, of a record of the particul characteristics, aptitudes and preferences displaye by the pupil. Such a record would be of conside able value at the time when discrimination made between secondary, junior technical ar junior commercial schools.

For those entering industry at the lowest sta there is, at present, little conscious preparati for industry from the educational point of vie other than that in the junior technical schools. Th practical industrial bias given in these schools, f at least the final two years, is of definite advantag A much greater proportion of junior technic school pupils who enter industry advance rapid than is the case with their fellows not so educate Indeed the tendency is for many of them to recruited to the ranks of foremen, junior manage draughtsmen and so on, with the result that t equally important field of artisanship is not ve well fed numerically from this source. Records one factory, compiled over a period of years, sho that whereas 64 per cent of the entrants fro elementary schools became artisans, less th 10 per cent of the entrants from junior technic schools did so, in the same period.

The type of industrial training required for t manual worker who aspires to learn a trade acquire a craft consists of a long period of practi

---

* From the presidential address to Section L (Educational Science) of the British Association, delivered at Dundee on August 31.

perience with the tools, materials and processes
his chosen trade or craft, and accompanying
ssroom education which may be secured by
ening study in a local part-time institution, by
rt-time day training, or in a works' school
ring working hours. The character of these
dies varies considerably, but it is becoming
reasingly desirable that they should lead to
tional Certificates, as a course of this type
vides sufficient basic technical knowledge.
oreover, it provides a good basis for further
dy for the youth who is worthy of promotion.

For those youths who do not aspire to technical
ployment and whose natural bent is of a
re practical character, the workshop courses
vide an admirable adjunct to their practical
perience.

Those who enter industry at the School Certificate
Higher School Certificate level have usually had
advantage of a preliminary science preparation,
ich facilitates their acquisition of industrial
cess experience. Moreover, their higher general
cational level makes it possible for them to
ain staff positions where their more maturely
eloped powers of judgment and their social
ributes are of advantage.

Those who enter after university training have
eady acquired a considerable amount of know-
ge of the technological and fundamental
nciples required in the particular branch of
ustry they select. A high degree of specialization
this stage is extremely undesirable. It is of
greater value to be well versed in the funda-
ntal principles of the selected and associated
ojects. Indeed the latest tendency in industry
for any specialized training that may be required
be provided by the concern itself a year or two
er entry.

Much attention is now being devoted to the
oblem of finding suitable personnel trained to
dertake the increasingly difficult problems of
anagement. This is a matter of vital importance
ensuring continuity of progress in manufacturing
ncerns. It is essential that the selected men
ould be given preliminary and widely applied
sponsibility before making use of such aids as
ancillary instruction now available in many
hnical institutions.

Recruitment for research work in industry is
other case where the selection of personnel
erently suited for such work must be the basic
tor. Methods of training research workers are
ginning to evolve, but so far no recognized plan
established. In my own laboratories, general
prenticeship in the factory is followed by
perience in several of the laboratories under the
idance of experienced research workers, supple-
nted by lectures on the work in their own and associated fields by senior members of the department. In some cases such workers are sent back to a university or other research laboratory for further experience.

There is a natural tendency to concentrate attention on those engaged in some form of handicraft skill or technical operations for which particular education and training are required. It must not be overlooked, however, that there are vast numbers of young men and women engaged in clerical and other branches of employment in industry. For the most part, however, their education and training can be adequately satisfied by the existing facilities.

The normal trend of industry and its corresponding educational requirements can to some extent be forecast, though contingencies arising from an abnormal international political situation may disturb this.

New scientific knowledge with its technical application is likely to continue to be a determining factor in industrial development. Continual improvement in efficiency of production tends to reduce the amount of labour required, and to that extent accentuates the unemployment problem. On the other hand, out of scientific discoveries new products, processes and materials arise, and these, through the formation of new industries, contribute towards redressing the balance of employment. The film and the radio industries may be cited as examples of large-scale employment brought about by the technical application of scientific discovery. Such developments, however, emphasize the need for mobility and adaptability on the part of the personnel employed, because new industrial activities demand modifications to established handicraft technique as well as to the planning and organization of production.

It is apparent that the mechanization of processes, more particularly where repetitive work is involved, will become more extensive, and this should ultimately result in the securing of the necessary volume of production in shorter working periods—especially if employment could be more evenly distributed. Some of the time then available for additional leisure might be well employed in education of a cultural and social character and in physical training. By suitable planning it should be possible to reduce and eventually to eliminate the system of part-time evening study. The deficiencies of this system of technical education for those engaged in industry are well understood, but whether technical study is conducted in part-time day or part-time evening periods, the practice of compressing a large amount of highly specialized knowledge into intensive courses should be avoided.

While appreciating the present usefulness of courses such as those leading to the Higher National Certificate, particularly to those young people who have no other means of acquiring the basis on which to proceed to technical employment, such courses should, in a planned educational system, be considered as expedients only. They provide neither the time for original, critical, or constructive thought, nor the means of developing latent personal qualities by any form of social and corporate life; and above all it is important to encourage educational methods which develop ability to think independently rather than simply to add to a store of knowledge. That so many young people succeed by the existing methods is a tribute to the individual rather than to the system.

Certain industrial activities, notably those associated with supplies such as water, gas and electricity, are easily recognizable as public services. As time goes on there will be a growing realization that every industry is in fact a national service, although it may be conducted, as at present, by private enterprise. Considered in this light, the importance of employing every means of increasing the efficiency of industry becomes apparent. The conventional system of education is subject to control by national and local educational authorities; but there is no control over the equally important practical side of education for the industrial worker. No national means exist whereby a standard can be set for this phase of education, nor in fact are the resources for training in industry fully utilized.

The *laissez-faire* methods whereby the quality and extent of practical education of industrial personnel depends on a relatively few progressive industrial concerns compare unfavourably with the planned and more efficient methods that are possible in authoritarian countries. Under present conditions this weakness can be remedied only by more complete voluntary co-operation within industry. Such co-operative effort would relieve the burden that now falls upon a few individual firms. An effective way of stimulating this might be the remission of income tax on the money expended on such training. Control could be instituted by restricting the remission to courses approved by a suitably constituted authority.

The establishment in industrial firms of separate 'nursery' workshops in which the fundamentals of handicraft skill and machine operations are taught concurrently with the appropriate workshop instruction will become more widespread. A few schemes of this type are already in operation in private firms and in a number of Government establishments in Great Britain, while the method has been extensively developed in Germany and to a lesser extent in other countries.

The result of introducing manual training at early age, such as exists in the educational syste in the U.S.S.R., will be watched with much intere In contrast to this, with the raising of the scho leaving age, the tendency in Great Britain will for young people to enter industry for practic training at progressively increasing ages. T may involve a more intensive period of practic training, but the difficulties of this should be offset the greater maturity of the trainees concerned, whi the longer period of general education will ensu

An educational problem that is already acu and will be even more so in the future is the supp of suitable teaching staff for the universities a technical institutions. Formerly much of t scientific and technical development relating industry came from the universities. Due larg to the establishment of large-scale research industrial concerns and to the great expansion their technical staffs, the initiative in progress h passed to industry, and many scientific work who previously found their vocations in acade life are now attracted to scientific and techni employment in industry. The result is that in th faculties in which the work has a technologi bearing, there is a great shortage of person available for teaching, so that the time is opportu for the technical institutions and universities consider a long-term policy as regards selecti and training those who will eventually beco the academic leaders.

The practical industrial side of this training of paramount importance. In this connexi co-operation should be arranged with industry provide a suitable range of practical experien without the permanent absorption of the person so trained. Industry has already shown willingness to co-operate with education in t respect by providing short 'refresher' courses those in academic employment who have lit opportunity of maintaining close contact w industrial developments. The technical knowled and experience of eminent technologists in indust might well be utilized more completely than present by co-opting such men to the professor staffs of universities and technical colleges, a thus augmenting, for special courses, the existi teaching facilities. New technical processes n arise so rapidly from scientific discoveries a become so promptly established in industry th the text-books used for teaching purposes c never be completely up to date. The introducti of post-advanced courses in the Lancashire ar appears to be the correct solution to this proble These courses, which comprise short series lectures on specific technical subjects, are giv mostly by experts in industry and are conduct on a basis of exposition and discussion.

The greater availability of technical scholarships id fellowships might well serve as a means of tracting suitable personnel to industrial employent. The extension of fellowship facilities vailable for those who seek experience abroad extremely valuable, particularly if these are warded to men who have already had sufficient xperience to know definitely in what particular irections they wish to supplement their existing nowledge. In the past, many educational pportunities of this type have not been used to the st advantage due to the immaturity of those ceiving the awards, who have not had sufficient perience to appreciate fully that educational and dustrial methods can never be transferred wholly om one country to another because social and onomic conditions differ. Some industrial ganizations have established research fellowips, whereby university staffs can spend ne in industrial research organizations, which ovides experience of inestimable value to e fellowship holder on his return to ademic life.

As yet there is no clearly defined and assured th by which a youth can proceed through the rious stages of education into industrial employent. The national system of education provides e means whereby those of suitable ability can tain education and training up to and including e university or technical college level, but the actical training in industry and an assured start a job is at present fortuitous. In this direction ere is room for greater co-operation by industry ensure the completion of the industrial training and a start in the chosen career. Such an arrangement would give direction and impetus to the various stages of preparation between school or college and industry, would cut down some of the time spent in obtaining what may be unnecessarily detailed technical knowledge, and moreover would relieve both the youth and his parents of a good deal of anxiety.

Greater co-operation than at present exists between education and industry is essential in regard to the syllabuses of workshop and technical studies appropriate to the educational level at which entrance into industry is made. Equally also, co-operation in needed to ensure the adequacy and up-to-date-ness of the laboratory and workshop equipment of the technical institutions and universities.

In this address I have purposely stressed the technical aspects of education for industry, since these to a considerable degree serve also as a basis for the industrial education of the personnel in those branches of industry not directly of a technical character. In so doing I am acutely conscious of the risk that, speaking as an industrialist, I may convey the impression that industry is concerned with the education of its personnel in a narrow sense only. This is far from being the case. All education should be on the most liberal lines, and even to meet the urgent needs of industry no technical specialization should be permitted which excludes the possibility of time being devoted to broadening the mind and equipping the individual to play his part most worthily in the community in which he is placed.

GAS PRODUCERS FOR MOTOR-CARS

THE appearance on a road in the London district of an omnibus with a trailer carrying gas-producing apparatus to provide gas as fuel r its engine is a spectacular event which marks important stage in mechanical propulsion in reat Britain. Although the method is by no eans new, its adoption, even if only on an perimental scale, by a responsible authority on e of its public services, raises it from the category the practically neglected to a position as one the recognized possible alternatives to the use liquid fuel. The trailer is not an essential part the apparatus, and as soon as practical details ve been settled by experience it will be possible embody the gas producer in the vehicle so as to nstitute a self-contained unit; but in the case of e existing pattern of omnibuses there is no surus space in which such an apparatus can be placed. In the case of the private car or delivery van, there is usually room for the required size of gas generator and little difficulty need be experienced in mounting it and its accessories quite conveniently.

In the issue of NATURE of May 6, p. 771, some notes were published on a paper read before the Institute of Fuel by Goldman and Clarke Jones entitled "The Modern Portable Gas Producer" (*J. Inst. Fuel*, 12, 63, Feb. 1939). The authors argued in favour of official recognition of portable gas producers as a means of supplying power for motor-vehicles. Now, nearly twelve months later, the argument for recognition is greatly strengthened, for economists have assured us that transport is the life-blood of modern conditions. Yet now transport is greatly restricted and, for lack of petrol, many cars have been laid up indefinitely or their use limited. The possibilities claimed for this new method of power production, therefore, deserve fuller examination, and, as the fuel is home-produced, those who require a greater degree of use of their cars can consider its adoption. In our earlier article, the process of gasification was described and readers may now wish to have information regarding the British-made apparatus referred to in the paper.

This plant has been successfully mounted on private cars of medium power, on transport and other vehicles, and is so designed as to require no special skill on the part of the driver. A supply of fuel is dropped into a hopper placed above the generator, where a moderate fire is maintained and a gas of high calorific value produced. The gas is cooled by the air going to the generator, to which some steam is also supplied in order to keep the temperature below the ash fusion point, thus eliminating a possible source of trouble. On its way to the engine the gas is passed through a cleaner to remove dust. Photographs reproduced in the paper show the complete apparatus as fitted to a Humber car, a Bedford lorry, and to a tractor hauling a plough, and in each case the addition has been effected without inconvenience or unsightliness. The first lighting of the fire—a matter of no great difficulty—takes ten or twelve minutes, and it does not require to be relit afresh each day. The hopper is charged occasionally with fuel, and this can be done without stopping th engine.

Suitable fuels, such as anthracite or one of th low-temperature cokes—for example, coalite- although abundant, are certainly not so con veniently obtainable as was petrol in ordinar times. This difficulty would be overcome, but i any event users could easily store ample suppli if the authorities granted permission. As regar operating costs, the claim is made that the advan tage lies with the gas producer. On the basis the prices of a year ago, the total operating cos for a 1½-ton vehicle making a weekly round 600 miles would be £11 10s. per week when petr is used and £9 17s. in the case of the gas produce It may therefore be seen that the system practicable and not necessarily expensive.

Official approval of a form of gas produc was conveyed by an announcement made by th Secretary of Mines in the House of Commons la week. He said that the Government, recognizi that in time of war it is clearly in the nation interest to make the best possible use of hom produced substitutes for imported oil, had son time ago set up a committee to consider th problems of such gas producers. As a result, n only has the use of producer gas been sanctione but concessions have also been made to ensure th users do not suffer disadvantage in making th change-over.

OBITUARIES

Prof. A. A. J. de 'Sigmond

It is with great regret that we record the death of Prof. Alexius A. J. de 'Sigmond, professor of agricultural chemistry and technology and soil science in the Royal Hungarian Palatine-Joseph University of Technical and Economic Sciences of Budapest, and formerly director of the Royal Hungarian Institute of Chemistry and Central Experimental Station at Budapest. Coming of an old aristocratic Transylvanian family, he found himself at the end of the War of 1914–18 compelled to choose between his work which lay in Hungary or his estates which were in the country ceded to Rumania. He decided for his work.

To English men of science de 'Sigmond was best known through his investigations on the alkali soils in Hungary, which he described in publications of the Imperial Bureau of Soil Science and the University of California Press. Although there were certain special features about these soils, he had carried out his researches on broad lines, which made the results particularly interesting and helpful to those engaged on soil improvement, reclamation, and similar problems in many other parts of the world, especially the semi-arid regions. His other important bran of study was soil classification, which he dealt wi at length in his book on soil science ; this was writte in Hungarian, but in somewhat abbreviated form was translated into English by Dr. Yolland und the title "The Principles of Soil Science". H classification had the double merit of being comprehensive and based on the chemical compositic of the soil : it was not intended to be final, but satisfactorily filled a number of gaps in other system It has not been universally adopted, nor indeed ha any as yet ; but it represents a distinct addition knowledge on a very difficult and important subjec

Prof. 'Sigmond was a regular attendant at meetin of the International Society of Soil Science, of whic he was an honorary member, and he was always a we come guest in any international group by reason of h wide linguistic abilities and broad sympathies. H was a man of great personal charm and artistic taste he was very fond of music ; and altogether a goo type of the cultured aristocracy of central Euro now unhappily fast disappearing, to the great loss our civilization.

E. J. Russell.

Dr. J. D. Comrie

DR. JOHN DIXON COMRIE, a well-known Edinburgh hysician and medical historian, whose death took lace on October 2, was born on February 28, 1875, he son of Dr. J. D. Comrie. He was educated at eorge Watson's Academy and the University of dinburgh, where he qualified M.B. with first-class onours in 1899, becoming F.R.C.P. (Edin.) in 1906 nd M.D. in 1911. After holding resident appointents at the Edinburgh and Glasgow Infirmaries, e attended post-graduate courses in Berlin and ienna, and was clinical assistant at the National ospital, Queen Square, London, before settling in ractice at Edinburgh, where he successively became athologist, assistant physician and full physician to e Royal Infirmary as well as consulting physician the Deaconess Hospital and the Princess Margaret ose Hospital for Crippled Children, Fairmilehead, dinburgh. During the War of 1914–18 he was onsulting physician to the North Russian Expedionary Force, with the rank of Lieutenant-Colonel, A.M.C.

Dr. Comrie's literary output was considerable. In ddition to his principal work entitled "The History f Scottish Medicine", of which the first edition ppeared in 1927, and the second, enlarged to two olumes, in 1932, he contributed many articles on edico-historical subjects to the *British Medical ournal*, *Edinburgh Medical Journal*, *Archiv für eschichte der Medizin* and the *Proceedings of the nternational Society of the History of Medicine*, at e congresses of which he was a well-known figure. n recognition of his valuable work on medical history e was appointed reader in the history of medicine the University of Edinburgh, honorary fellow of e Italian Society of the History of Medical Science, nd president of the Section of the History of edicine at the meetings of the British Medical ssociation at Edinburgh in 1927 and Winnipeg in 930.

In addition to his original work and his consulting ractice, Dr. Comrie was frequently engaged in an ditorial capacity, being editor of the Edinburgh eries of Medical Text-books, the selected works of . Sydenham, Black's "Medical Dictionary", and nce 1938 of the *Edinburgh Medical Journal*. His nfailing courtesy and kindness endeared him to all ho knew him and particularly his co-workers, by hom he was elected vice-president of the Royal ollege of Physicians of Edinburgh, chairman of the cottish Committee of the British Medical Association, nd president of the Royal Medical Society of dinburgh.

J. D. ROLLESTON.

Dr. Walther Horn

THE death of Dr. Walther Horn on July 10 last n his sixty-eighth year removes a familiar personality from the world of entomology. Although ssentially a worker in taxonomy who held very efinite views on its principles, his interests covered wider field, and he worked for the good of entomology s a whole.

A very regular attendant and contributor at international congresses, Horn became personally known to a wide circle of European and American entomologists. For nearly fifty years he was a student of the Coleoptera, becoming the world authority on the family Cicindelidæ. A few years before the War of 1914–18 he became director of the newly founded Deutsches Entomologisches National-Museum in Dahlem, and devoted great energy in bringing it up to its present status and efficiency. The Museum suffered a severe setback by the advent of the War. Horn was called up for military service and, in this period, he exercised his original profession of a doctor. During the supervening period of inflation, the funds of his Museum dwindled away, and it was only by his untiring courage that things were kept together. By soliciting small sums from his friends in other lands, and by taking advantage of favourable monetary changes, he gradually acquired the means of saving his Museum from ruin. In 1921 its character underwent change and its name was altered to that of the Deutsches Entomologisches Institut, with affiliation to the Kaiser-Wilhelm Gesellschaft in Berlin. Its primary function became bibliographical rather than the maintenance of collections.

At the time of his death, Horn, in collaboration with Dr. Hans Sachtleben, edited three periodicals which were extensively used as a medium for procuring current literature for the Institute by way of exchange. During 1935–37 the publication of Horn's "Entomologische Sammlungen" was a notable effort wherein he recorded the history of all scientifically important insect collections from the time of Linnæus onwards.

Horn's singleness of purpose, coupled with wide travel, linguistic ability and cordiality towards men of all nations, made him many friends. He was able to free himself from some of the binding force of national limitations and, thereby, played a part in promoting international amity among co-workers that will be hard to replace.

A. D. IMMS.

WE regret to announce the following deaths:

Dr. Arthur P. Beddard, chairman of the Pharmacopœia Commission, formerly lecturer in medicine in Guy's Hospital, London.

Prof. R. A. Craig, professor of veterinary science in Purdue University, an authority on the diseases of pigs, on October 12, aged sixty-seven years.

Mr. J. A. Fulton, director of the Mackay School of Mines of the University of Nevada, on October 9, aged sixty-one years.

Prof. H. O. Knight, professor of anatomy in the University of Texas, an authority on the anatomy of the hand and foot, on October 5, aged fifty-eight years.

Dr. R. A. Sampson, F.R.S., astronomer-royal for Scotland during 1910–37, formerly professor of mathematics and astronomy in the University of Durham, on November 7, aged seventy-three years.

NOBEL LAUREATES

Prof. R. Kuhn

Prof. Richard Kuhn, who has been awarded the Nobel prize for chemistry for 1938, is Viennese by birth and a pupil of Willstätter. He has been head of the Department of Chemistry of the Kaiser-Wilhelm Institut für Medizinische Forschung in Heidelberg since the Institute was opened in 1930, and, after the death of von Krehl, was made director of the Institute in 1937. Kuhn's work does not consist of one single great achievement, although he has made important contributions to many problems in organic and biochemistry. His early work was concerned with enzymes and with stereochemical problems. He has done important work on the polyenes, of the general formula $C_6H_5(CH = CH)_n C_6H_5$, which he was able to synthesize up to $n = 15$. It was thus possible to gain information on the behaviour of long chains of conjugated double bonds, which are also of interest in other fields of work such as photographic sensitizers.

Kuhn has also worked out the synthesis of a new class of chemical compounds, the cumulenes. This work led up to a synthesis of vitamin A, which was preceded by investigations on the constitution of carotene. He recognized at about the same time as O. Warburg that the prosthetic group of a yellow ferment which is responsible for the degradation of sugar phosphoric acid esters is present in vitamin B_2. With the synthesis of lactiflavine-5′-phosphoric acid, he achieved the preparation of the active group of an enzyme. Through the application of boric acid in the condensation with alloxan, he was able to increase the yield up to about 90 per cent of the theoretical value. His most recent work is concerned with the chemical nature of sex substances necessary for the copulation of gametes of various algæ. Specific carotinoids, such as crocin and *cis*- and *trans*-crocetin-dimethylester, are essential for the mobility of the Protozoa under anærobic conditions and for the process of copulation. Prof. Kuhn is well known in Great Britain, and he delivered the sixth Pedler Lecture of the Chemical Society in 1938, when he discussed the synthesis of polyenes.

Prof. A. Butenandt

Prof. Adolf Butenandt, who shares this year's Nobel prize for chemistry with Prof. L. Ruzicka, is well known in Great Britain. For a number of years Prof. Butenandt held the position of *Privat Dozent* in the Department of Chemistry of the University of Gottingen under Prof. A. Windaus. There can be little doubt that his association with this laboratory, the work of which had been devoted to the elucidation of the structure of the sterols for so many years, played an important part in his success in determining the constitution of œstrone. It was while he was at Göttingen that Aschheim and Zondek made their classical discovery of the presence in the urine pregnancy of large quantities of œstrogenic materia It was found to be in a purer state and more subje to processes of purification than when extracted fro the ovaries or follicular fluid. The large-scale commercial collection of this material in Germa rendered available in 1928 quantities of startin material. To Butenandt fell the task of elucidatin the structure, and in 1929 he succeeded in obtainin the compound in a crystalline form.

The announcement was made simultaneously wit that of the independent discovery of a crystallin material by Doisy in the United States. Marrian Great Britain had also obtained a crystalline substance, but it was found later to be of a differen constitution from the crystals of Butenandt a Doisy. The work of Butenandt on the seleniu treatment of œstrone resulted in the demonstratio of the presence of the phenanthrene ring system, an a classical paper on this was communicated to meeting of the Chemical Society held in London March 1933. Later Butenandt worked on the constitution of the male sex hormone. He isolate androsterone in the crystalline form and proved i constitution, and his work on progesterone and oth derivatives of the sterols forms the background this important development in chemistry. He le Gottingen to take the chair at Danzig, and was f a few years professor of chemistry in that Universit Some two years ago he was appointed director the Kaiser-Wilhelm Institut of Biochemistry Berlin, which position he now holds. Many of ou readers will remember the three lectures Pro Butenandt delivered at the London School of Hygien and Tropical Medicine in 1936, lectures which we noted for their clarity of style and for their excellen delivery in faultless English.

Prof. L. Ruzicka

Prof. L. Ruzicka, professor of chemistry in th Federal Technical Highschool of Zurich, has a lon record of brilliant investigations in the field of pu organic chemistry. Without doubt, however, th present award is mainly on account of his developmen of the degradation synthesis of hormones from sterol It will be remembered that the workers at Göttinge devoted many years to the elucidation of the structur of the side-chain of the sterols, it being well know that these could be removed by appropriate chemic treatment. The recognition of the structure of progesterone, testosterone, corticosterone and othe highly active hormones of the steroid group le organic chemists to attempt their synthesis. Th formidable nature of this task will readily be appreciated, since not only is the cyclopentenophenanthrene system, with double bonds, polar groups an so on, an extremely difficult object for syntheti iok, but also there is an almost infinite number of eo-chemical isomers due to the presence of lohexane rings. It occurred to Ruzicka that the ; system of the sterols might provide the basis for synthesis of hormones, and he therefore chose a ol with a suitable stereo-chemical configuration the ring system and removed the side chain by dation. This provided a most important basis for synthesis of the hormones, and by suitable nipulation of double bonds, conversion of hydroxyl ups to keto groups, and so on, it was possible to duce from a neutral sterol such as cholesterol the hly potent hormone testosterone. It can be said t the recognition of this principle has solved the blem of hormone production, quite apart from its at theoretical interest. Prof. Ruzicka has been a quent visitor to Great Britain; his addresses are ed for their clarity and for their wit.

f. E. O. Lawrence

HE announcement of the award of the Nobel ze for physics for 1939 to Prof. E. O. Lawrence, fessor of physics in the University of California, Berkeley, will be received by physicists ywhere with approbation. Lawrence's early arches were concerned with photo-electric cts but, in 1930, he became interested in possibilities of using the method of resonance eleration in order to obtain positive ions of very h energies, by means of a number of consecutive elerations through relatively low differences of ential. The method of linear resonance accelera- was pushed to its practical limit in Lawrence's oratory when, in 1934, mercury ions were obtained ing energies equivalent to accelerations through otential difference of nearly three million volts, g, however, applied potential differences having eak value of only 79,000 volts. The limitations of method of linear resonance acceleration in its lication to the acceleration of ions of small mic mass had, however, been recognized by vrence in 1930, in which year he proposed a modition of the method for such ions. This consisted in elerating the ions back and forth between two i-cylindrical hollow conductors, the paths of the ions being rendered circular by means of an intense magnetic field. Thus was conceived the magnetic resonance accelerator, or cyclotron as it is now more generally called.

At that time, it was somewhat generally considered that the practical difficulties involved in the cyclotron were of a magnitude likely to preclude the translation of this conception into terms of practical physics. All the greater then, was the tribute to be paid to the experimental genius of Lawrence when, little more than a year later, he announced the success of the method in obtaining light ions of high energy. His success was acclaimed on both sides of the Atlantic, by the awards of the Comstock Prize of the National Academy of Sciences in 1937 and, in the following year, of the Hughes Medal of the Royal Society, the latter being given for "the most important instrument of physical research since the C. T. R. Wilson expansion chamber". Later, however, Lawrence's interest turned rather towards the vast field of physiological research to which the cyclotron, with its prolific output of radioactive indicators, had opened up a new approach. Important results in nuclear physics continued to pour from the Radiation Laboratory at Berkeley, but at the same time a new side was being developed, and the physiological effects of neutrons and the metabolism of phosphorus and iron, and of like elements which could be obtained in a radioactive form, were being exhaustively studied. Not to Lawrence's laboratory alone was this work confined, his generosity providing for scientific workers in many places in America and in Europe as much radioactive material as they could conveniently use. Lawrence is not only a respected director of a research laboratory but, above all, a valued friend of those who have worked with him.

The 1939 Nobel Prize for literature has been awarded to N. Frans E. Sillanpää, the Finnish novelist. His novels are based chiefly on the peasant life of Finland. The Nobel Prize for Physiology and Medicine for 1938 was awarded to Prof. C. Heymans, and that for 1939 to Prof. G. Domagk (Nature, November 4, p. 777).

NEWS AND VIEWS

al Medals of the Royal Society

His Majesty the King has been graciously ased to approve the recommendations made by Council of the Royal Society for the award of two Royal Medals for the current year as follows: f. P. A. M. Dirac, F.R.S., Lucasian professor of hematics in the University of Cambridge, for the ling part he has taken in the development of the quantum mechanics; Prof. D. Keilin, F.R.S., ok professor of biology and director of the Molteno itute in the University of Cambridge, for his contributions to biochemistry and entomology, in particular for his demonstration of the part played by cytochrome in the oxidation reduction mechanisms of the living cell, and for his studies of the higher Diptera.

Centenary Celebrations in New Zealand

In December 1642, Europeans first discovered New Zealand, although they mistook its general character. A century and a half later their mistake was rectified by Captain Cook. His reports attracted traders and whalers, but lawlessness, arising from "the absence of necessary laws and institutions", led, a hundred years ago, to bringing the islands under the sovereignty of the Queen of England. It is the centenary of this event which New Zealand began to celebrate last week when a great exhibition was opened at Wellington. It is fitting in a new country that prominence should be given to the natural resources of the country, forests, farm lands, and minerals, and to the means which have led to their exploitation, of which the development of methods of transport has been pre-eminent. Two thirds of New Zealand's land is now 'occupied', for the most part not by great landowners but by persons holding less than 320 acres. It is these European settlers who have developed the resources of their country in such a way as to minimize the disadvantages of isolation from the great consuming centres of the world. Happily the economic exploitation of the country has not been accompanied by a disappearance of the native people, for the sixty thousand Maoris live in friendly co-operation with the Europeans and enjoy full social and political equality. This successful experiment in State-building will be worthily celebrated in New Zealand throughout the coming year, and it must be a matter of regret that the war, which has, once again, brought out the loyalty of the Dominion, should have prevented more active participation in this event by citizens from other parts of the British Commonwealth.

Politics and Academic Qualifications in Germany

RESTRICTIONS on academic freedom in Germany, already sufficiently stringent, are to cut more deeply still into the roots of intellectual development. According to the Berlin correspondent of a Copenhagen newspaper, quoted in *The Times* of November 13, the German censorship will see in future all scientific works written for doctors' degrees. This, it is said, is intended to guard against the introduction of theories offending against Nazi doctrines in politics, law, literature, and the population policy. In view of the distorted interpretation of certain scientific and historical facts which alone is acceptable officially in Germany to-day, it might be thought that any further bar to research or freedom of thought would scarcely be necessary to render any approach to originality innocuous. In order, however, to ensure that orthodoxy, or at least what is regarded as such, shall prevail over any attempt at a scientific and dispassionate examination of fact, which might lead to conclusions at odds with officially approved conclusions, decision as to the fate of any given thesis will not rest with an academic body, which at least might be expected to bring a trained and instructed intelligence to the examination of the bearing of an argument and the value of its evidence, but with the censorship. No thesis will even be submitted for scientific examination until it has passed the censor. Regimentation thus strikes at the very root of intellectual development and scientific training. These must no longer be concerned with the search for truth in the investigation of the facts of Na
and history in both the broad and narrower se
but only with the fanatical application of a selec
theory dictated by political prejudice.

Horrocks's Observation of the Transit of Venus

THREE hundred years ago on Sunday, Noven
24 (O.S.), 1639, the young Lancashire curate Jere
Horrocks, and his friend William Crabtree, the
at Hoole, near Preston, and the other at Brough
near Manchester, observed the transit of Ve
across the sun's disk, and thus, as Robert Grant s
"did two young men cultivating astronomy toge
in a state of almost complete seclusion in one of
northern counties of England enjoy the privileg
witnessing a phenomenon which human eyes
never before beheld and which no one was desti
again to see until more than a hundred years
passed away". At Broughton the sky had been o
cast most of the day, but fortunately cleared jus
time for Crabtree to see the transit. At Ho
Horrocks had watched from sunrise until his du
called him to church. At 3.15 p.m., when again f
he resumed his observations, when, as he wrote, '
most gratifying spectacle! the object of so m
earnest wishes, I perceived a new spot of unu
magnitude, and of perfectly round form, that
just wholly entered upon the left limb of the sun
that the margins of the sun and the spot coinci
with each other, forming the angle of conta
Owing to the approach of sunset, he was unabl
observe the planet longer than half an hour,
during this period he measured its distance from
sun three times. His younger brother Jonas
Liverpool was prevented from seeing the transit
account of cloud.

HORROCKS, in 1639, was about twenty-two y
of age. The son of a farmer, he was born at Tox
Park, Liverpool, and was taught the classics b
country schoolmaster. He was already "a very cur
astronomer" when on May 15, 1632, he ente
Emmanuel College, Cambridge, as a sizar. T
years later he left the University without takin
degree, but at home he again began his astronom
observation. Through the antiquary Christop
Towneley (1604–74) he began to correspond w
Crabtree, his senior by about seven years, and t
became fast friends. At the suggestion of Crabt
Horrocks abandoned the study of Lansberg for t
of Kepler, and set about revising the Rudolph
Tables. Early in 1639 he became curate at Ho
and there made his calculations regarding Ve
Having set down his observations in a manusc
entitled "Venus in Sole Visa", he resolved to v
Crabtree. Three letters dated October 3, Decem
12 and 19, 1640, referred to this intended visit,
it was on the back of the last that Crabtree wrote t
his friend had died on January 3, 1641, being the v
day previous to that he had planned for the vi
Crabtree appears to have survived him a very sh
time. Owing to the Civil War, the name of Horro
was for the time completely forgotten, but his ma

t, with others, had been preserved and was nately published. Nearly two centuries passed re any memorial was raised to him whom Herschel d "the pride and boast of British astronomy". 1826, however, the Preston astronomer and urer Moses Holden (1777–1864) devoted the eeds of a lecture to the erection of a tablet to rocks in St. Michael's Church, Toxteth, Liverpool; 859 a memorial chapel and window were added Hoole Church; and after the transit of 1874 a ement was set on foot which resulted in the ing within the monument to Conduitt, Newton's hew, in Westminster Abbey, of a scroll recalling great achievement of Horrocks in 1639.

ust Kundt (1839–1894)

November 18, the centenary occurs of the inguished German physicist August Adolph ard Eberhard Kundt, the successor of Helmholtz erlin. Born at Schwerin, Mecklenburg, he studied eipzig under Hankel, Bruhns and Neumann, and Berlin under Encke and Förster, first devoting self to astronomy. Entering the laboratory of nus, in 1864 he graduated with a thesis on polarization of light. He became a *Privat ent* in Berlin in 1867 and then was successively essor of physics at Zurich Federal Technical hschool (1868), at Würzburg (1870), and at sburg (1872), where he took a prominent in the organization of the new university; this he became rector in 1877. Finally, in 3, he was chosen to succeed Helmholtz in the r of experimental physics and as director of the sical Institute at Berlin. He died at Israelsdorf Lübeck on May 21, 1894, a few months before nholtz. His original researches were mainly in domains of light and sound. By an ingenious hod he was able to determine the velocity of d in various gases. In light, he made inquiries the problems of anomalous dispersion by liquids vapours and by very thin films of metal. 'Kundt's nomenon' is the rotation observed, under the ence of magnetic force, of the plane of polariza- in certain vapours and gases. For his experi- ts on dispersion by metal films he made no fewer 2,000 prisms prepared by electrolytic deposition n platinized glass.

Georges Dieulafoy (1839–1911)

ROF. GEORGES DIEULAFOY, a celebrated Paris sician, was born on November 18, 1839, at louse, where his uncle, Paul Dieulafoy, was pro- or of clinical surgery in the medical faculty and ced him to become a doctor. After acting as his e's house surgeon for two years, he went to Paris omplete his education and spent seven years as ital resident under Trousseau, Velpeau, Denon- ers, Jaccoud, Potain, Axenfeld and Tardieu. He lified in 1869 with a thesis on sudden death in oid fever. In 1872 he became an assistant pro- or (*agrégé*) with a thesis on contagion, and the wing year published a medico-chirurgical treatise he diagnosis and treatment of morbid fluids in which he described the aspirator to which his name has been given. In 1880 appeared the first edition of his famous "Pathologie de médecine interne", which in the course of thirty-one years went through sixteen editions and was translated into English, Italian, Spanish, Russian, Polish and Greek. Six years later he was appointed to the chair of internal pathology at the Necker Hospital, where he remained until 1896, when he succeeded Germain Sée at the Hôtel Dieu as professor of clinical medicine; he held that office until his retirement in 1909. During this period he published a number of clinical lectures in six volumes under the title of "Clinique médicale de l'Hôtel Dieu de Paris". In 1910 he was elected president of the Academy of Medicine, of which he had been a member since 1879. His death took place on August 16, 1911, at the age of seventy-two.

The Newcomen Society

THE annual meeting of the Newcomen Society was held on November 8, when Col. C. E. Davies, secretary of the American Society of Mechanical Engineers, was elected president for the ensuing year. Col. Davies for many years acted as corresponding honorary secretary in the United States for the Society. The annual report referred to a further large increase in membership, the total number of members on October 1, 1939, being 1,252. Twenty-five papers were contributed during the year, while in England a summer meeting was held in Suffolk and in the United States a pilgrimage was held in Alabama. For the information of members a *Newcomen Quarterly Bulletin* is now published. The finances of the Society continue to remain in a satisfactory state and the issue of a fifth *Extra Publication* is under consideration. Though for the time the monthly meetings have been suspended, papers are being sent in for the *Transactions*. At the close of the business, the retiring president, Mr. W. A. Young, read his presidential address on "Thomas Newcomen—Ironmonger: the Contemporary Background", and Dr. T. E. Lones read "A Précis of Metallum Martis and an Analysis of Dud Dudley's Alleged Invention".

Statistics of London

THE latest volume of "London Statistics," that for 1936–38 (London: P. S. King and Son, Ltd., 15*s*. 6*d*.) raises once more in an acute and realistic form some of the most vital and interesting questions in social science and economics and in practical statesmanship that we of the present generation have to face. Among them not the least significant are those concerned with population movements to and from the London area and within that area. The population of this Greater London increased during 1937 by 80,000, and numbered 8,655,000 before evacuation, as compared with 7,000,000 for New York. This huge total is about double that of the administrative county over which the L.C.C., has partial control and from which there has been continuous migration since 1901. In that year the population of the administrative county was 4,536,267, but it has steadily declined, so that in 1938 it was 4,062,800. This has involved among other things difficult readjustments in educational facilities, especially elementary schools; for the decrease in elementary school children from 900,000 in 1915 to 543,000 in 1937 is very much greater proportionately than that in the total population. In this connexion it is interesting to note that, of the 50,000 children leaving elementary schools in 1937, 89 boys and 127 girls were described as of "super-normal" mental condition.

The subject chosen in this volume for special analysis is libraries. In the year ended March 31, 1938, 40,116,733 books were issued to borrowers from public libraries in Greater London, and 20,175,088 from libraries maintained by local authorities in extra-London. In addition there were 2,078,559 issued from public libraries in extra-London under county council control. In the administrative county alone, issues of books have risen from 14,512,112 in 1928 to 19,941,654 in 1938, the number per registered borrower increasing from 29·3 to 31·1. For some reason or other, Woolwich heads the boroughs in respect of reading—as measured by use of public libraries—whilst St. Pancras is at the bottom of the list. Readers have 2,431,832 books from which to choose, and they borrow three novels for every non-fiction work.

Recent Comets

An I.A.U. telegram from Copenhagen announces that Comet Faye has been discovered by Jeffers at Harvard on November 3 at 4h. 1m. U.T. Its position is given as R.A. 20h. 13m. 28·3s., S.Dec. 10° 18′ 15″, and it is described as diffuse with central condensation. In the "Handbook of the British Astronomical Association", 1939, the elements and ephemeris of this comet have been computed by Messrs. W. P. Henderson and P. J. Harris, who applied the perturbations of Jupiter and Saturn. Perihelion passage is given as April 23, 1940, but it will be apparently half a day later. A comet was discovered by Frien at Harvard on November 4 at 13h. 30m. Its position is given as R.A. 16h. 52·9m., N. Dec. 34° 03′. The daily motion is +7m. 30s. in R.A. and −10′ in Dec. It is described as diffuse without central condensation or nucleus. Nothing is stated about its magnitude.

Engineers' Study Group on Economics

An emergency programme to meet the difficulties occasioned by the war has been issued by the Engineers' Study Group on Economics. Consideration of the problems which followed the War of 1914–18 has led to the view that, while the first effort must be directed towards winning the present war, attention must be given in good time to plans for reconstruction, so that practical proposals may be ready when required. The Group has accordingly resolved to make a special study of reconstruction, dealing particularly with such problems as demobilization, industrial change-over, agricultural chan international trade, paying for the war, etc. Th interested are asked to communicate with the Gr at 35, Gordon Square, London, W.C.1.

Announcements

The annual Huxley Memorial Lecture of Royal Anthropological Institute will be delivered November 28, at 2.30 p.m., at 21 Bedford Squa W.C.1, on "Charity and the Struggle for Existenc by Dr. R. R. Marett.

The Tilden Lecture of the Chemical Society be delivered by Dr. L. E. Sutton on December at 2.30 p.m. in the Society's rooms. The title of lecture will be "The Present State of Vale Theory".

A paper on the "Penetration of Rays through Skin and Radiant Energy for the Treatment Wounds" will be read by Sir Leonard Hill, at Royal Society of Arts, on November 22 at 2.30 Applications for tickets should be made to Secretary, Royal Society of Arts, John Str Adelphi, W.C.2.

The following have been elected officers for 1 of the Mineralogical Society: *President*, Mr. Art Russell; *Vice-Presidents*, Prof. C. E. Tilley, Dr. Campbell Smith; *Treasurer*, Mr. F. N. Ashcro *General Secretary*, Dr. G. F. Claringbull; *Fore Secretary*, Sir Thomas H. Holland; *Editor of Journal*, Dr. L. J. Spencer.

The following appointments and promotions h recently been made in the Colonial Service: C. Johnston, chemist, Department of Science, Barbad F. H. Ormerod, agricultural superintendent, G Coast; V. D. Van Someren, zoologist, Cent Veterinary Research Institute, Kenya; H. Waters, director of agriculture, Kenya, director agriculture, Gold Coast.

Mr. G. M. Harvey, deputy electrical inspecto mines, has been appointed electrical inspector mines, with effect from November 1, in succession Mr. J. A. B. Horsley. Mr. Horsley is undertak special duties for the Mines Department during war, more particularly in connexion with the org ization of the electrical supplies required for working of mines and quarries. He will also compl so far as possible, the work in connexion with revision of the existing code of safety regulati for coal mines.

The Geological Society of London announces t the eighteenth session of the International Geolog Congress, which was to have been held in Lon during July 31–August 8, 1940, is postponed definitely.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 869.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

estigation of Cosmic Ray Showers of Atmospheric Origin, using Two Cloud Chambers

JSING two simultaneously operated cloud chambers, have investigated the occurrence of large cosmic showers originating high in the atmosphere[1], and transition behaviour of these showers in absorbing terial. The cloud chambers were 28 cm. in diameter h an illuminated depth of 4 cm. (chamber I) and m. (chamber II) respectively. The counters used select showers and so to operate both chambers re all situated around chamber I, there being none und chamber II. The whole apparatus was uated beneath a light roof.

In the first experiments, chamber II was placed at rizontal distances of 5½ m. and 19 m. from chamber and observations over a period of 250 hours were de at each separation. The frequency with which wers selected by the counter array at chamber I tended to the distant chamber II is shown in ble 1. The third and fourth columns give the rate which showers reaching the stated particle density *both* chambers were observed. Portions of a single wer are thus frequently to be found over a distance 5½ m., but to a much smaller degree over a tance of 19 m.

BLE 1. CHAMBERS SEPARATED 5½ M. AND 19 M. HORIZONTALLY

hower density Vo. of particles per 100 cm.²)	Chamber I (rate per hr.)	Chambers I and II simultaneously (rate per hr.)	
		5½ m apart	19 m. apart
> 1	0·39	0·069	0·025
> 3	0·177	0·024	0
> 6	0·082	0·012	0
>10	0·049	0·004	0
>20	0·020	0	0

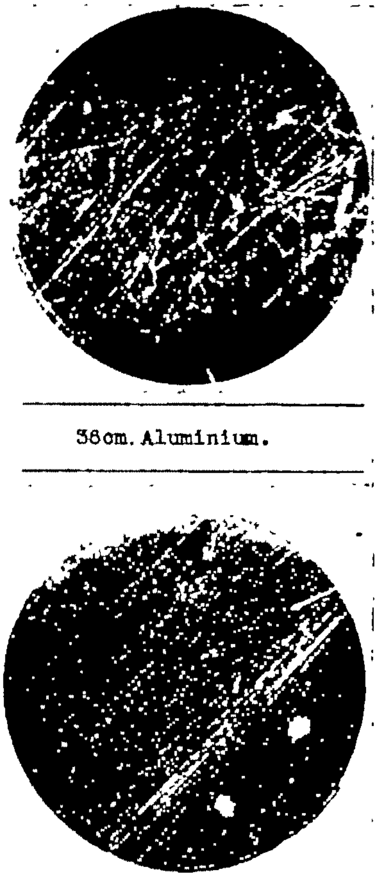
BLE 2. CHAMBER II 120 CM. VERTICALLY ABOVE CHAMBER I

terial between chambers—(i) 36 cm aluminium, (ii) 3 cm. lead. ning time of experiment—(i) 278 hr., (ii) 182 hr.

Particles in lower chamber (I)	Number of photographs			
	Aluminium Total	Aluminium 5 or more tracks in top chamber	Lead Total	Lead 5 or more tracks in top chamber
> 2	143	12	131	11
> 5	85	10	75	9
> 10	41	5	40	6
> 20	12	3	19	3
> 40	2	1	4	1
>100	1	1	1	1

Particles in lower chamber (I)	Percentage of showers in lower chamber associated with 5 or more tracks in top chamber	
	Aluminium	Lead
> 2	8 per cent	8 per cent
> 5	12 ,,	12 ,,
> 10	12 ,,	15 ,,
> 20	25 ,,	16 ,,
> 40	50 ,,	25 ,,
>100	100 ,,	100 ,,

In a second series of experiments, chamber II was placed vertically above chamber I at a distance of 120 cm. Absorbing layers of (i) aluminium (36 cm.) and (ii) lead (3 cm.) were placed immediately above the lower chamber (I), and the relation between atmospheric showers detected in chamber II and the shower phenomena in chamber I was investigated. Table 2 shows the extent to which showers of a given size below the absorber are the result of entrant showers with a certain minimum particle density. For both aluminium and lead, the largest showers result from fairly dense groups of particles entering at the top of the absorber. The average multiplication taking place for atmospheric showers in these thicknesses of material is small (about twice), and so we may conclude that the dense parts of showers have almost reached equilibrium.



A DENSE SHOWER UNDER 36 CM. ALUMINIUM WHICH HAS DEVELOPED FROM A LARGE ATMOSPHERIC SHOWER. THE SEPARATION OF THE TWO CLOUD CHAMBERS IS MORE THAN 1 METRE

Experiments by Nie[2] have been interpreted[3] as evidence for the occurrence of large showers in light materials by an explosive process. We find, however, that both in lead and in aluminium the large showers are the product of only a slight multiplication of pre-existing shower groups. The relative frequency of such showers in lead and aluminium will depend largely on the size distribution and energy spectrum of the incident showers. Little is yet known of these factors, but it is clear from the small average multiplication involved, and from the form of the cascade spectrum in air, that large showers will be relatively much more frequent in the light elements than is indicated by the cascade theory applied to a single entrant particle.

The photograph shows a portion of a large shower below 36 cm. aluminium derived from a large atmospheric shower above the absorbing layer. We estimate that the complete shower contains at least 40,000 particles, and so has a lower limit of energy of 10^{15} e-volts.

A. C. B. Lovell.
J. G. Wilson.

Physical Laboratories,
University of Manchester.
Oct. 10.

---

[1] Auger, Maze and Grivet-Meyer, *C.R. Acad. Sci.*, 206, 1721; 207, 228 (1938).

[2] Nie, *Z. Phys.*, 99, 453 (1936)

[3] Euler and Heisenburg, *Ergebn. exakt. Naturwiss.* (1938).

Evaporation of Mist Particles and its Bearing on Air Sterilization

During the determination of particle size distribution in various germicidal aerosols, a qualitative correlation was noticed between the biological activity and the persistence of the droplets in the field of the ultra-microscope. The instrument was therefore adapted for the determination of evaporation rates; the disappearance of a selected particle was followed by successive measurements of its fall under gravity, its position being restored after each by a screw which displaced the cell contents upwards. Provisions were also made to follow the particle throughout its wanderings in the horizontal plane. It was then possible to watch a single particle for an indefinite period limited only by its complete disappearance or by physical fatigue in the observer.

A number of phenolic germicides have been examined, in solution both in polyhydric alcohols and non-hygroscopic solvents, such as water and benzyl benzoate.

For the most part, droplets of the binary mixtures examined behave like pure substances in giving a straight-line relation between velocity of fall and time[1,2,3], and therefore between surface area and time, over the greater part of their lives. For example, resorcinol-water mixtures appear to evaporate at a constant rate $\left(\frac{ds}{dt} = \frac{\delta \text{ surface area}}{\delta \text{ age}} = \text{const.}\right)$ which is independent of the concentration and also of the initial particle size over a range 5–50 per cent resorcinol, 0·5–2·5 μ radius. But it can scarcely be taken that such mixtures evaporate at constant composition irrespective of what this is, and, in fact, improved technique has shown that it is not necessary to assume this; in many cases it has been possible to observe a very rapid initial evaporation during which an unknown amount of the solvent is removed, and even with such a high boiling solvent as ben benzoate, this phase is complete in about ten secon when it contains as much as ten per cent of a sol of volatility similar to its own. Generally, the cha in slope of the evaporation curve is so large and sharp that there is nothing indefinite in the divis into stages. The second stage in the evaporat follows the straight line law already mentio $\left(\frac{ds}{dt} = \text{const.}\right)$, and when the particle has beco quite small, there may or may not be a slowing according to the volatility of the solute or presence of impurity. (But there are many anoma in behaviour at this stage; for example, 5 per c glycerol in water (weight in weight) particles evapor completely according to the straight-line law down a radius not greater than 0·05 μ.)

As a result of the initial stage in the evaporati it is not generally possible to estimate the composit of particles when they are under observation, a with volatile solvents it may be remotely differ from that of the parent solution. Ternary mixtu behave in a more complicated way, and by obser tions over a range of initial concentration and droplet size, it is sometimes possible to ded qualitatively the changes in concentration on evapo tion of mixtures of this type. Thus particles resorcinol-glycerol-water mixtures having radii than 1 μ after passing the initial stage begin to l more resorcinol than water, and this continues do to a very small size.

It is found that solutions of phenols in a relativ inactive solvent like benzyl benzoate have a n persistence which is anti-parallel with the volati of the solutes, whereas with hydroxylic solvents t is not always the case, and the anomalies are down to chemical association between the substan present.

Bacteriological experiments have been carried by workers in the biological section of th laboratories on the solutions which we have examin and we are grateful for permission to quote th results.

It was evident from the start that the germici activity of a mist is far more dependent upon volatility of its particles than upon their Ride Walker value. Experiments with highly vola substances, such as phenol, confirmed Bechho contention[4] that their vapours are generally inact against bacteria in suspension; only when the amo of germicide atomized was more than enough saturate the available air space was any kill obtain

Germicidal mixtures of phenol and volatile solv only were roughly divided into three classes.

(*a*) Highly volatile solute: No kill observed unl the air is saturated with respect to the germici Effect dependent on vapour pressure, and not Rideal-Walker value.

(*b*) Volatile solute: A kill occurs over a sh period, after which no further effect is obtained unl the air is saturated. Effect dependent on Ride Walker value to a large extent, since all the must take place in the limited life of the droplets

(*c*) Involatile solute: Almost independent Rideal-Walker value (for example, 50 per c calcium chloride, in water, Rideal-Walker value than 0·05, gives a better result than phenol wh dispersed). The lethal effect extends over a v long period, and some effect is noticeable at enorm dilutions (greater than $2 \cdot 5 \times 10^{10}$ c.c./gm. in case) with a fine mist, if sufficient time is allow se classes correspond roughly to the three stages a typical complete evaporation curve.

t is hoped that a more detailed report of this k will shortly be published.

S. R. Finn.
E. O. Powell.

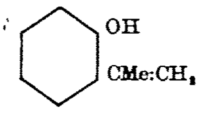
ortslade Laboratories, Ltd.,
South Street,
Portslade.
Oct. 12.

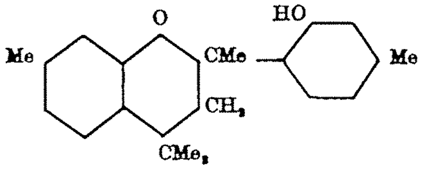
ibl, *Ann. Phys Chem*, 7, 888 (1883).
rso, *Proc. Amer. Acad. Arts and Sci.*, 45, 363 (1910).
ngmuir, *Phys. Rev.*, 12, 368 (1918).
chhold, *B.P.*, 472,623.

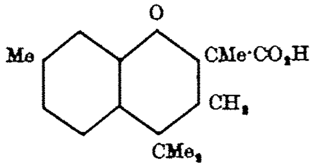
---

tructure of the Dimeric Forms of *o*-*Iso*propenylphenols

-Hydroxy*iso*propenyl compounds, for example readily polymerize to dimeric forms on long


(I)


(II)


(III)

nding or on treatment with hydrogen chloride[1]. se dimerides can be distilled under diminished ssure and are generally resinous at ordinary temature, but they yield well crystalline *mono*acetyl ivatives, and contain only *one* free hydroxyl up. They exhibit only extremely feeble phenolic perties, are saturated, and depolymerize when tilled under atmospheric pressure. A study of the eric form of *iso*propenyl-*m*-cresol (I)[2] has shown t it yields on vigorous oxidation with potassium manganate a stable carboxylic acid, $C_{13}H_{17}O.CO_2H$, degradation of a *m*-cresyl group to a carboxyl up.

)nly one very improbable structure has been prosed for these dimerides[3]; this contained an olefinic k, and was based on a formula for a condensation duct of *m*-cresol and acetone now known to be orrect[4]. There appears to be only one structure sistent with the above facts and with theoretical uirements. Solely on valency considerations, there fourteen monohydric phenols (excluding those taining a 4-membered ring fused to an aromatic cleus) which could be produced from two molecules an *o*-hydroxy*iso*propenyl compound such as (I) by mutual addition of the two *iso*propenyl groups d ring closure to a saturated cyclic ether. Of these uctures, four may be rejected on stereochemical unds as they contain 7- or 8-membered oxygen gs, and seven because they do not involve the symmetrical addition of the two *iso*propenyl ups, as occurs in the polymerization of styrenes d related compounds; the first step in the densation is regarded as the formation of a $\text{Me}_2.\text{CH}:\overset{(+)}{\text{C}}\text{Me}.$ or less probably $.\text{CMe}_2.\text{CH}_2.\overset{(+)}{\text{C}}(:\text{CH}_2).$ dge between the two aromatic nuclei[5]. Finally, o of the remaining three possibilities may be minated because in ring closure an oxygen atom st unite with the more cationoid of the two saturated carbon atoms (marked with (+)), double bonds being polarized owing to the jacent phenolic group. In the case of either intermediate the ring closure, therefore, leads to 2′-hydroxy-2 : 4 : 4 : 7 : 4′-pentamethylflavane (II), which must represent the dimeride of *iso*propenyl-*m*-cresol.

This structure adequately accounts for the cryptophenolic properties by the presence of the grouping $.\text{C(O.)Me.CH}_2.\text{CMe}_2.$ in the *ortho* position to the hydroxyl; the group $.\text{CMe}_2.\text{CH}_2.\text{CMe}_2$ even para to a phenolic hydroxyl group renders it extremely feebly phenolic. The acid, 2 : 4 : 4 : 7-tetramethylflavane 2-carboxylic acid (III), would not be expected to undergo further ready oxidation.

The structures of the dimeric forms of other *o*-hydroxy*iso*propenyl compounds must be analogous to (II), and there can be little doubt that the dimeric forms of cyclohexenyl-*m*- and *p*-cresols[6] are similarly constituted.

A full account of this work will later be published elsewhere.

Wilson Baker.
D. M. Besly.

Dyson Perrins Laboratory,
University of Oxford.
Oct. 7.

[1] Fries, K., and Fickewirth, G., *Berichte*, 41, 368 (1908); *idem*, *Annalen*, 362, 42 (1908); Fries, K., Gross-Selbeck, W., and Wicke, O., *Annalen*, 402, 306 (1913); Schering-Kahlbaum A.-G., Eng. Pat., 273,684 (1927); Jordan, H., Eng. Pat., 279,856 (1929). There is some doubt as to whether the substances described by G. Guillaumin, *Bull. Soc. Chim.*, [4], 7, 378 (1910), and by J. B. Niederl, R. A. Smith and M. E. McGreal, *J. Amer. Chem. Soc.*, 53, 3390 (1931), as the dimeric form of *iso*propenyl-*m*-cresol are really this compound.

[2] Eng. Pat., 273,684 (1927); Baker, W., and Besly, D. M., *J. Chem Soc.*, 199 (1939).

[3] Jordan, H., Eng. Pat., 279,856 (1929). This structure has been accepted by F. Boettcher, Dissertation, Berlin (1930).

[4] Baker, W., and Besly, D. M., *J. Chem. Soc.*, 199 (1939).

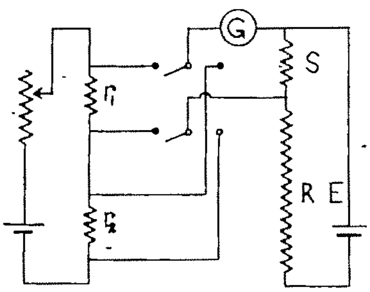
[5] Compare structure of a dimeric form of anethole, Goodall, G. D., and Haworth, R. D., *J. Chem. Soc.*, 2482 (1930).

[6] Boettcher, F., Dissertation, Berlin (1930).

Comparing Resistances of Four-Terminal Resistors

In a letter in Nature of September 30, Mr. Arvon Glynne describes an elegant and simple method for the comparison of four-terminal resistors. In it, as he points out, two of the 'potential' leads have to carry a small current. I would like to direct attention to another method, almost as economical in apparatus, in which no current passes in any of these leads. Resistors of about 1/1000 ohm can be compared in this way with an accuracy of one part per thousand, using apparatus ordinarily available in a laboratory. The principle will be evident from the accompanying diagram.

A low-resistance storage cell *E* supplies current to the circuit *R*, *S*; and *R* is adjusted so as to obtain zero deflection of the galvanometer *G*, first with the resistor r_1 and then with r_2 in circuit. If good storage cells are used in both circuits, steady balances are



readily obtained. In practice, S is given such a fixed value (which need not be known precisely) that R will be several hundred ohms, or more, for either balance. Under these conditions, the resistance of the cell E will be quite negligible and

$$\frac{r_1}{r_2} = \frac{R_2 + S}{R_1 + S}.$$

This principle has, obviously, other applications; for example, to thermo-couple measurements, in view of the low values possible for the resistances of S and G.

JOHN J. DOWLING.

Department of Physics,
University College,
Dublin.

Decomposition of Hydrogen Peroxide by Catalase

In a recent letter[1] Johnson and van Schouwenburg dispute Keilin and Hartree's observation[2] that catalase activity depends on the presence of oxygen. In their reply, Keilin and Hartree[3] point out that the experiments of Johnson and van Schouwenburg are only qualitative and therefore not conclusive.

Soon after the publication of Keilin and Hartree's paper[2], we attempted to repeat their experiments, following all their directions as closely as possible, but with negative results. Our experiments were carried out in Warburg manometers with a purified catalase from red blood cells and with an enzyme from cucumber seeds prepared according to Zeile[4]. To ensure complete absence of oxygen, the manometers were gassed with purified nitrogen until no oxygen could be detected by the ferrous pyrophosphate method in control experiments. No difference was found in the rate of the decomposition of hydrogen peroxide in presence or absence of oxygen. The non-enzymatic decomposition was controlled in experiments with heat-inactivated enzyme and was certainly not larger than in the experiments of Keilin and Hartree.

The successive oxidation and reduction of catalase was first suggested by Haber and Willstätter[5] so long ago as 1931. This theory has been developed by one of us[6] along the lines previously suggested by Haber and Weiss[7]. It is based on a radical chain mechanism: the reduction of the ferric form of catalase is brought about by the anion of hydrogen peroxide (HO_2^-) and the oxidation of the ferrous form by the hydrogen peroxide molecule itself. The decomposition of hydrogen peroxide would therefore proceed with the same velocity in the presence and absence of oxygen, as we have indeed observed.

Although, contrary to Oppenheimer and Stern[8], it cannot be generally assumed that an oxidation by hydrogen peroxide would be faster than an oxidation by molecular oxygen, a re-oxidation of reduced catalase by oxygen only would have the effect that no decomposition of hydrogen peroxide could t place at all. The reason for this is that, unles radical chain mechanism is assumed, all the oxy formed by the reduction of the ferric form of catal must be quantitatively used up again for the oxidation of a stoichiometric amount of the ferr form and the oxygen thereby reduced to hydro peroxide. To avoid this difficulty, Keilin and Hart formulated the oxidation reaction by the follow equation:

$$4Fe^{\cdot\cdot} + 4H^{\cdot} + O_2 = 4Fe^{\cdot\cdot\cdot} + 2H_2O,$$

thereby assuming the reduction of oxygen to wa without the intermediate formation of hydro peroxide. This is contrary to accepted theories autoxidation and would appear impossible on basis of the kinetic theory if only for the reason t it implies collisions of a very high order.

Further, on the basis of Keilin and Hartr theory, one would expect the reaction, if carried in nitrogen, to show the characteristic curve of autocatalytic process owing to the increasing forr tion of oxygen. This is, however, not corrobora by the figures of Keilin and Hartree.

Conclusions as to the behaviour of catalase deri by analogy from spectroscopic observations on called 'azide- or hydroxylamine-catalase' cannot accepted as strong evidence for the problem un discussion.

JOSEPH WEISS.

Department of Chemistry,
King's College.

H. WEIL-MALHERB

Cancer Research Laboratory,
Royal Victoria Infirmary,
Newcastle-upon-Tyne.

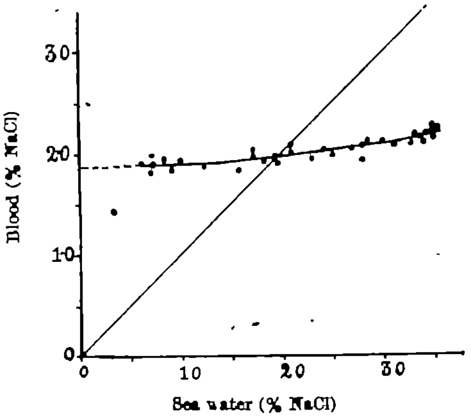
---

[1] Johnson, H., and van Schouwenburg, K. L., NATURE, 144, 634 (19
[2] Keilin, D., and Hartree, R. F., *Proc. Roy. Soc.*, B, 124, 397 (19
[3] Keilin, D., and Hartree, R. F., NATURE 144, 787 (1939).
[4] Zeile, K., and Hellstrom, H., *Z. physiol. Chem.*, 195, 39 (1931).
[5] Haber, F., and Willstatter, R., *Ber. dtsch. chem. Ges.*, 64, 2844 (19
[6] Weiss, J., *J. Phys. Chem.*, 41, 1107 (1937).
[7] Haber, F., and Weiss, J., *Proc. Roy. Soc.*, A, 147, 332 (1934).
[8] Oppenheimer, C., and Stern, K. G., "Biological Oxidations" (Hague: W. Junk, 1939).

Osmotic Behaviour of *Palæmonetes varians* (Lea

Palæmonetes varians var. *microgenitor* is a comm brackish-water inhabitant of northern and weste Europe well known for its ability to live in differ concentrations of sea water. Specimens collect from brackish waters in the vicinity of Plymou (salinity 23–29 ‰) are quite at home in t tanks of the laboratory containing normal sea wa of salinity 34–35 ‰. Estimations of osmo pressure of blood, by Baldes' modification of Hi thermo-electric technique[1,2], from specimens kept different concentrations of sea water, indicate th while this species is hypertonic in sea water of lov dilutions, it is definitely hypotonic in normal water.

The blood of animals that have been in the s water tanks for some months is isotonic with solution of 2·3–2·1 per cent sodium chloride. Hyp tonicity is maintained by the shrimps in dilutions sea water equivalent up to about 2·0 per cent sodi chloride, when the internal and external media observed to be approximately isosmotic (see acco panying graph). In sea water of 1·8–0·6 per c sodium chloride, there is a slight fall in the va



Relation between the osmotic pressure of lood and the external medium of *Palæmonetes varians*.

alues in per cent sodium chloride. Abscissæ, sea ater; ordinates, blood. Straight line indicates here points would fall if blood and medium were isotonic.

blood from 2·0 to about 1·8 per cent, but the blood ays retains a higher osmotic pressure than the ternal medium, and variations are confined to the ove limits. Dilute sea water equivalent to 0·6 per t sodium chloride was approximately the lowest vival limit for the species in mixtures made with mouth tap water.

The homoiosmotic behaviour of the species is clearly licated by the figures given above, the difference tween the highest and lowest values for blood ing only about 0·5 per cent sodium chloride for corresponding difference of 2·9 per cent sodium loride in the external medium. As compared th typical freshwater Crustacea[3,4,5] the blood of *læmonetes* is found to have a much higher osmotic essure. It is all the more interesting because this operty of maintaining hypotonicity in concentrated d hypertonicity in dilute sea water is known only a few euryhaline crabs[6,7,8]. It would seem that is physiological character of *Palæmonetes varians* ll to a great extent explain its peculiar habits and stribution.

Details of experiments will appear elsewhere.

N. Kesava Panikkar.

Marine Biological Laboratory,
Plymouth.
Oct. 11.

---

aldes, H. J., *J. Sci. Instr.*, 11, 223 (1934).
ll, A. V., *Proc. Roy. Soc.*, A, 127, 9 (1930).
uval, M., *Ann. Inst. Oceanogr.*, 2, 232 (1925).
ermann, F., *Z. vergl. Physiol.*, 14, 479 (1931).
enemann, L., *J. Cell. Comp. Physiol.*, 11, 149 (1938).
dmonds, E., *Proc. Linn. Soc. N.S.W.*, 60, 233 (1935).
nklin, R., and Krogh, A., *Z. vergl. Physiol.*, 26, 239 (1938).
rogh, A., "Osmotic Regulation in Aquatic Animals" (C.U.P. 1939).

Amylase in Amphioxus

Specimens of *Amphioxus caribbaeum* collected ile working at the Tortugas Laboratory of the rnegie Institution of Washington were examined th respect to the amylase present in the gut. terminations were carried out by the micro- thod of Linderstrøm-Lang and Holter as modified Holter and Doyle[1]. The intestine was divided into three regions, namely, hepatic cæcum, proximal intestine and lower intestine. The gut was split open, washed, and the area of each piece measured. When examined for amylase activity, the relative activities per unit area were found to be: cæcum, 62; proximal intestine, 41; lower intestine, 30.

In a determination of the relation of amylase activity to pH, the region of the junction of intestine, cæcum and pharynx was used. The final reaction mixture was 2 per cent glycerine, $M/50$ Sørensen phosphate buffer, 1 per cent soluble starch and 1 per thousand sodium chloride. The reaction time was 8–12 hours at 32·2° C. Taking the amylase activity at pH 7·0 equal to 100, the relation to pH is as shown in the accompanying table, with an optimum at pH 7·0. The values given are each averages of six determinations.

pH	Relative activity
6·5	75 ± 4
7·0	100
7·5	74 ± 3
8·0	69 ± 1

Wm. L. Doyle.

Bryn Mawr College,
Bryn Mawr,
Pennsylvania.

---

[1] Holter, H., and Doyle, W. L., *J. Cell. and Comp. Physiol.*, 12, 295 (1938).

Cytochrome Oxidase in Tea Fermentation

An endo-enzyme system in tea leaf which could oxidize tea tannins directly was recently reported by Sreerangachar[1]. The enzyme remained bound to the tissue after exhaustive washing with water or phosphates of acetone-dried tea leaf tissue. Attempts to confirm this work in Assam at first proved fruitless. An enzyme preparation made apparently in identically the same way was completely devoid of oxidase activity. Tea tannin was not oxidized and no characteristic colour with the Nadi reagent was observed in the absence of hydrogen peroxide. An orange coloration developed in the fibrous portions of the leaf but this was found to be due to the interaction of the lignins with p-phenylene diamine. The endo-enzyme, however, showed strong peroxidase activity when hydrogen peroxide was added.

Some Ceylon leaf preserved under acetone which was sent to Tocklai still showed strong peroxidase activity, but no catechol oxidase activity could be detected.

On the other hand, it was shown at St. Coombs that the endo-enzyme could oxidize both tea tannins and catechol directly without the addition of hydrogen peroxide.

We believe the failure to confirm Sreerangachar's findings at Tocklai to be due to the higher temperatures prevailing in Assam. When green tea leaf is treated with alcohol at a laboratory temperature of 30° C. a crude enzyme preparation results with little or no oxidase but high peroxidase activity. If special precautions are taken to keep everything as cool as possible during the treatment of the tissue with alcohol, the enzyme preparation can bring about the oxidation of tea tannins and catechol without the addition of hydrogen peroxide. Treatment with alcohol at the higher temperature has obviously inactivated an enzyme which is essential for the direct oxidation of tea tannins.

The lability of this latter enzyme and the firmness of its attachment to the tissue suggests its identity with cytochrome oxidase. If this latter enzyme were present in the leaf, Sreerangachar's preparation would be expected to contain both the enzyme and its substrate. Cytochrome oxidase together with cytochrome can oxidize both catechol and ascorbic acid, although the enzyme alone is completely specific for cytochrome. The peroxidase in the preparation would also utilize the hydrogen peroxide produced during the oxidation of cytochrome for oxidation of its substrates. In these conditions, with hydrogen peroxide already present, addition of more hydrogen peroxide might not accelerate the oxidation, and the enzyme preparation would apparently have no peroxidase activity.

This interpretation would seem to explain our apparently contradictory findings as to the nature of the oxidizing enzymes in tea leaf. Sreerangachar's finding that tea tannin can be oxidized directly by an enzyme preparation obtained from tea leaf does not necessarily establish the presence of a tannin or catechol oxidase in the system. The claim put forward by one of us[2] that ascorbic acid oxidation is the primary stage in the fermentation process is also withdrawn. The direct oxidation of ascorbic acid by tea leaf tissue finds an adequate explanation in terms of the above theory. Other evidence has also been found against the existence of ascorbic acid oxidase in tea leaf, and these findings together with a fuller investigation of the cytochrome oxidase will be published elsewhere at a later date.

J. Lamb.

Tea Research Institute of Ceylon,
St. Coombs, Talawakelle,
Ceylon.

E. A. Houghton Roberts.

Indian Tea Association,
Tocklai, Cinnamara P.O.,
Assam.
October 5.

---

[1] Sreerangachar, H. B., *Curr Sci.*, 8, 13 (1939).

[2] Roberts, E. A H, *Biochem. J.*, 33, 842 (1939).

Role of Manganese in the Biological Synthesis of Ascorbic Acid

In continuation of my previous work[1], it has been found that the guinea pig liver also can synthesize ascorbic acid from the sugar precursors both *in vitro* and *in vivo*. The concentration of manganese necessary for the synthesis is much higher than that required in the case of rat liver.

In vitro			*In vivo*		
% Mn in R.-L.	Sugar	Mgm. ascorbic acid per gm. liver	Exp.	Mgm. ascorbic acid per gm. liver	Remarks
0 10	Mannose	0 20	1 c.c. N S. intraperitoneally	0·21	Killed after five hours.
0 01	Mannose	0·14	40 mgm. galactose in 0·04% Mn intraperitoneally (1 c.c.)	0·25	
0 10	Galactose	0·17	0·5 c.c. N.S.	0 24	Young growing guinea pigs killed after 8 hours
0 01	Galactose	0 13	25 mgm. mannose in 0·5 c.c of 0 04% Mn	0 30	
Nil	Nil	0 13			

The hypothesis is advanced that the inability the guinea pig and man to synthesize their requi ment of ascorbic acid is due to the lack or insufficier of manganese in their tissues. The active oxidat or dehydrogenating mechanism is made up of m ganese and the dehydrogenase, manganese acting the capacity of a coenzyme.

Further investigation in support of the hypoth is in progress. Details will be published elsewhere

M. N. Rudra.

Department of Medical Chemistry,
Prince of Wales Medical College,
Patna. Sept. 25.

---

[1] Nature, 143, 811 (1939).

Polyploids are More Variable than their Origi Diploids

Studying the modification of a large number experimentally produced polyploid plants of vari species and families (Solanaceæ, Gramineæ, Co positæ, etc.) within the single plants and in the po ploid lines in respect to the modification of th diploid forms, when the plants grew in equal envir mental conditions, I found the following regularit Cell dimensions showed in the majority of the ca studied a greater modification in the tetraploid th in the diploid plants. Cell dimensions of the exp mentally produced octoploids were more varia than the cell dimensions of tetraploid and dipl forms. The numbers of chloroplasts per pair stomatal cells were more variable in the tetraplo than in the diploids and much more variable in octoploids than in the tetraploids and diploi Counting, for example, the chloroplasts[1] in 100 pa of stomatal cells of each form of *Nicotiana ala* diploid, tetraploid and octoploid, the following val for the standard deviations were respectively foun $\sigma_{2n} = 1{\cdot}81$, $\sigma_{4n} = 4{\cdot}76$, and $\sigma_{8n} = 7{\cdot}03$. (It found that polyploidy does not affect the size of chloroplasts[1,2]. It also does not significantly aff the variability of the chloroplast diameter.) T modification of the cell dimensions decreases son what gradually in the subsequent polyploid gene tions, that is, it decreases with the increase of t polyploid generations. But in the cases stud tetraploids still had more variable cell dimensio in the fifth generation than the corresponding diploi

It was logical to expect that a greater modificati of the cell sizes and of the numbers of the chlo plasts (assimilatory organs) of the polyploid for should condition a greater modification of the pla size as well as of all the dimensions of the pla organs. Our measurements showed that this is tr in the majority of the cases. Plant size, leaf dime sions, and flower dimensions were in the majori of the cases much more variable in the tetraploi than in the diploids. The organ dimensions of t octoploids were more variable than those of t diploids and tetraploids.

It was also logical to expect that a greater modific tion of the cell dimensions of the octoploid a tetraploid plants should lead to more freque developmental anomalies. It was found that tet ploid plants formed a greater percentage of abnorm flowers and leaves than the diploids. The tenden was noted for tetraploids originating from spec with large chromosome numbers to form a somewh greater percentage of abnormal flowers than t tetraploids originating from species with sm chromosome numbers. Experimentally produc octoploids formed a much greater percentage normal flowers and leaves than the tetraploids and loids. Modifications of the organ dimensions and ger percentages of anomalies of the tetraploids ve the tendency somewhat to decrease with the rease of the polyploid generations, but, in the ajority of the cases both were still greater in the raploids than in the diploids.

F_1 species hybrids of distantly related species had, the majority of the cases, more variable cell and gan dimensions than the parental species; they o formed abnormal leaves and flowers more often. ll dimensions of the majority of the amphidiploids at were studied were also more variable than those F_1 species hybrids from which they were produced. ey also formed abnormal organs more frequently. amphidiploid, however, did not show greater difications of the cell and organ dimensions and l not form many more abnormal flowers and leaves an the F_1 hybrid from which it originated, but the ter was a cross product of distantly related species, owing very great modifications of cell and organ nensions and forming a very large percentage of normal flowers and leaves. The numbers of seeds per flower by the auto- and allo-polyploid plants re much more variable than the numbers of the ds set by their ancestral forms. A series of allo-typloid species, studied recently, showed greater difications of cell and organ dimensions than the loid species of the same genus. But there were o allopolyploid species that did not show greater difications of the cell and organ dimensions in mparison with the diploid species of the same genus. e increase of the modifiabilities of polyploids and certain F_1 species hybrids (the products of distantly ated species) are of great significance from the olutionary and plant breeding (agricultural) points view, because they are closely connected with the sticity and adaptability of the plants, playing at e same time an important role in the geographical tributions of the plant organisms.

A series of allopolyploids and F_1 hybrids have, in addition to the increased modification, increased frequency of abnormal mitosis[2], and more often produced somatic mutations[3,4] than the parental species. Both allopolyploids and autopolyploids that propagate sexually often give rise to new hereditary variations as a result of abnormal meiosis and crossings-over between partially homologous chromosomes[5,6]. Extensive studies in the genuses Triticum and Nicotiana showed that in the majority of the cases polyploids are characterized by a much greater polymorphism than diploids. Our data are in close agreement with those obtained by N. I. Vavilov upon the same problem but from another point of view.

DONTCHO KOSTOFF.

Institute of Genetics,
Academy of Sciences of the U.S.S.R.,
Moscow. August 22.

---

[1] Cf. Kostoff, D., *Curr. Sci.*, 7, 270–273 (1938).

[2] Kostoff, D., and Orlov, A., *Ann. Bot.*, 2, 883–886 (1938).

[3] Kostoff, D., NATURE, 144, 599 (1939).

[4] Kostoff, D., *Curr. Sci.*, 3, 302–304 (1935).

[5] Kostoff, D., and Kendall, J., *Gartenbauwiss.*, 9, 20–44 (1934).

[6] Kostoff, D., *J. Genet.*, 37, 129–209 (1938).

Sir Frank Dyson

I HAVE been planning to write the life of my father, the late Sir Frank Dyson (formerly Astronomer Royal), but owing to war work have had to postpone the task for the present. I am, however, anxious to collect letters and other material before these are destroyed.

May I appeal to those who knew my father for any letters they may have of his, or for any reminiscences they may care to give me. I should very much value the personal reminiscences of his scientific friends.

I shall naturally take the greatest care of all papers sent to me, and I undertake to return them within a few days.

MARGARET WILSON.

The Chimes,
Radford Rise, Stafford.

Points from Foregoing Letters

OBSERVATIONS are recorded by A. C. B. Lovell and G. Wilson of the frequency with which cosmic ray owers from the atmosphere affected two cloud ambers operated simultaneously and arranged in fferent ways. From the average multiplication served when lead or aluminium is interposed be-een the chambers, they conclude that large showers ll be relatively more frequent in light elements than indicated by the cascade theory applied to a single trant particle.

The evaporation of droplets in mists of phenolic rmicide solutions has been studied by S. R. Finn d E. O. Powell by means of the ultra-microscope. e results, correlated with the biological findings, show at three rough classes of bactericidal behaviour are stinguishable according to the volatility of the solute.

From a study of the dimeric forms of o-hydroxy-opropenyl compounds, W. Baker and D. M. Besly nclude that they must be derivatives of flavane. his structure satisfactorily explains their properties.

J. J. Dowling describes a method for the com-arison of small resistances using ordinary laboratory paratus.

J. Weiss and H. Weil-Malherbe state that further antitative work on the action of catalase has shown that catalase activity does not depend on the presence of oxygen. This is in agreement with the theory proposed recently and based on the earlier discussion by Haber and Willstätter. It was not possible to corroborate Keilin and Hartree's results, whose theoretical views are also criticized.

N. K. Panikkar finds that *Palaemonetes varians* is hypotonic in normal and hypertonic in dilute sea water. The osmotic pressure of its blood ranges from 1·8 to 2·3 per cent NaCl for a corresponding range of 0·6–3·5 per cent NaCl in external medium, isotonicity being at about 2·0 per cent. The homoiosmotic behaviour of the species is of interest in view of its habits and distribution.

In examining the intestine of Amphioxus for amylase activity, W. L. Doyle found that the greatest activity per unit area was in the caecum and the least in the lower intestine. The relation of *p*H to amylase activity was also studied and showed an optimum at *p*H 7.

J. Lamb and E. H. Houghton produce evidence that the oxidase responsible for the oxidation of ascorbic acid in the tea leaf may be identified with cytochrome oxidase, and that it is unlikely that an ascorbic acid oxidase is present.

RESEARCH ITEMS

Ghost Figures of Santa Cruz

The wooden figures from Santa Cruz, which represent the ghost or soul of a person who has been successful during his life and has gained prestige, are figured and described by Joyce Gillett, of the Cranmore Ethnographical Museum, Chislehurst, in *Man* of October 1939. These wooden figures are made after death and erected in the house of the deceased, when a feast is given. After the feast, the figure remains in the house standing in a corner. Very often skulls are seen standing around the figure, and these are said to be the skulls of past owners and keepers. Each figure has one keeper, and often gifts of tau and conch shells are placed before it. The figures are made, and regarded with esteem, not on account of an unwillingness to forget the dead, but because of a fear that unless something tangible is made in the likeness of a man who was lucky, that which was for the good of the people during his lifetime may be lost for ever. But if such an image is made, it is believed that the maker has captured for all time the gift of being lucky which was bestowed on the deceased, and this can now be transferred into the body of any living person—usually a member of the family or a relative—where it will continue to function. One example, now in the Cranmore Museum, was found in a disused house, not a ghost house, suspended from a height of five feet, and encased in a conical bird-cage of wood, the whole being covered with mats and tapa cloth, which appeared to have been smoked over a fire. On unwrapping, a very carefully decorated male form was found, in the nose and ears of which were pendants of pearl shell; pearl shell pendants hung on the hair, which was wrapped in tapa cloth and dressed in the shape of a cone, and protruded at the back of the neck. Biceps, wrists, knees, and ankles are circled with fibres on which are pendants and adornments of shell or seeds, while around the waist was a loin-cloth and a girdle of currency. The whole figure was dusted with turmeric.

The Quintuplets

J. W. MacArthur and A. R. Dafoe (*J. Hered.*, 30, 359–364; 1939), continuing their analyses of the Dionne quintuplets examine their growth up to their fifth birthday. The quintuplets were unlike at birth but have become, as is usual in monozygotic twins, more similar than fraternals. The variability in weights was greatest at times when growth was retarded—birth—weaning—before removal of tonsils. The maximal differences fell from 45·1 per cent at birth to 7·2 per cent at five years. Similarly height differences fell from 4·5 per cent at one year to 1·1 per cent at five years. The rates of growth of the quintuplets are neither equal, nor proportional to birth weight, but are regulative as with regenerating parts which tend to reach their potential dimensions under equal environmental conditions.

Inheritance of Disease-Resistance

L. T. Webster (*J. Hered.*, 30, 365–370; 1939) has analysed the reactions of mouse populations to mouse typhoid and encephalitis virus. Progenies of parents who died within 10 days of infection wi mouse typhoid were more susceptible than th from surviving parents. Selection and inbreedi from susceptible and resistant parents retained th characteristics, while hybrids between highly resiste and highly susceptible mice showed a monofactor F_2 segregation for resistance to both typhoid and cephalitis virus. Resistance is dominant in both cas The outbreak of epidemics in genetically hete geneous populations is discussed. Epidemics caused in hitherto uninfected populations by introduction and spread of a highly virulent, stable infecting agent. In an infected population agent remains stable but the resistance of the po lation is reduced by inadequate diet or other caus The dosage in the population therefore increas Those individuals which are innately suscept become infected first. The epidemic curve refle this genetical difference in susceptibility.

Genetic Differences in Wild *Drosophila pseudoobscura*

Th. Dobzhansky (*Proc. Nat. Acad. Sci.*, 25, 31 314; 1939), continuing his studies on geneti differences in wild populations, shows that samp of different populations of *Drosophila pseudoobsc* caught in southern Texas show structural differen in the third chromosome similar to those previou found in California. Further, although some popu tions were only 1¼ miles apart, these appeared be different in constitution and to be distinct breedi units.

Mouth-parts of the Female Anopheles Mosquito

In *Parasitology* (31, 212–242; 1939), G. G. Rob son gives an account of the piecing mechanism us by the female mosquito during feeding. It appe that the observation made by Vogel in 1920 that t labral canal is closed ventrally by the opposed edg of the labral groove is confirmed. The hypopharyn on the other hand, plays no part in the vent closure of the food channel, except at its base. T use of the term 'labrum-epipharynx' is dispensed w in favour of the simple designation of 'labrum Snodgrass, it is pointed out, disagrees with t homology of the labella with labial palpi on t ground that the lobes of the labium have usua each a single muscle inserted directly upon it, where the palpi have antagonistic muscles. It is sho that in Anopheles the labella have these antagonis muscles as in typical palpi, and the homology consequently upheld. During feeding, penetration the skin of the victim is made by the labrum a the wide terminal blades of the mandibles act as cap to the entrance of the labral canal and serve f its protection during penetration. The function the maxillæ is to help in the efficient and smoo penetration of the host's skin.

North American Bees of the Genus Osmia

Under this title the Entomological Society Washington presents the first volume of what expected to be a series of memoirs. Written Grace A. Sandhouse, it is a cloth-bound publicati of 167 pages and was issued in August 1939. Bees genus Osmia are essentially denizens of the earctic and nearctic regions, few being found where, and they are entirely wanting from the ctic and Ethiopian regions. Of approximately names, which have been proposed for species of oia in the nearctic region, about 120 become onyms and 30 are referred to other genera, thus ing 130 names now in the genus. The issuing of memoir was made possible from accumulated rest on a monetary bequest of the late Frederick ab which was supplemented by a donation by E. A. Schwarz. Inquiries regarding the sale of publication should be addressed to the Corresnding Secretary of the Entomological Society of shington, care of the Bureau of Entomology and nt Quarantine, Washington, D.C.

astrous Earthquakes, January–June 1938

. P. Rothé has discussed the earthquakes felt man during the first six months of 1938 (*Revue r l'étude des calamités*, 2, No. 7, 230–241; July–gust 1939). The five most disastrous shocks were e of February 5 in Columbia, April 19 in Asia or, May 3 at Iguala in Mexico, May 19 at Célèbes, d June 11 in Belgium. The epicentral region of Columbian earthquake, which was felt as far as ama, corresponded roughly with the great 'graben' he Cauca Valley, the depth of focus being 150 km. siderable damage was done and people were killed d injured at Armenia, Calarca, Pereira, Manizalles, nzazu, Villa Maria, Riosucio, Aguadas, Medellin d Amaga. Probably the greatest shock of the iod was the one with epicentre in the vilayet of sehir in Turkey, where ten villages were comtely destroyed. Altogether about 756 houses were troyed and 800–1,000 people were killed or gravely ured. The epicentre of the earthquake of May 3 been determined at the Observatory of Tacubaya have been near Huilziltepec (Guerrero). This ck resulted in the destruction of much property, deaths of five people and injury to thirty-eight ers. The earthquake of May 19 with epicentre the Straits of Macassar was particularly violent l did great damage at Dongala, where sixty houses re ruined. The earthquake was followed by a sea ve 2–3 m. high which flooded areas 80–100 m. and, doing great damage to dwellings, crops and rchandise and resulting in death and injury several people. According to M. O. Somville, the centre of the Belgian earthquake of June 11 was the centre of the Mons-Brussels-Ghent triangle l its depth of focus 50 km. This shock resulted in deaths of three people and damage to property several millions of francs. Damage to property s at Brussels, Audenarde, Courtrai, Lille, etc., ndows were broken at Anvers, and the shock was t at Paris and at distances up to 300 kilometres m the epicentre.

ocity of Coloured Light

DURING the last twenty years, observations have n made to determine whether light of different ours travelled through interstellar space with the ne velocity. They have in general been based on ervations of the times of the primary minima of light of two wave-lengths of a binary star, genery Algol. Some have led to the conclusion that d light travels faster than blue, others the reverse. e question has been recently examined by J. S. Hall Amherst College Observatory, working at the Sprout Observatory with grants from the American Philosophical Society and Swathmore College (*J. Franklin Inst.*, 228; Oct. 1939). He measured the light of Algol, of wave-lengths 5599 A. and 8060 A. respectively, by a photo-electric photometer and compared them with that of a non-variable star Alpha Persei, making corrections for background illumination, atmospheric extinction and sensitivity of the photometer. He concludes that the minima for the visual and infra-red rays occur at the same time with an uncertainty of 3 minutes. As the light from Algol takes 195 light years, that is, 55×10^6 minutes, to reach the earth, this means that the speeds of the two lights are identical to within 3 parts in 55 millions. This supports the similar conclusion of Russell, Fowler and Borton from the scarcity of matter in interstellar space and the earth's atmosphere.

The Minor Planets of the Hecuba Group

THE above is the title of the Halley Lecture delivered by Prof. A. O. Leuschner on June 16, 1938 (Oxford: Clarendon Press. 3*s*. 6*d*. net). The Hecuba Group comprises about one third of all the known minor planets, and they revolve about the sun with approximately twice the angular daily rate of Jupiter. When very close commensurability exists, for example, if a planet revolves at almost twice the angular daily rate of Jupiter, the determination of the exact motion of the planet becomes complicated. Bohlin's Group Method has been applied to the problem with considerable success, and von Zeipel and also Leuschner and his colleagues have developed the method, tables being published to facilitate the computations. In the "Berkeley Tables", produced by Leuschner, higher order terms have been used than were employed by von Zeipel, and their application to Hygeia and a few other planets confirms their great accuracy. The Rechnen-Institut has recently utilized these tables for the development of the perturbations of the planets of the Hecuba Group, and Dr. Raube has already published the results for Erato and Antiope. There is a considerable amount of detailed examination of particular cases which present various difficulties, and those who are engaged in this highly specialized form of work will find much useful material in Prof. Leuschner's lecture to assist them.

New Mathematical Tables

A SEVEN-PLACE parallel table of $\tan^{-1} x$ in radians and $\log_{10}(1 + x^2)$, computed by Dr. L. J. Comrie, has been added to the "Tracts for Computers" of the Department of Statistics, University College, London. Prepared in the first instance to assist in the fitting of curves of Pearson's Type IV to frequency distributions, the table will obviously assist in any other problem which involves the numerical integration of a rational function with a definite quadratic denominator; that the logarithms are not natural does not imply a complication in practice, for in any application except to a manufactured example a logarithm is sure to be multiplied already by some numerical constant. Second differences are provided for interpolation, and Dr. Comrie's name is a guarantee of absolute accuracy. The printing is excellent, and if we complain that paper wrappers are an inadequate protection, that is because we have no doubt that the tables are going to be subjected to hard wear. The tables are published by the Cambridge University Press, price 3*s*. 9*d*.

COALBURSTING

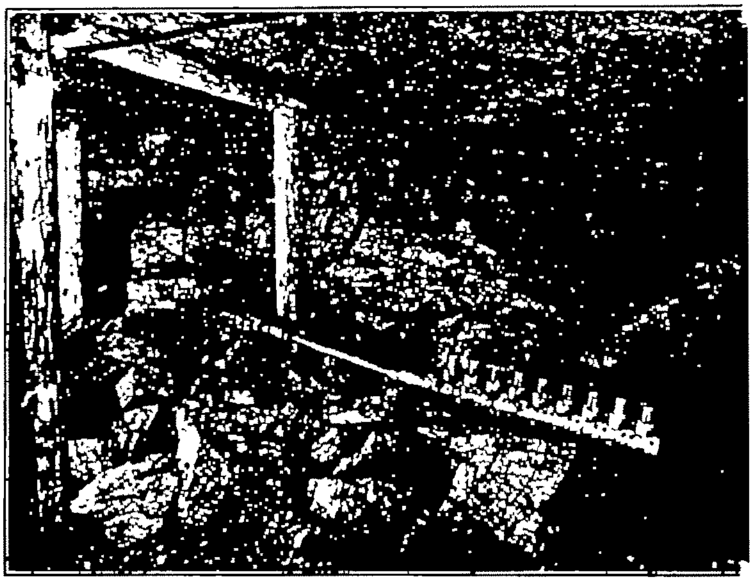


Fig. 2.

Dislodgment of coal completed: note the pistons of the coal burster fully extended and the chunky nature of the coa brought down.

As the coal mines of Great Britain were mechanized, the standard practice became to undercut the coal seam by means of a coalcutting machine and then to bring down the coal by drilling holes in the seam above the cut, inserting charges of 'permitted explosives' and then detonating these. This method of winning coal, however, suffers from grave disadvantages. Every shot that is fired is a potential danger, especially when detonation results in what is technically known as a blown-out shot. Even if no explosion results, the cloud of coal dust produced tends to make the mine atmosphere unpleasant and dangerous. Furthermore, when shots are being fired, the workmen must be withdrawn from the coal face to a place of safety, thus interrupting work. Finally, the shock of the explosion may damage the roof so that the men on returning to the face are confronted with a changed set of conditions which may be very dangerous, especially when the roof is friable. When it is realized that in a single colliery 100,000 shots may be fired per annum, the magnitude of the potential danger is obvious.

Any method which obviates the necessity for firing shots is of interest to the mining community, and furnishes an opportunity for pure science to be of assistance to industry. A great variety of chemical and physical methods of bringing down coal h
been tried during the last fifty years, one of th
being the Tonge hydraulic wedge. The modern 'c
burster' is a development of Tonge's hydraulic we
which has been made possible by the developme
in metallurgical science and engineering practice
relation to the transmission of hydraulic power
high pressure. It entirely elimina
shot-firing and has been used ove
sufficiently long period of time
its usefulness and efficiency to
assessed; several hundred co
bursters are now in use in
British coalfields.

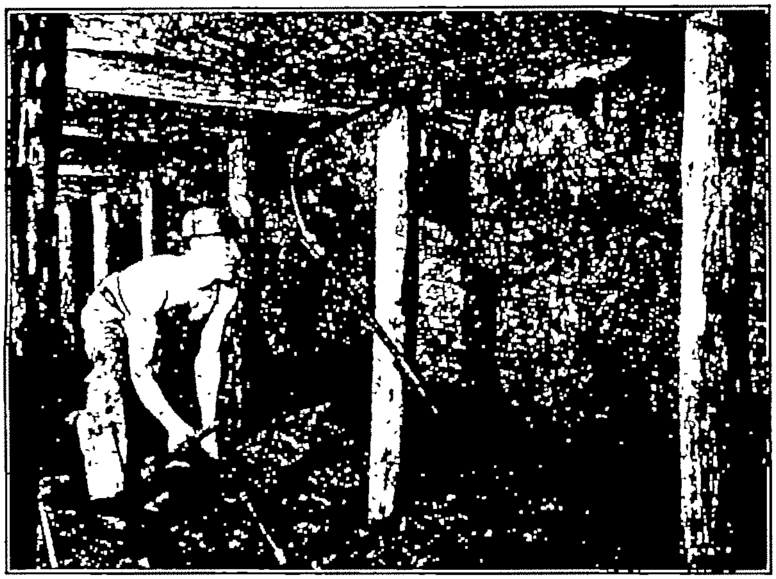


Fig. 1.

Building up pressure in the coal-burster.

In coalbursting, the seam is
dercut as before with a mechani
cutter and holes are bored in
coal above the cut by electric dr
or compressed air drills of the t
bine type. Now, however,
coalburster is placed in the h
instead of a charge of explosi
Briefly, the coalburster consists o
round stainless steel barrel (ab
3 ft. in length and 3 in. in diame
being a common size) chamber
on one or both sides to accomm
date a number of pistons,
plungers, each about 2 in. lo
which can be forced out radia
from the barrel by hydraulic pr
sure. This hydraulic pressure is
veloped by a small hand-pump, co
nected to the burster by a length
armoured hose, a pressure of so

00 lb. to the square inch being developed and com- nicated to the pistons. Since the hole in the coal been drilled as a snug fit for the bar and steel liner ch goes beneath it, the forcing out of the pistons in- ves the disrupting and breaking down of the coal. er the burster has been placed in the hole, the miner ires to the pump some 10–20 ft. away and operates hand pump to generate the pressure required to st down the coal. As a rule, the coal comes down hin two or three minutes of commencing to rate the pump, and several tons of coal are ught down at each operation.

ne advantage of this technique is obvious—there no possible risk of an explosion. Moreover, very le coal dust is produced, so that conditions pre- posing towards an explosion are absent, and, of rse, the mine atmosphere is much pleasanter and lthier for the workmen. Again, round coal of ximum market value is produced and it is not ttered or rendered 'tender' by an explosion; therefore it does not suffer from disintegration in transport. Finally, but not least important, the roof is in general not disturbed. Should any change in conditions take place, however, the fact that the men are present all the time, and not withdrawn as in shot-firing, means that there is a very much better chance of detecting changes in roof conditions.

It is found in practice that the coalburster has very few limitations, that it will operate successfully on all types of coal, hard or soft, in stalls as in widework, and will function well under a variety of conditions. One colliery in Great Britain has for some years now been getting its whole output (8,000 tons per week) by means of coalbursters, shot-firing being completely eliminated. The device must be looked upon as a notable contribution to the safer working of coal mines and to the production of coal of higher market value than has been possible by the use of explosives.

A. Harvey.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN NEW ZEALAND*

HE thirteenth annual report of the Department of Scientific and Industrial Research, New land, which covers the year 1938–39, refers to initiation of a number of new research activities. e of the most important of these is the formation a Timber Protection Research Committee of the ncil to direct and co-ordinate research on the servation of timber from the attacks of wood- ing insects and fungi. The depreciation of build- securities from the attacks of these pests presents erious problem in New Zealand, and the research gramme planned by the committee contemplates rk by the Entomological Division and Plant eases Division of the Plant Research Bureau, uding biological studies of wood-infesting insects, etration tests for wood preservatives, and toxicity ts with insects and fungi, as well as further work the Dominion Laboratory on the analysis of wood servatives and the chemical aspects of penetration ts.

he serious effects of uncontrolled soil erosion have to the establishment of an expert technical com- ttee on soil erosion and land deterioration, to ort on the measures necessary to maintain vegeta- e cover in New Zealand and prevent irreparable mage. The report of this committee is in process publication and indicates that in few cases is the mage beyond repair, although in many areas soil sion has reached a serious state, and a programme handle the problems that are now apparent is lined.

n addition to its intensive studies on cheese rters, the Dairy Research Institute has carried out number of investigations on butter-making, in- ding the oxidation of the fat of butter in cold rage, starters for butter, and the factors affecting rdness of butter. Other work has been concerned th the chemistry of incipient oxidation defects in tter, and the control of mould in dairy products, including the resistance to mould attack offered by different pigments, and the effect of various paint vehicles and driers. The Plant Diseases Division of the Plant Research Bureau has continued its investigations on the control of dry rot in swedes and turnips, the control of club-root, and the use of arsenate, derris and nicotine sprays and dusts for the control of diamond-back moth. Other work of this Division has been concerned with timber preservation and the testing of seed disinfectants; a fourth list of certified sprays has been issued. The Entomological Division has continued its work on the introduction of parasites for the control of the diamond-back moth, on the sheep maggot fly problem, and on timber borers. Animal research at Massey College has been concerned with the application of accurate scientific methods for measuring wool characteristics to the grading of individual stud sheep, and arrangements are being made with the Wool Manufacturers Research Association at Dunedin for the commercial processing of wool with known and accurately measured characteristics.

Fruit research has covered fertilizer, rootstock and pruning experiments on apples, and studies for the chemical control of bronze-beetle and red-mite, physiological studies of internal cork of apples, spraying experiments and the testing of certified sprays. The Fruit Cold Storage Committee has investigated the use of copper-treated wraps for the control of the spread of grey mould in winter cole pears, as well as the effect of fertilizer treatment on the keeping quality of Cox's Orange Pippins and other varieties of apples. Storage trials have been continued with Ballerat and Washington apples. Experimental work on boron in relation to physiological diseases has been directed towards the persistence of boron dressings in soil.

The Tobacco Research Advisory Committee has been concerned with seed-bed experiments, seed germination studies and investigations on mosaic disease. The plant selection work has yielded a natural Italian perennial rye grass cross ecotype,

---

Thirteenth Annual Report of the Department of Scientific and ustrial Research. Pp. 134. (Wellington, N.Z.: Government nter, 1939.) 2s. 9d.

showing definite promise for short-rotation arable lye, such as occurs in the South Island. Interesting work has been carried out by the Plant Chemistry Laboratory on plant growth-substances and their effect in promoting the rooting of cuttings, and particularly effective results have been obtained with β-indolylbutyric acid.

The report also refers to the work of the Leat and Shoe Research Association, the Wool Ma facturers Research Association, which has contin the study of the raw wool scouring process, to ra research, the activities of the Social Science Resea Bureau and of the Dominion Laboratory and G logical Survey.

THE CRAB NEBULA: A PROBABLE SUPER-NOVA

THE Crab Nebula in Taurus, which has the distinction of being No. 1 in Messier's Catalogue, is of peculiar interest, as is shown by articles published respectively in *L'Astronomie* (August 1939) and in the *Telescope* (September 1939). These articles summarize the results of several technical papers published on this subject during the past few years. It seems likely that the Crab Nebula was first recorded by John Bevis, an English physician, in 1731. It was rediscovered in 1758 by the French astronomer, Charles Messier, and was later the subject of careful scrutiny by Sir William Herschel. It was observed with the great reflector at Parsonstown, Ireland, by Lord Rosse, whose drawing of the nebula, published in 1844, probably suggested its name. It remained, however, for astronomical photography to show, first in 1892 by Isaac Roberts and later by the American astronomers (Keeler, Curtis and Ritchey), its peculiar filamentary structure and afterwards to provide data for measuring its linear rate of expansion of about 0·18″ per annum.

Using this value and the present angular dimensions of the nebula and extrapolating backwards, an interval of about 800 years is obtained for the nebula to expand from a point of origin. A similar time interval (900 years) was obtained by Hubble. Spectra of the Crab Nebula, first obtained in 1913–15 at the Lowell Observatory, showed a bowing of the emission lines, when the slit of the spectrograph crossed the whole extent of the nebula (major axis 6′). Interpreting this feature as a differential Doppler effect due to the approaching nearer side of a shell of gas and the receding further side, Mayall in 1937 derived a velocity of expansion of about 1,300 km./sec. fr Lick spectrograms. Assuming a constant rate expansion, he concluded from the available data t the epoch of the outburst was about A.D. 11 Meanwhile, Lundmark had pointed out that Crab Nebula was near the position of the bri object recorded in Chinese and Japanese annals having been seen for six months in A.D. 1054. 1934, a translation by Y. Iba of the Japanese rec gave the position of the object as near the s ζ Tauri and its brightness as equalling that Jupiter. By combining the apparent linear expans in seconds of arc per annum with the absolute pansion in km /sec., the order of distance was rived as 1,500 parsecs, equivalent to nearly 5, light years. Using this distance and the appar magnitude of Jupiter (− 2·2 m.), the absol magnitude of − 13·1 is obtained for the nova, wh must have been at least one hundred times as bri as an ordinary nova.

In *Contributions* from the Mount Wilson Obser tory No. 600, W. Baade assembles the evidence the existence of two classes of novæ, common no and super-novæ, which differ in luminosity by factor of about 10,000. Typical of the former cl is the nova which appeared in the Andromeda neb in 1885 and reached a maximum apparent vis magnitude of 7·2, equivalent to an absolute mag tude of − 15·0. To this recently recognized cl of super-novæ, so the evidence suggests, the no of 1054 may have belonged, and the expanding sh of gas originating with the cosmic explosion is s visible as the Crab Nebula.

TREATMENT FOR ROT-PROOFING SANDBAG REVETMENTS

SANDBAG revetments exposed to the weather tend to break up, due to rotting of the sandbags, and inquiries have been made about preservatives. Two types of preservative are suitable. They are respectively a creosote or tar distillate, used as a water emulsion, or a solution of an organic copper salt in creosote made up into an emulsion. The former is more widely available than the latter and is suitable for treatment of revetments in position which have already deteriorated by being exposed to the weather for some time. The latter is more potent but is also more expensive, and its use will not generally be justified unless the bags are in good condition and unless it is desirable to take down the whole revetment, treat all the bags and then re-pile them.

The application of the preservatives should confo with the following specification:

(1) A creosote or tar distillate of medium creos type applied as a water emulsion in such a quantity to give on the exposed portion of the bag a coating creosote not less than one fifth of the normal d weight of the fabric exposed. This is given appro mately by a 25 per cent creosote emulsion wh sprayed on the bags to give a thorough coati completely satisfying the absorption of the fibr The creosote should comply with British Standa Specification No. 144/1936, 'Creosote for preservati of timber'.

Any normal emulsifying agent may be used a the following is given as an example of the proc of emulsification.

The following ingredients are used: 65 parts osote and 35 parts water with 1·2 parts oleic acid, 3 parts casein and 0·36 parts sodium hydroxide as emulsifying agent. The agent is dissolved in ter and the two fluids are mixed in a jet similar to at of a cream-making machine. An emulsion pre- red in this way should be stable and can be trans- rted in drums or kegs. Before use it should be uted with water. to a suitable consistency for raying so that the creosote content does not fall low 25 per cent.

(2) An organic copper salt is dissolved in creosote tar distillate of the type indicated in (1) above, e solution then being made up into an emulsion th water, by the use of a special type of emulsifying ent. The copper salt should be one of an organic ty acid of high molecular weight (such as, for ample, copper oleate). The organic copper salt ould be added in the proportion of 16 per cent of e weight of the creosote, and the whole should be ulsified with water. When sprayed on the bags it ould be applied as 20 per cent emulsion. This will ve 0·5–1·0 per cent of metallic copper, estimated the normal weight of the fabric when conditioned der ordinary atmospheric conditions.

Care should be taken to coat thoroughly any ms visible on the face of the pile and to work the ulsion well into the seams. The spraying should done with a paint spray or horticultural spray, d the stirrup-pump recommended for A.R.P. fire otection may be used if no other spray is available. re is needed to avoid fire risk during application when handling creosote in the ordinary way. creosote may cause permanent stains, suitable asures should be taken to protect the surface of ildings against which the bags are placed whilst raying is in progress.

In order to obtain the best possible penetration o the revetment the preservatives should not be plied immediately after a heavy rain. They will far more effective if the pile is given a reasonable e for drying after rain.

It will be desirable to repeat the treatment, and this ould be done at intervals not exceeding three nths.

UNIVERSITY EVENTS

Durham.—The honorary degree of D.C.L. has been nferred on Sir Charles Peers, chief inspector of cient monuments and architect in charge of the rham Castle restoration scheme since 1933. The norary degree of M.Sc. has been conferred on Mr. A. Linge, clerk of works for the scheme.

London.—Owing to the war, and the absence of e University from London, the following honorary grees among others have been conferred *in absentia*: Sc. on Prof. Niels Bohr and Sir Robert Robinson; .Sc. (Economics) on Mr. R. G. Hawtrey and Mr. mon Marks.

Oxford.—R. S. G. Rutherford, Wadham College, s been appointed a research officer in the Institute r Research in Agricultural Economics as from tober 1.

Dr. S. N. Chakravarti, St. Catherine's Society, has en granted the degree of D.Sc. for his work in nthetic organic chemistry.

SCIENCE NEWS A CENTURY AGO

Fecundation and Development of Plants

At a meeting of the Ashmolean Society, at Oxford, on November 19, 1839, Prof. Daubeny explained the new views with respect to the fecundation and the development of plants, which had been brought forward by Brown, Mirbel, Schlieden and other botanists of the day. When Linnæus, he said, had established the doctrine of the sexuality of plants he left to his successors two branches of inquiry in a manner untouched, namely, first, in what precise method do the stamens operate upon the pistils when they cause fecundation to take place; and secondly, to what extent can we trace an analogy between the mode of fecundation and development in the case of flowering plants where sexes exist, and in that of cryptogamous ones, where they are not discoverable. The first of these points had been elucidated by the researches of Brown, A. Brongniart and Ehrenberg, while the analogy subsisting between flowering and cryptogamous plants had been investigated by Mirbel in France and Schlieden in Germany. The former observed new cells originating out of those already existing in the case of Marchantia; while the latter appears to have shown that a process the same in kind takes place within the pollen tubes emitted from flowering plants at the very time they reach the ovary and impregnate it, as well as the cells of the plant in the subsequent stages of its growth. From Schlieden's researches it would seem to follow that the embryo exists in the pollen, and not in the ovary; the office of the latter organ being merely that of furnishing to the young individual a receptacle and nourishment. This, however, was disputed by Mirbel.

Conception of the Steam Hammer

In his "Autobiography", James Nasmyth, when speaking of the iron ship *Great Britain*, which it was at first intended to drive by paddlewheels, said that Mr. Francis Humphries, finding great difficulty in obtaining tenders for the large wrought iron shaft, approached Nasmyth. "In this dilemma," said Nasmyth, "he wrote a letter to me. . . . This letter immediately set me a-thinking. How was it that the existing hammers were incapable of forging a wrought-iron shaft of thirty inches diameter? Simply because of their want of compass, of range and fall, as well as of their want of power of blow. A few moments' rapid thought satisfied me that it was by our rigidly adhering to the old traditional form of a smith's hand hammer—of which the forge and tilt hammer, although driven by water or steam power, were mere enlarged modifications. . . . The obvious remedy was to contrive some method by which a ponderous block of iron should be lifted to a sufficient height above the object on which it was desired to strike a blow and then to let the block fall down upon the forging, guiding it in its descent by such simple means as should give the required precision in the percussion action of the falling mass. . . . I then rapidly sketched out my Steam Hammer, having it all clearly before me in my mind's eye. In little more than half an hour after receiving Mr. Humphries's letter narrating his unlooked-for difficulty, I had the whole contrivance, in all its executant details, before me in a page of my Scheme Book. . . . The date of this first drawing was the 24th November, 1839."

The Fossil Fishes of the Yorkshire Coalfields

On November 20, 1839, the naturalist William Crawford Williamson (1816–95) contributed to the Geological Society a paper "On the Fossil Fishes of the Yorkshire and Lancashire Coal Fields". Within the previous four years the Coal Measures of these counties had assumed a zoological importance which hitherto they had not been supposed to possess. In Lancashire ichthyolites had been lately found to pervade the whole of the series from the Ardwick limestone to the millstone grit, and in Yorkshire they had also been found in abundance. These remains, except in the case of the Ardwick limestone, always occurred in highly bituminous shale and were most abundant where plants were least numerous. The fishes were found chiefly in the roof of the coal, rarely in the seam itself, and not often in its floor. The author made some observations on the manner in which ichthyolites were associated with other fossils in the Coal Measures. At Burdiehouse they occurred in the midst of fresh-water shells and Cypris; at Coalbrook Dale with marine Testacea; at Middleton, near Leeds, with Lingulæ; and at the top of the series in Lancashire and Derbyshire with Mytili and Melaniæ. When he read this paper, Williamson was a medical student; in 1851 he became first professor of natural history, anatomy and physiology at Owens College, Manchester. He was Wollaston medallist in 1890.

Roman Causeway

"Some works for improving the channel of the Scheldt", according to the *Gentleman's Magazine* of November, 1839, "have occasioned several extensive cuttings across the old Roman causeway called La Chaussé de Brabant de Brunehaut, which connects in a straight line the towns of Bavay and Tournay. These cuttings took place on the spot described in the Itinerary of Antoninus as the Pons Scaldis. In the course of the works there have been discovered on various points remains of constructions, and large quantities of material which indicate the site of a town or large village; and it appears that in this locality several bridges have been thrown over the Scheldt. This discovery shows that the point given by antiquaries as Pons Scaldis was not merely a bridge over the Scheldt, but a Roman station which was probably fortified."

Royal Botanic Society

The issue of the *Gentleman's Magazine* of November 1839 contains the following information: "A charter of incorporation has just been granted to this Society, 'for the promotion of botany in all its branches, and its application to medicine, arts, and manufactures, and also for the formation of extensive botanical and ornamental gardens within the vicinity of the metropolis'. The Charter appoints the Duke of Richmond as the first president, Mr. Marjoribanks the first treasurer, and the Duke of Norfolk, the Earl of Albemarle, Mr. Rushbrook, Philip Barnes and James de Carle Sowerby Esqs. the first councillors. The organization is similar to that of other scientific societies, and meetings for the discussion of scientific subjects will be held periodically. The anniversary meeting is assigned by the charter for the first of January. Steps are in active progress for the completion of the gardens in Regent's Park, in which exhibitions will be held in the approaching season."

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned:

Lecturer in the Mining Department—The Principal, Techn College, Sunderland (November 25).

Sub-Librarian of the University of Cape Town—The Secret Office of the High Commissioner for the Union of South Afr Trafalgar Square, W.C.2 (December 31).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

The British Academy. Presidential Address, 12 July 1939, by David Ross. (From the *Proceedings of the British Academy*, Vol. Pp. 8. (London: Oxford University Press.) 6d. net. [2

Borough of Falmouth Public Library. Descriptive Catalogue the Paintings and Engravings in the Maritime and General Art lections. Pp. 28. (Falmouth: Public Library.) 2d. [2

Other Countries

Commonwealth of Australia: Council for Scientific and Indust Research. Bulletin No. 129: Investigations on Chilled Beef. Part Cooling and Storage in the Meatworks. By W. J. Scott and Dr. J Vickery. Pp. 68. (Melbourne: Government Printer.) [2

Indian Forest Records (New Series). Botany, Vol. 1, No. 5: cently Introduced or Otherwise Imperfectly Known Plants from Upper Gangetic Plain. By Mukat Behari Raizada. Pp. vi+223–2 12 annas; 1s. Entomology, Vol. 5, No. 3: New Species and Biol of *Coccotrypes* and *Thamnurgides* (Scolytidae, Col.). By C. F. Beeson. Pp. ii+279–308. 10 annas; 1s. (Delhi: Manager of P lications.) [2

Ministry of Agriculture, Egypt: Technical and Scientific Serv Bulletin No. 186: The Pomegranate Fruit Butterfly *Virachola l* King; Morphology, Life-History and Control. By Dr. A. D. Han Pp. ii+54+40 plates. P.T. 10. Bulletin No. 196: Further Tonn Tests of Imported Sugar Cane Varieties. By Arthur H. Rosenf Pp. 10+2 plates. Mills. 15. Bulletin No. 203: Manurial Requ ments of Sugar Cane in Egypt 3: Further Rate of Nitrogen Exp ments. By Arthur H. Rosenfeld. Pp. ii+24+5 plates. Mills. Bulletin No. 209: Some Mealy Bugs of Egypt and Experiments their Control by means of Chemicals. By M. Beshir and M. Hos Pp. 16. P.T. 2. Bulletin No. 216: Some Notes on the Potato Tu Moth (*Phthorimaea operculella*, Zell.). By Rizk Attia and Bish Mattar. Pp. ii+136. P.T. 10. Bulletin No. 223: Study and Cont of Antirrhinum Rust. By Dr. Amin Fikry. Pp. ii+16+21 plat P.T. 4. Bulletin No. 226: Pneumococcus in Camels. By Dr. Hus Kamel. Pp. 12+4 plates. P.T. 2. Bulletin No. 235: The Cottons Egypt. By H. A. Hancock. Pp. 24. P.T. 2. (Cairo: Governm Press.) [2

Egyptian Government: Ministry of Public Works. Annual Rep for the Year 1932–33. English Version. Part 1. Pp. 214. P.T. Part 2. Pp. 438+12 plates. P.T 100. (Cairo: Governm Press.) [24

U.S. Department of the Interior: Office of Education. Bulle 1939, Misc. No. 3: Education in the United States of America. 55. 15 cents. Leaflet No. 52: Know Your Modern Elementary Sch By Helen K. Mackintosh. (Know Your School Series.) Pp. ii+ 5 cents Vocational Division Bulletin No. 198 (Business Educat Series No. 11): Conference Topics for the Retail Grocery Business. written and revised by Kenneth B. Haas and B. Frank Ky Pp. iii+128. 20 cents. (Washington, D.C.: Government Print Office.) [24

Proceedings of the United States National Museum. Vol 87, 3069: A Generic Revision of the Staphylinid Beetles of the Tr Paederini. By Richard E. Blackwelder. Pp. 93–126. (Washingt D.C.: Government Printing Office.) [24

Memoirs of the Entomological Society of Washington. No. The North American Bees of the Genus *Osmia* (Hymenopter Apoidea). By Grace A. Sandhouse. Pp. iv+167 (11 plates). (Wa ington, D.C.: Entomological Society of Washington.) [24

U S Department of Commerce: National Bureau of Standar Research Paper RP. 1221: Rate of Oxidation of Steels as determi from Interference Colors of Oxide Films. By Dunlap J. McAdam, and Glenn W. Geil. Pp. 63+124. (Washington, D.C.: Governm Printing Office.) 10 cents. [24

National Advisory Committee for Aeronautics. Report No. 67 Tensile Elastic Properties of 18:8 Chromium-Nickel Steel as affect by Plastic Deformation. By D. J. McAdam, Jr. and R. W. Mc Pp. ii+42. (Washington, D.C.: Government Printing Office.) cents. [24

New Zealand. Thirteenth Annual Report of the Department Scientific and Industrial Research. Pp. 134. (Wellington: Gove ment Printer.) 2s. 9d. [2

Report upon the Mining Industry of Malaya. By Sir Lewis Le Fermor. Pp. xv+240. (Kuala Lumpur: Government Press.) 2 dollars; 6s. [2

Royal Observatory, Hong Kong. Magnetic Results, 1938. Prepa under the direction of C. W. Jeffries. Pp. 51+2 plates. (Hong Kon Government Printers.) 1 dollar. [27

litorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 144 SATURDAY, NOVEMBER 25, 1939 No. 3656

SCIENTIFIC AND TECHNICAL LITERATURE AND INFORMATION

HE incidence of hostilities has already brought in its train considerable dislocation he various activities that are concerned with provision of literature and information. In world of science and technology this dislocamay seriously affect the national effort unless implications are rapidly appreciated and ropriate readjustments made. To the dis- ance that, as in the War of 1914–18, resulted n interference with the supply of foreign ature and from the diversion of money and ur into activities apparently more necessary n the provision of information, the present lict has added the distraction caused by air- l precautions. In consequence of these latter, y institutions have ceased their activities, or sferred them to locations relatively remote from tres of storage and distribution of information. re-orientation of scientific and technical inves- tion is essential in war-time. To a certain ex- t research based on careful analysis of previous k must yield place to intensive experimentation oted to the rapid solution of urgent problems, to enhanced productivity along well-estab- ed lines, involving observation and testing er than co-ordination and deduction.

here is still a case to be made out for research the more fundamental type, divorced from siderations of purely war-time expediency, just there is a case strongly supported for the vision of intellectually satisfying literature and

But the present review is more concerned h the provision of literature and information cifically germane to the war demands.

f outstanding importance in this connexion is supply of current scientific and technical odicals, both domestic and foreign. Second only to this factor of supply of literature is that of its distribution for individual consultation in accessible localities. Lastly, there is the problem of adaptation of the literature to meet specific needs, that is, the problem of co-ordinated information or documentation.

As regards the supply of scientific periodicals, there is no reason to anticipate interruption in the receipt of the publications of non-European countries. But there may be delays in receipts, and occasional lacunæ due to enemy action. Probably the only real trouble will be delay, since replacement of any issues actually lost will be fairly simple. In the case of supplies of European periodicals, especially those emanating from Germany, considerable reduction in the normal supplies must be anticipated, and replacements will be difficult, if not impossible. It is important, therefore, that such stocks as are received should be wisely allocated to storage and distribution centres, and that any copies received for purely temporary perusal should be conserved in case of need. A clearing-house for this section of literature is needed at the outset, to which surplus copies can be sent for conservation, and demands for filling gaps submitted. Something on the lines of the Smithsonian Institution service might perhaps serve the purpose.

In regard to distribution, it is obvious that more elasticity will be needed in consequence of the re-distribution of centres of research. Many provincial libraries will have abnormal calls upon them for literature, whereas many London libraries will experience a falling off in demand, especially for consultation on the spot. The necessity for lending will be augmented, and the risk of casual losses in transit enhanced; added to this risk, there will be that of destruction of publications issued, due to enemy action or accident.

From the point of view of increased need for borrowing publications, it is satisfactory to know that the lending service of the Science Library, South Kensington, will be maintained, and augmented to any necessary degree. The situation is being carefully watched, and appropriate steps are to be taken to meet any increase in demand for these widely appreciated facilities. But it must be remembered that this library is situated in a fairly vulnerable area, and alternative supplies ought to be provided in case its own are dislocated. The National Central Library is still functioning as a clearing-house for demands for books on loan, but it relies very largely upon the Science Library for supplies of scientific and technical publications. Probably, in this respect, it is not so much necessary to create alternative central scientific lending libraries as to establish a system of co-ordination among the various provincial libraries, of the university and research types.

A union-catalogue of war-time holdings of important foreign (especially European) periodicals in such libraries as are willing to lend appears to be a necessary first step. This catalogue could very rapidly be compiled, and located at the proposed institution serving as a clearing-house for supplies.

Finally, there remains the problem of supplying information, that is, of documentation; this service naturally comprises the initial one of indexing or abstracting. So far as is known, the normal peace-time British abstracting services are continuing to function, and our workers can rely also upon a steady supply of abstracts, etc., from the United States. But these latter may be delayed and interrupted, and the importance of an acceleration in the tempo of abstracting must be emphasized. A review of the available machinery in Great Britain is obviously needed in the present circumstances. Perhaps, as the sequel, a better co-ordination will be secured and overlapping avoided; what is important, however, is that any gaps should be closed.

On the wider question of documentation, a warning against over-emphasis upon specialization is needed. British research services are rightly proud of their diversity and individuality. But with the threat of war-time economies, and the urgent need for increasing the speed of the survey of available literature on certain problems, there is grave danger of undesirable duplication. Moreover, it has always been a defect of system in Great Britain that undue attention is focu upon outstanding publications, whereas oth are very largely neglected. This criticism app particularly to publications in difficult langua There is no excuse for neglecting such publicati at a time when thousands of refugees, represent many different languages, are living in Gr Britain and anxious to assist in any possible w the national effort.

Finally, the methods now in vogue for rec stituting published scientific and technical reco into forms adapted to easy reference in relat to specific problems need to be improved. It long been obvious that our present methods largely a legacy from the last century, w records were much less numerous and activ less interdependent. Moreover, new techni have been introduced, for example, into business world, that are capable of adapta with great resulting advantage into the fiel scientific documentation. Hitherto their us this field has been hesitating and half-hear and consequently their value has been diminis A co-ordinated, large-scale adoption of mo methods is long overdue, and the present em gency suggests itself as providing the neces inducement, for the reason that now the eff of research workers, technologists and busi *entrepreneurs* are directed to a specific task, canalized in particular channels. Co-operatio endeavour and interchange of information essential if the effort is to be a maximum.

To sum up: a central body is needed im diately to meet the conditions now obtainin respect of the supply and use of current Europ scientific and technical periodicals. Its funct would be to record holdings of such publicati in the various centres of research and libra and to maintain a service of spare issues replacements in the various centres. It would serve as a centre for lending via regional serv outside London, and to co-ordinate informa services and ensure adequate 'coverage' of periodicals selected for attention. Any additi abstracting or digesting, translation or repro tion necessary might also come within its purv Eventually it might be possible to cover European literature in addition, but the estab ment of a central body for the limited pur suggested appears to be an urgent need. La it would act as a repository of information, distribute appropriate extracts, epitomes or c plete dossiers as needed.

THE BIOLOGY OF THE CELL SURFACE

The Biology of the Cell Surface
By Ernest Everett Just. Pp. xi+392. (London: The Technical Press, Ltd., 1939.) 26s. net.

DR. JUST has written an interesting account of his personal views on a group of subjects ncluding fertilization, cell division, and the function of chromosomes. The first part of the book, dealing mainly with the structures, functions, and movements of the ectoplasm (the outer layers of the protoplasm) of marine eggs, contains a large amount of material on which there is fairly general agreement. The following chapter, on water, deals with the movements of water in eggs, and between eggs and their environment. It is stated that when eggs are placed in hypertonic saline, water leaves the egg in discrete droplets, which apparently have to pass through comparaively narrow channels in penetrating the ectoplasm. This extremely interesting observation, if confirmed, would invalidate the majority of the work which has been done on the permeability of marine eggs, in which it is assumed that water leaves the egg by simple diffusion. In the same chapter, Dr. Just betrays some doubt as to the existence of a relatively impermeable membrane at the surface of the cytoplasm. There is to-day no ambiguity on this point; the impedance studies of Cole (*J. Cell. Comp. Physiol.*, 1, 1; 1932; *J. Gen. Physiol.*, 18, 877; 1935) have hown that such typical eggs as those of Arbacia and Hipponoë have a membrane which is mpermeable to ions, while Chambers (*Biol. Bull.*, 69, 331; 1935) has shown by microdissection that this membrane is liquid and fatty in character.

The account of fertilization and parthenogenesis s excellent and perhaps the most interesting part of the book. Dr. Just's objections to Loeb's superficial cytolysis correction' theory of parthenogenesis are justified by adequate experimental evidence; he presents an alternative view (p. 245): "The most important factor in all modes of nitiating development is a dehydration process affecting directly or indirectly the ground subtance" of the cytoplasm. With this statement here may be some measure of agreement, although ultra-violet light, which is an effective parthenogenetic agent with many eggs, and the prick with a needle which will initiate development in a frog egg, can scarcely be considered as dehydrating agents. This rebuttal of Loeb scarcely justifies, however, the following remarks (pp. 238–239):

"The history of biological research furnishes us with other examples which illustrate the shortcomings of such physico-chemical approach in the setting-up of a singly studied property of living matter as synonymous with the whole complex of life-processes. Witness the theories of oxidation, permeability, electrical conductivity, viscosity, and the like. . . . Or take the almost universal fashion in which Hill's work on nerve conduction was accepted. By 'proving' that a nerve conducts without heat-loss this work must lead logically to the conclusion that the nerve fibre is not living, since it gives no evidence of metabolism. Strictly orthodox morphologists have likewise often presented theories of life-processes on the basis of demonstrations that only emphasize anew the capacity of the living thing, though debased, to respond according to its specific and intrinsic irritability. The now perfect collapse of the organizator theory is a case in point."

The first sentence of this paragraph shows that Dr. Just is flogging a horse which is not only dead, but had never lived except in the minds of a few holding extreme views. Such remarks impair a book which is always interesting when dealing with the author's own experimental work, and their rather frequent occurrence may lead many to dismiss it at less than its true value.

Succeeding chapters on cell division and cleavage are of great interest. Much ingenious indirect evidence is quoted to show that cell division may be independent of nuclear division. It is regrettable that the excellent work of E. B. Harvey on parthenogenetic merogeny (*Biol. Bull.*, 71, 101; 1936) is not once mentioned. Mrs. Harvey has shown that non-nucleated egg fragments of a number of species, for example, *Arbacia punctulata*, will develop, after parthenogenetic treatment, in a manner closely similar to that of the normal egg up to the stage of a blastula of about 500 cells. They do not, however, form free-swimming larvæ, and it seems highly probable that development beyond this stage is normally controlled by the nucleus. Thus the possibility of independent division of nuclei and of cytoplasm inferred by Dr. Just has, in fact, been directly observed.

The later chapters, dealing with chromosomes, etc., are almost entirely speculative. Some idea of the direction of these speculations may best be given by quotation:

"As development of the egg progresses [pp. 320-321], the egg potencies are restricted through their withdrawal from the cytoplasm by the chromosomes with each successive cell-division. Thus the cytoplasm forms functional areas. At some time in the history of the eggs' development, the potencies, having been previously taken out and stored by the chromosomes during cleavage and succeeding stages of differentiation, escape into the cytoplasm. The cytoplasm of the fertilized or parthenogenetically developing egg restores them again to the chromosomes."

P. 328: "The active 'factors' for Mendelian characters do not reside in the genes; rather, the genes, by extracting definite materials from the cytoplasm, render possible the reaction of the cytoplasm-located hereditary factors. Only in so far as they take out substance do the genes determine heredity. Thus finally every cell in the mos complex organism has in its nucleus all the poten cies bound except that one which is free in th cytoplasm, and which makes the cell specific."

Dr. Just does a useful service in directin attention to the role of the cytoplasm, but it is t be feared that in his attempts to give importan roles to the cytoplasm, he has abstracted mor from the significance of the nucleus than is pe missible.

J. F. DANIELLI.

PRAGMATICAL LOGIC

Logic
The Theory of Inquiry. By John Dewey. Pp. viii + 546. (London: George Allen and Unwin, Ltd., 1939.) 18*s*. net.

THIS book is the author's fourth on the subject, but only one other, "How We Think", is listed in the English Reference Catalogue. The present work is suited to more advanced students: it is discursive and controversial in manner, and Mr. Dewey's characteristic style will not encourage the puzzled beginner. It views logic—somewhat strenuously—as the study of the methods of solving problems.

Problems are all practical: "How to arrange things to suit us? What would suit us?" Evaluation and actual experiment are necessary for securing final judgment (pp. 160, 179) Final judgment has an actual subject and an ideal predicate (p. 124). Truth is defined by reference to ultimate agreement through certain methods of inquiry (p. 345). No actual judgment is incorrigible (p. 141): inquiry is continuous. Propositions are instruments for reaching judgments: they are defined by reference to symbols (pp. 51, 110). They include two fundamental sorts: existential, which express factual data, and non-existential, which define concepts (pp. 136, 283). The former are generated by the operations of selection-rejection, unifying-discriminating—which are the organic basis of 'is', 'is not', 'and', 'or' (p. 186). No existential proposition is ever universal: general existential (or 'generic') propositions, though expressed by 'all' or 'no', are not A or E propositions, since they assign only *observed* singulars to kinds (p. 380). Genuine universals are all definitive of kinds—that is, they exhibit possible substitutions within one system of symbols (pp. 300, 404). Such syntactical relations, however, are instituted on the basis of past discoveries: so that transformation from one expression to another (deduction) leads t inference, which is existential and probable. chief aim of science is to institute a language tha facilitates inferences. Mathematics is the fre development of syntactical relations—the exhib tion of language as a system (p. 394). Induction—gathering of evidence—proceeds under directio of hypotheses the implications of which ar explored by deduction (p. 427). Universal pro positions are used as causal laws in order to sho the continuity of series of events: causation i not itself an ontological category (p. 458). frequency theory is offered to justify the relianc we place in inductive-deductive methods (p. 470

The inquiry begins as an empirical descriptio of inquiries (a kind of directed behaviour). Th rules of inquiry appear as contracts, demands t be satisfied (pp. 16, 406). The psychology of usin symbols is described as the organic basis logical functions (p. 186). But logic must not onl describe, it must also justify, the methods inquiry. Here I detect an ambiguity: we ma *justify* a given rule by deriving it, according t certain principles, from more fundamental rule Such justification is absolute: by it we distinguis valid arguments from merely persuasive argument It consists in exhibiting all valid procedures one system unified by certain principles of co sistency, identity, etc. This justification is pr vided by formal logic. But what justifies t system itself? Rationalists *justify* (in anoth sense) the laws of thought, by appeal to a 'inerrable faculty'. Pragmatists—rejecting 'supe natural' reason—seek a merely *practical justifica tion* of inquiry. Their typical error is to try justify particular principles without showing the place in one system. This ignores absolute, logist justification altogether; and plainly we cann complete a practical justification of any definitio merely by reference to special interests a situations. For we must justify the rules th vern the inter-relations of terms, that is, the rmal rules and formal signs that bind a system gether. This might be done by showing that nless terms have fixed meanings throughout one gument, the aims of inquiry cannot (causally) e achieved.

A painstaking reader will come to the conclusion at Mr. Dewey is highly successful in avoiding pical pragmatist errors. There are, however, rtain hesitations which will excite the suspicious nd disconcert the unwary. Does Mr. Dewey nfuse formal and nonformal (p. 312), logical and sychological (pp. 106, 186)? Does he confuse the formal dilemma '*A* or *not-A*?' with the nonformal '*A* or *B*?' and so miss the fundamental importance of consistency (p. 346)? Does he understand necessary connexion (pp. 19, 44)? This last question is answered very satisfactorily indeed in Part 3—but doubt may survive until then.

Formalists will find many of their objections met if only they can be persuaded to read 546 pages of wordy and repetitious discourse. Pragmatists and logical positivists will welcome an able and comprehensive account of the views of one of the three or four founders of pragmatism.

KARL BRITTON.

SEISMIC PROSPECTING

ractical Seismology and Seismic Prospecting
y Prof. L. D. Leet. (Century Earth Science
eries.) Pp. x + 430 + 5 plates. (New York and
ondon: D. Appleton-Century Co., Inc., 1938.)
5s. net.

OTH from an academic and a commercial point of view, the exploration of the crust of the arth by explosion waves has assumed considerable nportance in recent years. Of great geological terest, for example, are Prof. Ewing's seismic xploration of the continental shelf of the northastern part of the United States and Dr. Bullard's ecent delineation of the Palæozoic floor of East nglia, whilst on the industrial side seismic prosecting has been employed in the search for oil nd in supplying data required in the construction f highways, bridges and dams. A treatise giving ore than a mere outline of the technique is herefore of considerable interest, especially as ctual surface strata by no means conform to the lealized uniform sheet usually depicted in works n seismology; it is all the more acceptable since is written by a practical seismologist who is qually familiar with the geological, geophysical nd technical aspects of the work.

The book is in five parts, with tables and ppendixes; it has a large number of excellent lustrations and copious references. The kernel f the treatise consists of Part 2 (elasticity and lastic waves), Part 3 (instrumental methods) and art 5 (seismic prospecting). Although the title f the work indicates a twofold purpose, workers n seismological observatories have been adequately atered for already, and the justification—a ufficient one—of the present volume is the dearth f easily accessible information on seismic prospecting.

Part 2 is of great interest. The first chapter (Chapter iii, on elastic constants) describes laboratory methods and gives valuable tables of elastic moduli of a large number of rocks as determined by modern experiments, including also the high-pressure determinations of Bridgman and others Chapter iv, on the propagation of waves in surface strata, is very thorough, and is as clear an account of the subject as could be desired; two- and three-layer structures, with inclined interfaces, are treated, as likewise is Slichter's important work on layers in which wave velocity varies with the depth. Chapter v, on the paths and travel times of earthquake waves, completes Part 2, and is complementary to the two preceding chapters.

Part 3 consists of two long chapters. Instruments (Chapter vi) are given an adequate theoretical treatment, and the theory of the Benioff electromechanical transducer is included. One is disappointed to find so little about the seismographs used in prospecting, although to some extent this is explained by the secrecy maintained (probably needlessly) by commercial geophysical organizations concerning details of their apparatus. Chapter vii, on the instrumental observation of earthquakes, outlines the interpretation of records and summarizes the general conclusions that have been drawn concerning the interior of the earth; some of this work could scarcely be called 'practical seismology', but it is perhaps as well not to insist on too rigorous a distinction.

It is Part 5, to be read in conjunction with Part 2, that makes the most distinctive contribution to seismological literature. A fairly full account is given of the reduction of observations, in particular of the tracing of a salt-dome. Formulæ are developed for dealing with reflexion shooting and for working up the results by the method of least squares; there is also some information on the reading of explosion records. The chapter on special commercial applications includes a table of patents on seismic prospecting taken out in the United States.

The great drawback of this book is its expense. The portion already outlined is just about all that the title of the volume demands, and for the practical student this content, occupying some 250 pages and costing perhaps 15s., would have been admirable. The author, however, wanders over so wide a field that the title is misleading. For example, he opens with a chapter on "Cause of Earthquakes", which is mainly an interesting but irrelevant summary of the geological histor of North America; the long chapter on the distribution of earthquakes might well have bee omitted. There are short chapters on terminolog and the history of seismology, and substantia chapters on the effects of earthquakes, importan earthquakes of history, and the mechanics o earthquake occurrence; all these are interestin enough in their proper setting, but quite out o place in a work of the scope indicated by its titl It would be a real help to the average student wh has little to spend on text-books if this attractivel written and well printed treatise could be re issued without Parts 1 and 4 and at about hal its present price.

R. STONELEY

PROF. STEPHEN TIMOSHENKO

Contributions to the Mechanics of Solids

Dedicated to Stephen Timoshenko by his Friends on the occasion of his Sixtieth Birthday Anniversary. Pp. viii + 277. (New York: The Macmillan Company, 1938.) 22s. net.

EMINENT scientific workers are frequently the recipients of special awards and public or professional honours, but it is rare to find the ceremony of presentation displaying these features that transformed the annual dinner of the Applied Mechanics Division of the American Society of Mechanical Engineers in December last, into a function wholly and variously devised to honour Prof. S. Timoshenko, who then completed his sixtieth year. The most impressive event in a programme of appreciative items and speeches was undoubtedly the presentation to Prof. Timoshenko of a commemorative volume to which twenty-nine engineers and men of science of international reputation contributed original papers. This volume has now been published and is a striking and unusual tribute to one who, on the subject range covered by the papers, is an outstanding authority. It is seldom that a teacher and investigator receives such a demonstration of regard while still actively engaged in his work; but the range and power of Prof. Timoshenko's studies, the importance of his contributions to scientific engineering and his great reputation as a teacher, have rightly won for him this notable and spontaneous tribute.

The brief outline of Prof. Timoshenko's career which prefaces the collection of papers is of great interest as showing the varied lines along whic he has progressed to the position of a leadin authority in the use of analytical methods o behalf of technical problems. While Timoshenk considers himself primarily a teacher and prefer the academic life, his work shows his direc concern with the practical issues of analytica processes; and even his most theoretical studie are enriched by a regard for the technical applications possible to the methods elucidated or derived This is, of course, a natural outcome of the wid experience acquired in the tenure of importan research and consulting positions in industry; an when such experience is allied to the exceptiona analytical powers that have made him famous a the occupant of professorial chairs in Russia an America, the results are bound to be valuable an are rightly acclaimed. His publications mak an impressive list comprising five books an twenty-three papers in Russian and ten book and forty-eight papers in English, French o German.

The twenty-nine papers in this commemorativ volume cover a wide field in the subject of th mechanics of solids, and the topics treated ar highly appropriate considering the aim an inspiration. The majority are on theoretical processes and applications of theory to stress analysi and vibration subjects, on which lines Timoshenk has written very extensively. Fatigue and cree of metals receive considerable attention, whil special subjects like photo-electricity and frictio are also represented. Mainly the authors ar American friends and associates, but admirer oad are also well represented. Papers are uded by Föppl, Prandtl, von Mises, Huber, thwell and Taylor.

uch a book dedicated to such an authority uld give a true reflection of modern methods problems. In this it does not fail. Buckling stability studies ; critical conditions and plex vibration systems ; studies in creep and stic flow characteristics ; on fatigue data and mechanism of friction ; on methods of analysis calculation ; on basic equations ; in reviews of development, etc., are tackled with power and highly specialized knowledge. The range must be examined to be appreciated. It would be impossible even to detail the themes here, and to select a few for individual mention would be invidious and contrary to the spirit of the publication. The volume is a storehouse of advanced method and knowledge, and forms a fitting and graceful tribute to one who is universally acknowledged to be a leading exponent of the lines studied.

MEXICO: PRESENT AND PAST

An Eye-Witness of Mexico

R. H. K. Marett. Pp. xi + 268 + 8 plates. ndon, New York and Toronto : Oxford Unisity Press, 1939.) 8*s*. 6*d*. net.

Mexican Mosaic

Rodney Gallop. Pp. 300 + 48 plates. (London: ber and Faber, Ltd., 1939.) 15*s*. net.

these two books, widely different aspects of Mexico are presented ; but they should be d in conjunction, if it is desired to obtain a nplete picture of what Mexico has become after r hundred years of contact with European ilization. The term 'contact' is used advisedly. hough it is a common assumption that the ple of what is generally called Latin America the heirs of Spanish, or more strictly Iberic ture, of most of them, at least so far as the eral run of the populace is concerned, it would more correct to say that their inheritance is damentally Indian, but with modifications by ropean tradition and forms of religious belief. is is certainly true of Mexico, perhaps above all others ; for, of the Mexican population one rd is of pure Indian stock, and not more than sixth is of unmixed white blood. Sixty ferent languages or dialects are still spoken hin its borders and more than a million of the ple have no Spanish. In the north, indigenous lian tribes, Yaqui, Cora, Tarahumare and ers, are virtually untouched by modern civiltion.

(1) In this remarkably varied society, ranging m a comparatively advanced modern civilizan to the primitive Indian, it is not surprising find that there is much that is instructive for iologist and anthropologist. Mr. Marett, as author of a work on Mexican archæology, is ly alive to the claims of the past, but here he concerned mainly with present-day tendencies, though he is able at times to add point to his argument by references to earlier history. He examines present trends in politics, thought and belief, development in social relations and above all in the competitive struggle now taking place between agrarianism and industrialization. In these matters his business experience in Mexico, extending over some years, as well as his social contacts through his marriage with a Mexican lady, enable him to speak with a double, and for a European, exceptional authority.

(2) Mr. Gallop, on the other hand, is not concerned with forward movement. His interests lie in the past, the survival in custom, belief, ritual and practice among the populace of much which in all essentials is not European, but Indian, handed down by tradition from the time of the Spanish conquest and probably from long before.

Mr. Gallop came to the study of the Mexican people with an intimate knowledge of the people and folk-lore of northern Spain, the Basques in particular, and therefore is well qualified for the task of disentangling the threads of Spanish influence from the Indian strands with which it is interwoven. On the religious processions, dances and feasts which form so large an element in popular practice, he is able to speak with especial confidence, as, for example, in his analysis of the cult of Our Lady of Guadeloup, in which he sees, with good reason, that it is essentially the ritual ceremonial of the Aztec goddess of fertility. From the various feasts and ceremonies which Mr. Gallop records, more especially the ritual battles and the survival of the Indian ball game, it is evident that the cult of fertility is no less prominent in the lives of the modern Mexicans, even if not always consciously, than it was among their ancestors.

THE CELL AND PROTOPLASM

SYMPOSIUM AT STANFORD UNIVERSITY

By Prof. C. V. Taylor,
Stanford University, California

THE Symposium on the "Cell and Protoplasm", which was convened at Stanford University, California, during June 30–July 5, began on the last evening of sessions of the Pacific Division of the American Association for the Advancement of Science and closed on the day of registration for the Sixteenth National Colloid Symposium. This time relation would partly account for the large attendance at the Cell Symposium, which increased with each session to an audience of about seven hundred at the closing lecture on "Structural Units" by Prof. J. D. Bernal, of the University of London.

The attendance and growing interest that marked this commemorative Symposium can be accredited primarily to the excellence of the papers presented—all by investigators of merited eminence. Their number included several distinguished biologists whose names have been familiar in the front ranks of biological science for more than a quarter of a century. Among the other participants were those whose more recent physical and chemical analyses of the cell and its protoplasmic constituents have greatly extended the confines of biological knowledge and have doubtless pointed the way for further productive researches of fundamental importance.

In all, thirteen American men of science participated, representing eleven universities and research institutes, and three visitors from Europe: Prof. A. Szent-Györgyi of Hungary, Prof. Hugo Theorell of Sweden and Prof. J. D. Bernal of Great Britain.

Of the papers presented, one each morning, afternoon and evening of the five-day session, the first three were concerned with early and modern concepts of the cell and protoplasm.

In the initial address on "An Historical Account of Cell and Protoplasm Concepts", Prof. E. G. Conklin of Princeton University re-emphasized the social nature of scientific discovery in which the end result of successive achievements of many minds is often given undue recognition. Thus credit for the formulation of the cell theory as commonly accorded to Schleiden and Schwann was believed unwarranted because their accounts had been antedated many years by the published results of various workers, beginning notably with Robert Hooke (1667).

The second paper, by Prof. Robert Chambers New York University, on "The Micromanipulati of Living Cells", essentially resolved our mode concepts of the living cell as a protoplasmic u to the unified nature and interrelations of molecular constituents. As illustrated in a moti picture, the protein constituents of the livi protoplasm tend to retain their integrated state the presence of an engulfed droplet of oil, althou upon cytolysis, induced through mechanical d ruption of the nucleus or otherwise, a prote 'skin' forms and becomes wrinkled around the droplet. This film formation likewise ensues wh such a droplet is added to a protein solution on microscope slide. This integrated protein fram work of living protoplasm, which may be demo strated also by the air-driven ultracentrifug strongly indicates a multimolecular organizati for the living cell.

Another modern aspect of protoplasmic co stitution, gained chiefly through studies on prot plasmic elaborations, was presented in the thi paper, by Prof. I. W. Bailey of Harvard Universit on "The Cell Wall and Protoplasm". Clearly t structural nature of the cellulose wall laid do by the plant protoplasm should offer invaluab clues to the nature and spatial relations of t protoplasmic constituents. Hence, the regulari of a highly specific and characteristic structur pattern—whether concentric, radial, ramifying radio-centric—of a given cell wall evidently reflec a potential pattern in the arrangement and orient tion of the protoplasmic constituents from whic the wall is derived. All evidence thus far indicat that the cellulose matrix of the cell walls of high plants is a continuous rather than a discontinuo system of anastomosed chain-molecules the lo axis of which is oriented parallel to the long axis the cellulose fibril. They exhibit positive anisotro and sharply defined extinction angles in mon chromatic polarized light. At present, there is reliable evidence that the structural framework the cell wall is ever composed of any random oriented chain-molecules.

Complementing these three papers on the c and protoplasm, there followed two on the c and chromosomes. The first of these was giv by Prof. H. S. Jennings of the Johns Hopki iversity on "Chromosomes and Cytoplasm in the)tozoa", and the second by Prof. Richard Goldımidt of the University of California on "Genes l Chromosomes".

The well-known nuclear cycle that recurs with h cell division during the ontogeny of a multi- lular organism was cited by Prof. Jennings as cial evidence of material interchanges between nucleus and cytoplasm. Accordingly, each ndensed chromosome enlarges during the later ases of mitosis to become vesicular from material en up from the cytoplasm. Within the resulting tiguous chromosome vesicles which constitute reformed nucleus, the newly acquired cyto- smic material is altered and, as such, is returned in to the surrounding cytoplasm upon the sequent breakdown of the vesicular wall of each omosome, the residue of which again condenses the following mitosis. These cyclic interchanges l transformations apparently provide the essential chanism of cellular differentiations both in the ogeny of multicellular organisms and in the racial iations of these and of unicellular organisms. illustrative of the latter, De Garis's recent results m crossing large and small races of Paramecium re discussed. These results showed that the conjugants, having unlike cytoplasms but like lei, retained their size differences for about nty-two generations, whereupon these differ- es gradually disappeared. Evidently, there- e, the two different cytoplasms were finally nsformed by the like nuclei such that the two es of unequal size came to have the same size. By what mechanism of the nucleus the cyclic difications, and so racial differences, may be cted was discussed in the succeeding paper by f. Goldschmidt. His thesis tended to discount commonly accepted gene theory of Mendelian edity, and proposed instead a chromosome theory which the occurrence of genes as discrete entities, anged bead-like in a definite order, need not be umed. Taking into account the similarities in omosome form and structure in the cells of all anisms, wherein a visible fibril-like core may resent a single protein unit of definite stoichio- tric properties along its axis, it would be more accord with recent X-ray, chemical and polari- tric analyses to identify the chromosome as a mical unit. Such a unit might show any ount of differential chemical complexity in erent chain-molecules of similar length. This cept would ascribe to the chromosome a linear tern and would account for mutational changes e bar-effect, mosaicism, position-effect, etc.) as to changes in the chromosomal pattern (inver- ns, translocations, duplication of parts, etc.) her than to changes within discrete particles, or es, of molecular order.

The demonstrable interrelations between cytoplasm and nucleus which would account for differentiation in both the individual and the race obviously represent but one of the two major components in the fundamental phenomena of living things. The other essential component is, of course, the environment. The role of environmental factors was well exemplified in the three papers that followed on developmental aspects of the cell and its relation to the organism. These included: "Cellular Differentiation and External Environment" by Prof. C. M. Child of the University of Chicago and Stanford University, "Cellular Differentiation and Internal Environment" by Prof. Ross G. Harrison of Yale University, and "Cell and Organism" by Prof. C. A. Kofoid of the University of California.

The external environment of the primordial cell, according to Prof. Child, is a determining factor in its differentiation at the very onset of development. The cell's primordial pattern is essentially a surface-interior pattern which reflects an intimate relationship with its environment. Also, by action of a suitable differential in its external environment, its polar or axiate differentiation is duly determined. Any one or more of various environmental differentials may induce this superimposed axiate pattern, as demonstrated, for example, in Whitaker's experimental studies on the ova of Fucus, as well as in numerous previous experiments by Prof. Child. Accordingly, the axiate pattern arises as a gradient which is initially quantitative in nature and which, once established, constitutes a gradient in rate of metabolic activity. Moreover, this environmentally induced axial or metabolic gradient then conditions the production and transfer of active constituents (chemical substances) in differentiating cells and so predetermines the course of later development.

Factors of differentiation in later stages of early development were discussed by Prof. Harrison as factors of the internal environment. These were illustrated especially from his extensive transplantation experiments on amphibian larvæ. Here the developmental pattern, which has progressed well beyond the initial axiate stage of Prof. Child's account, has demonstrably a primary cellular locus ('organizer') in the region of the dorsal lip of the blastopore and later various secondary loci, which determine organ differentiation throughout ensuing development. Depending upon the age of donor and of host as well as on the piece removed and its disposition where transplanted, the fate of the transplant and its effect upon the organogeny of the host were strikingly illustrated. From this it was evident that the fate and effect of a developing part are a function of its relation to other parts. This fundamental relationship obviously marks the internal environment of cellular differentiation.

In the succeeding paper, presented by Prof. Kofoid, it was emphasized, however, that even were the roles of both genetic and environmental factors of ontogenetic development well understood, that knowledge, essential as it must be, could constitute only part of any adequate understanding of the cell and organism. For the organism, beginning its individuality as a primordial cell, represents in its complete life-history not only the ontogeny that follows its unicellular stage but also the phylogeny preceding that stage. All organisms exhibit in this fundamental respect comparable life histories which may include, even for numerous so-called unicellular forms, a multicellular as well as a unicellular phase. Accordingly, it is only in terms of their total life-history, as an expression of their evolutionary and developmental history, that the cellular organization of living things can have basic significance and so the results of fundamental investigations a satisfactory basis of interpretation.

The two lectures that followed, one on "Chemical Aspects of Microorganisms" by Prof. C. B. van Niel of Stanford University, and the other on "The Structure of Viruses" by Dr. W. M. Stanley of the Rockefeller Institute, marked a transition from considerations of the cell and protoplasm of the more conspicuously cellular organisms to a discussion of the subcellular bacteria and of those ultramicroscopic, reproducing entities, the viruses, whose systematic status, whether animate or inanimate, apparently remains a problem of great moment.

Recognizing Schwann's important contribution not only to the formulation of the cell theory but also to the concept of yeast cells as vital agents of alcoholic fermentation, Prof. van Niel recounted the later developments of that concept, beginning especially with Pasteur, which have now led to a distinctly basic and far-reaching generalization. This generalization affirms that all chemical activities of living organisms are fundamentally hydrogen transfer reactions. Postulated first by Wieland for respiration as essentially a dehydrogenation of the respiratory substrate with oxygen or some other agent as the final hydrogen acceptor, this concept has become expanded by Kluyver and others to its present broadest generalization. Thus enzyme activity in metabolic processes serves primarily to facilitate hydrogen transfer reactions. It now appears that in the catabolic process this leads to the formation of products from which are directly synthesized the building stones of cell growth and differentiation by means of thermodynamically spontaneous reactions. This comprehensive generalization re-emphasizes the processes common to living things as the fundamental processes, the elucidation of which provides our point of departure for an adequate understanding of the more complex vital phenomena.

In this respect, the succeeding discussion on
viruses by Dr. Stanley was distinctly of fun
mental significance. It now appears that th
entities represent a margin of animate Nat
beyond the limits of cellular organization
commonly understood, yet they exhibit propert
of organic synthesis and reproduction characteri
of the living cell. Evidently their size relati
alone are not definitive, since they are larger th
some well-known microbes but several times sma
than some protein molecules. Their apparen
complete dependence on a living cell for th
reproduction would place them among oblig
parasites the nutrient requirements of which
highly specific and, at present, beyond experimen
duplication. Their essential nature, however, m
have a counterpart in the chromosomal genes of
cell nucleus or in other known protoplas
constituents such as the enzymes—a relations
which would obviously carry fundamental im
cations.

Some of the major advances in modern researc
on the cell have had to do with its active pro
plasmic constituents. Résumés of some rec
results were presented on "Enzymes" by P
Hugo Theorell of the University of Stockho
on "Plant Hormones", by Prof. F. W. We
California Institute of Technology, and on "Vi
mins" by Prof A. Szent-Györgyi of the Univers
of Szeged.

The common theme of these discussions dem
strated the essential relations between th
several active constituents. The common role
enzymes in the formation or release of linka
within the carbon chain is referable initially to
prosthetic groups; and for a number of w
known enzymes, the vitamin nature of their act
groups is now established. Thus, Prof. Theo
isolated the prosthetic group of the 'yell
enzymes' from the protein component by means
electrophoresis and identified this active gro
with vitamin B_2. It is now known also that vi
min B_1, including its pyrophosphate derivative,
identical with the prosthetic group of the enzy
carboxylase, and that the anti-pellagra vitamin
identical with the nicotinic acid amide, which is t
essential part of the prosthetic group of vari
dehydrogenases.

Enzyme specificity, however, is evidently
due to the prosthetic group but to its associat
protein molecule—thus denoting a relations
between activating and reacting components of t
cell which may come to account fundamentally
all biological specificity. According to Prof We
therefore, the more generalized activity of t
growth hormones can be attributed to their id
tity with prosthetic groups. This was well ill
trated by the multiple effects of auxin in

ngation, bud inhibition, root formation and bably other functions inside the plant. The iation of these growth processes, or their ibition, is traceable to the effect of diffusing or e-moving auxin on the translocation of other ential growth factors. But the specificity of s effect is inherent in the co-growth factors of the oting tissues. The production of these essential ive groups by some cells, such as those of the wing tip of a coleoptile, and the transport of se groups to other cells of the plant, which ough cellular differentiation have lost this ducing capacity, afford an excellent illustration the interdependence of cells and the functional egration of the various differentiated organs. ese relationships obviously underlie a unity in plant organism that is entirely comparable h that in the animal.

These considerations of enzymes and growth mones clearly indicate the essential nature of vitamins. As re-emphasized by Prof. Szent-örgyi, vitamins may be identified with the sthetic group of certain enzymes, and differ from ormone chiefly through the accident of nomenture, according to the source of production. us for rats or plants, ascorbic acid is not a amin since they themselves are able to synthee it. In the same sense, thiamin is a vitamin for mals, a hormone in some plants and a vitamin other plants, depending only on their powers synthesis. Obviously these relationships give ther evidence of the fundamental unity in the nt and animal kingdoms, and, in terms of the yme concept noted above, the vitamins contute an important key to a better understanding the essential nature of protoplasm and the cell.

The three concluding papers, as originally nned, effectively linked this Symposium with National Colloid Symposium which directly lowed. These included: "The Molecular Struce of Protoplasm" by Prof. O. L. Sponsler of the iversity of California at Los Angeles, "Protosm and Colloids" by Prof. L. V. Heilbrunn of University of Pennsylvania, and "Structural its" by Prof. J. D. Bernal of the University of ndon.

The general concept of the living cell as an ganized protoplasmic unit, which was stressed in egoing discussions, evidently presupposes for its toplasm a fundamental architecture, that is, an egrated spatial arrangement of the protoplasmic stituents.

An analysis of this architecture was presented Prof. Sponsler, as based on the known molecular stitution of protoplasm and computed from w fairly well-established dimensions of its tein chains and their linkages through hydrogen nds. Assuming a degree of protoplasmic homogeneity, it was concluded that the protoplasm comprises parallel protein chains, of dimensions about 1000 A. by 10 A. by 4·5 A., which are laterally united by water hydration centres and which, in turn, compose a sponge-like framework intercalated with water containing the various solutes. From this elementary protoplasmic architecture is derived the fundamental pattern of the primordial cell which, through developmental differentiation, gives rise to the tissue cells and organs of the adult organism, as recounted in the earlier discussions.

The colloidal properties of protoplasm and its cellular differentiation were variously exemplified in the paper presented by Prof. Heilbrunn. His recent investigations have demonstrated especially a localization in the cortex of the cell of calcium which, upon appropriate stimulus, is released within and so effects a gelation of the protoplasm involving contraction. Further evidences of this gelating effect were found upon exposing cut surfaces of cells to various concentrations of calcium salts. Thereupon a reversible limiting membrane was formed on the cut surface, or a bulb-like contraction was locally induced, due to the penetrated calcium. Thus the age-old problem of contractility, a common property of protoplasm, may find its solution normally in the localization and release of calcium in the cell's cortex.

Recalling the emphasis given throughout the Symposium to the structural aspects of protoplasm, Prof. Bernal, in presenting the final paper, urged that consideration of the energy relations was equally important, since not only do the energies involved determine the sort of structure possible but also their nature must be known in order to account for that structure. These energies relate primarily to the protein constituents of the protoplasm, a model for which may be found in the tobacco mosaic virus when contained in known salt solutions. Here the virus entities, which are long protein molecules, become orientated in striking spindle-like patterns, or tactoids, and their regular distances apart vary directly with the concentration of the salt solution. Evidently long-range forces between the virus entities are operative through the ionic atmosphere of the surrounding medium with which the former are in equilibrium. The magnitude and direction of forces inside the tactoid pattern are different from those on the outside. These differences, in fact, account for the pattern formation. Apparently analogous forces may similarly account for the formation of the mitotic figure and the ensuing phenomena during the mitosis of the living cell.

These papers are soon to be published in book form by the American Association for the Advancement of Science.

THE RELATIVITY OF TIME

By Prof. Herbert Dingle,

Imperial College of Science and Technology, London

THE view is widely held that, according to the restricted theory of relativity, moving measuring rods are shortened in the direction of motion, and moving clocks run slow, in the ratio $\left(1 - \frac{v^2}{c^2}\right)^{1/2} : 1$, where v is the velocity of the rods and clocks relative to instruments otherwise identical but assumed to be at rest. This view is correct so far as measuring rods are concerned; but incorrect with respect to clocks.

No metaphysical significance is here implied with regard to length and time. The statement that a moving rod is shortened means that if an observer stands at the centre of a relatively stationary rigid scale, past which a parallel scale, of equal length when relatively at rest, moves in the direction of its length; and if light signals are emitted from the two ends of the first scale at the instants when the corresponding ends of the other are coincident therewith; then the signal from the rear end will reach the observer before that from the other end, by an interval consistent with the postulated contraction. The word 'contraction' is, of course, to some extent metaphorical, because the scale which is said to be contracted is simply the one on which the observer is not situated. A more direct expression of the fact is that the 'length' of a scale is measured not by l as ordinarily defined, but by $l\left(1 - \frac{v^2}{c^2}\right)^{1/2}$: it is then unnecessary to imagine that anything has happened to either scale.

The statement that a moving clock is slowed down by a definite factor means that if, by any means ordinarily recognized as physically legitimate, an observer compares the rates of two clocks, one moving and the other stationary with respect to himself, he will find them to differ in the manner indicated.

There is no direct evidence for either statement, the experimental difficulties being too great. Circumstantial evidence, however, for the effect described as a contraction of a moving rod is given by the Michelson-Morley and other experiments, and the observational justification for accepting it as verified is very strong. There is no evidence of any kind for the definite retardation of clocks, and it is impossible that there could be, for there is in physics no explicit definition of a clock. The statement that a clock is slowed down in such a such a proportion is therefore meaningless.

A clock is any mechanism which successiv records time intervals certified as equal by co parison with the standard intervals adopted Greenwich and other observatories: the charac of the mechanism need not be specified so long the recorded intervals satisfy this condition. I us, then, imagine an instrument of hour-gl type, in which a succession of precisely simi particles (for example, grains of sand, drops water) fall at the standard rate into a recepta The time of occurrence of any event is th indicated by the number of particles, N, whi have fallen between some chosen zero instant a the instant of occurrence of that event. If M a V are respectively the mass and volume of particle, then the time is equally well indicated MN or VN (in each case, of course, a consta factor may be introduced to give the unit of ti any desired value). For such a clock at rest, th the time t between two events is proportional N, MN or VN.

Now set the clock moving with velocity v, a suppose that when it is moving uniformly, N changed to N'. Then, by the well-known formu MN changes to $MN'\left(1 - \frac{v^2}{c^2}\right)^{-1/2}$, and VN $VN'\left(1 - \frac{v^2}{c^2}\right)^{1/2}$. If, then, dt and dt' be intervals recorded by the stationary and movi clocks, respectively, between the same events, ratio dt'/dt will be different in the three cases, shown in the accompanying table:

dt	dt'	dt'/dt
N	N'	N'/N
MN	$N'M\left(\frac{1}{1-v^2/c^2}\right)^{1/2}$	$N'/N\left(\frac{1}{1-v^2/c^2}\right)^{1/2}$
VN	$N'V(1-v^2/c^2)^{1/2}$	$N'/N(1-v^2/c^2)^{1/2}$

All three clocks are equally 'legitimate': he the restricted theory of relativity gives no inform tion, and makes no assumption, about the haviour of moving clocks.

It is certain, however, that the mathemati requirements of the theory are represented by Lorentz transformation formulæ, according which dt'/dt is unequivocally determined. follows, then, that the time-coordinate of mulæ does not represent (except possibly identally in a particular case) the reading of a ok. What, then, does it represent ?

o answer this question we note first that t is tainly equal in value to the reading of a clock rest, though t' is in general not that of a clock motion. We therefore inquire what t essentially The clock with whose readings it agrees was ed by a mean solar time clock at Greenwich, us say; that, in turn, by a sidereal clock; and t by the revolutions of the celestial sphere at is, rotations of the Earth). Here Greenwich ps.

t would seem, then, that the time scale of the sics of stationary systems is that according to ich successive sidereal rotations of the Earth upy equal times. But that cannot be so, for are told that the Earth itself is slowing down. lifferent, and still more fundamental, standard herefore implied: What standard is that ?

he only way to answer this question is to mine the evidence for the Earth's retardation. is found in the fact that there is a discrepancy ween the calculated and the recorded tracks of ient eclipses. If the rotation of the Earth ually defined the unit of time, the conclusion ld necessarily be that the principles (namely, laws of Newtonian mechanics) on which the ulations were based were wrong. The con- sion actually drawn, however, is that the repancy is due to the gradual lengthening the day. The drawing of this conclusion mits us to the time scale necessary to justify wton's laws of motion. What is that time le ?

he first law is sufficient for our purpose. It s that a body free from external influences will ve uniformly; that is, equal times are those which such a body covers equal distances. At t we have reached finality. This is the time le represented by the co-ordinate t in stationary tems. A clock recording this time scale (we call it an 'ideal' clock) would be a particle ving freely, without friction, along an infinite ce-measuring scale in a region free from vitational and other fields of force: the 'time' uld be the reading of the scale at the instan- eous position of the particle.

o such clock can be made, and we have there- e to use various artificial constructions, with plicated controlling mechanisms, in order to ermine what its indications would be. It is surprising, therefore, that the corrections to applied to the readings of such artificial con- ctions when they are set moving, in order to lize the readings which the ideal clock would e if it were set moving, are almost as various the constructions themselves.

We can now see the meaning of t'. If t is the reading of an ideal clock at rest, t' must be that of an ideal clock in motion: or, in other words, t' refers to the time scale which will make the laws of mechanics hold for moving systems. There is no need to make an experiment (which in any case is impossible) to determine the relation of dt' to dt, for that relation is determined logically from the fact of the Fitzgerald contraction. Suppose an ideal clock is set moving in the direction of its space-measuring scale. Since there is, by definition, no force between the particle and that scale, the velocity of the particle relative to the scale must be considered unchanged; that is, the time which the particle of the stationary clock takes to move over n divisions of its scale must be considered equal to the time which the particle of the moving clock takes to move over n divisions of *its* scale. But the latter scale is contracted with respect to the other in the ratio $\left(1-\frac{v^2}{c^2}\right)^{1/2}:1$. Hence the particle of the moving clock moves a shorter distance in the same time: that is, the moving clock must be considered to be running slower than the stationary one in the ratio mentioned.

It appears, then, that the transformation formula for t is a logical consequence of that for x. Only the latter is based on experiment; the former is the necessary consequence if Newtonian mechanics is to hold good for uniformly moving systems despite the change of x. It is useless to look for experimental evidence for the change of t, for if, in any attempted experiment in which the Fitzgerald space contraction were assumed, the Lorentz formulæ were not verified, the only possible conclusion would be that the clock used was not an ideal one, and the necessary corrections would have to be applied to its readings.

Kennedy and Thorndike, in describing their celebrated repetition of the Michelson-Morley experiment with an interferometer having unequal arms[1], state that "Among the several classical experiments which suggested the restricted principle of relativity there appears to be none in which any question as to the nature of time is involved. . . . Hence, although such experiments have suggested the relativity theory, they do not form a sufficient basis for the logical derivation of it." This, as we have seen, is erroneous. What the Kennedy-Thorndike experiment provided was not, as the authors stated, confirmation of the Lorentz transformation for time, but evidence that, if light be regarded in the ordinary way as having a certain "frequency", then that frequency must be subject to the Lorentz transformation if the Fitzgerald space transformation also be assumed. In other words, the Kennedy-Thorndike experiment showed that light (or, if hypotheses be introduced, a radiating atom) behaves as an ideal clock. This, of course, is highly figurative language, because it is a 'clock' which can neither tell the time nor be used to measure time intervals. The literal interpretation of the experiment is that Newtonian mechanics is peculiarly fitted for the treatment of light as a periodic phenomenon because the association of time and space measurements implied in Newton's first law is just that which makes λ and ν change by reciprocal factors, thus keeping the velocity constant.

Incidentally, two things may be noticed. First, the frequently heard statement that relativity has brought about a fusion of space and time has nothing mystical about it and it is not true. It is not mystical because the 'nature' of space and time is not involved; all that we are concerned with is the fitting together of measurements made in various ways. The statement is not true because the fusion of space and time, in the only sense in which it exists, was made by Newton when he chose, as a measure of time, the spaces covered by a freely moving body. What relativity has done in this regard is simply to show how that measure can be preserved in face of the experimental fact of the Fitzgerald space contraction.

The second point is that the conformability of light to Newtonian mechanics, established by the Michelson-Morley and Kennedy-Thorndike experiments, makes it possible to define correspond units of space and time in terms of light inst of Newton's hypothetical "uniformly mov body". This is, in fact, what Milne does in theory of 'kinematical relativity'. In practice two procedures are equivalent, at least to a h degree of approximation, as we know from exp ment. Epistemologically, however, they dif- profoundly, since Milne's definitions, being ba on theoretically possible observations, are, principle, rigorously realizable; whereas Newto are ideal, and any observed departure of a mov body from uniformity of motion can be ascrit either to the time scale used or to the interfere of a force. In other words, Newton's first l provides a language but says nothing; it cann therefore, be convicted of untruth, and the wo that can happen is that the language may be fou inconvenient or incapable of providing express for everything we find it necessary to say. Miln postulates, on the other hand, are definite sta ments, and may be falsified by observation. T chance that this will happen is, of course, m imized by the fact that they are made to confo to all the experimental knowledge available at present time. This safeguard was introduced Milne when he modified his theory so as to ident the originally unspecified signals used by observ with light beams.

---

[1] "Experimental Establishment of the Relativity of Time", P Rev., [illegible], 400 (1932).

OBITUARIES

Mr. M. A. Bailey

THE scientific career of Maurice Armand Bailey ran its course to memorable achievement with what almost seemed to be predestined continuity. If circumstance played its part, a mind splendidly equipped for investigation, linked to a grand character, were the prime forces.

From Dulwich Bailey went up to Clare College, Cambridge, to read for the Natural Sciences Tripos and then for the diploma in agricultural science. After three years as a research student at the John Innes Horticultural Institution he joined the Royal Field Artillery in 1915, gaining in France the Military Cross and the rank of brigade major.

The appointment as senior botanist to the Ministry of Agriculture, Egypt, in 1919 turned the young geneticist into a plant breeder. For the next six years Bailey's studies of the cotton plant, recorded in a few excellent papers, developed a scientific attitude and procedure in practical breeding such as have rarely been achieved in that difficult art.

Transfer to the Sudan as plant breeder under the Empire Cotton Growing Corporation (attached to the Sudan Government) gave Bailey a great probl and a grand chance. In that country cotton gove prosperity. A great irrigation scheme in the Ge makes cotton-growing possible where rainfall is scant and uncertain for any normal agriculture. I the soil is commonly recognized as the most intra able clay in the world, and climatic peculiarities many seasons check the growth of cotton desp irrigation.

Average yields of cotton of 3·5 kantars a fed had become customary and were remunerative, in 1923 a virus disease, leaf curl, was reported, occurrence being exceedingly rare. It spread swiftly that by 1929 the whole Gezira, involv 200,000 acres of cotton, was seriously affected. the ensuing years cotton yield fluctuated dangerou but search for causes in soil factors, in seaso effects and in disease, was for a time in vain. L curl evidently played a great part, and in one year yields dropped to 1·36 kantars. Sudan fortu were gravely menaced, but an outstanding combi tion of research in plant breeding, in entomology, mycology, and in crop husbandry gained a victo which the remarkable speed and extent are shown the cotton yields of the years 1935–38, which were ·5, 3·72, 4·47 and 4·55 kantars per feddan re- ctively.

When Bailey retired from the Sudan in 1938, ton growing in the Gezira had been rescued and tial plans had been laid for the wider agricultural elopment of the whole country, including the ı-irrigated south. Hope that the ability and racter by which the Sudan had profited would y a great part in the National Institute of Agri- tural Botany, which Bailey came home to direct, s ended by his death in Cambridge on October 16 t at the age of forty-nine.

t was specially fitting that a scientific worker n and educated in England and provided by ypt with great opportunities for studying cotton uld do his culminating work in the Sudan, in ich these two countries have a condominium. He yed two parts there. For the first six years plant eding occupied all his time: for the remaining en he was director of agricultural research. It Bailey's clear planning and quiet persistent uence which led to the complete reorganization the research service. He infused into it the spirit ich has made it remarkable for success in conjoint k.

eaf curl was checked by two lines of action. The tomological, Mycological and Agricultural Sections, a series of fine investigations, identified the vector white fly, an Aleurodid) and found means of rcising a considerable degree of control over it in d practice. Meanwhile, the Plant Breeding tion set itself to examine the possibilities of aining, by selection or crossing, new varieties ich, while equal in lint qualities to the customarily wn Sakel variety and adapted to the peculiar ira environment, had the further merit of specific stance to leaf curl. Hybridization had to be carded because of its inevitable slowness, and all rt was concentrated on selection. The field was imately narrowed down to plants resulting from ingle selection out of a field crop of Sakel in the ira made by Mr. A. R. Lambert of the Botanical tion in 1926. There finally resulted two strains wn as *X* 1530 and *X* 1730 which, showing in ls all the desired attributes, had spread to an a of 130,000 acres in 1937–38. Systematic plant eding has nowhere produced a quicker or more nificant result than this. F. L. Engledow.

Prof. A. P. Orekhov

HE death occurred on October 19, at the age of y-eight, of Prof. Alexander Pavlovich Orekhov, mber of the Academy of Sciences of the U.S.S.R. rekhov was one of the most eminent experts in chemistry of alkaloids in the Soviet Union. centrating his main research on vegetable bases, ascertained that most of the alkaloids were not cifically characteristic of definite vegetable species families and that one and the same alkaloid or aloids of similar structure may be found in plants of different families. Under his guidance more than eight hundred kinds of new vegetable raw materials were studied, found mainly in the southern republics and provinces of the U.S.S.R. During this research were discovered a hundred new alkaloid-bearing plants and ten new families, previously not known to possess alkaloid-bearing representatives.

Orekhov established the structure of anabasine, salsoline, salsolidine, convolvine and certain other vegetable bases. Many of the alkaloids he isolated were afterwards identified as substances already known and obtained by other investigators from quite different vegetable raw materials. From the point of view of scientific theory, of special interest is his elucidation of the structure of the alkaloids convolamine and convolvine, which have been proved to be ethers of veratric acid and tropine. It was thus ascertained that the derivatives of tropine are encountered in quite new families hitherto not held to be alkaloid-bearing.

A. P. Orekhov created his own school of research workers, and the laboratory which he directed at the Chemical Pharmaceutical Institute attached to the Commissariat of Health became the principal centre for the study of the chemistry of alkaloids. His work on "The Chemistry of Alkaloids" is the standard work on the subject in the Soviet Union. He was elected a member of the Academy of Sciences of the U.S.S.R. in January of this year.

Prof. C. F. Shaw

The death of Prof. C. F. Shaw of California removes one of the most prominent of America's pedologists. Prof. Shaw gained a reputation from his studies in the field of pure rather than applied soil science, his name being especially associated with the question of soil classification. He spent several years studying Chinese soils, besides having a wide experience of American conditions. His revolving-disk method of measuring and specifying soil colour has been one of the more notable advances in the technique of soil physics in recent years. He was an ardent believer in the American binomial system of soil nomenclature, and had been engaged for some years prior to his death in collecting and collating a world list of 'soil-series' names, which was to serve systematic pedology as the Linnean system has served botany. G. V. J.

We regret to announce the following deaths:

Mr. P. H. Grimshaw, formerly keeper of the Natural History Department of the Royal Scottish Museum, on November 14.

Dr. R. von Ihering, chief of the Serviço Federal de Piscicultura, Rio de Janeiro, on September 15, aged fifty-six years.

Dr. T. L. Prankerd, lecturer in botany in the University of Reading, on November 11, aged sixty-one years.

Sir William Prout, K.C.M.G., O.B.E., senior consulting physician to the Colonial Office during 1927–29, on November 18, aged seventy-seven years.

NEWS AND VIEWS

Germanization and the University of Prague

Ruthless as have been the measures of repression directed by the Germans against Czech students and intellectuals for their part in the demonstrations on Independence Day, October 28, and the following days in the city of Prague, yet none will give rise to deeper resentment, nor have more far-reaching effect than the closing of the University and the technical schools. Not only do the Czech people feel a special pride in the University of Prague as the oldest University in Eastern Central Europe, but also the University has always been a central rallying point in the development of Czech national life and national culture. So long ago as the thirteenth century, Prague was a gathering place for students, and when in the middle of the fourteenth century it was recognized under a Bull of Pope Clement VI, Charles IV, Emperor and King of Bohemia, its founder, while organizing it on the model of Paris, of which he had been a student, in four "nations", intended that primarily it should serve the needs of students from Styria. Nevertheless, it drew its students from all parts of Europe, and in repute equalled the greatest of the medieval universities. It was, however, after the Napoleonic wars and in the earlier half of the nineteenth century that the University attained its greatest measure of influence in the development of a Czech national culture and consciousness. Not only was the study of the national language and antiquities taken up with ardour, but also industrial development was fostered in the movement which led to the foundation of the technical schools. In the course of events which followed on the War of 1914–18 the University has been no less active in promoting in the people a consciousness of their historical and intellectual heritage. Its suppression will have repercussions of which a better knowledge of their own history might have conveyed a warning to the Nazi leaders.

The Advancement of Science

The first quarterly part of the *Advancement of Science*, the new journal of the British Association which is being issued in place of the annual volumes published by the Association from 1831 until 1938, contains the presidential address of Sir Albert Seward, "The Western Isles through the Mists of Ages", as well as the presidential addresses to Sections D (Zoology), H (Anthropology) and K (Botany), with abstracts of communications to those Sections. An admirably written introduction reviews the Dundee meeting and the circumstances which led to the premature termination of an exceptionally promising and well-attended meeting, and also indicates the tentative policy of the new journal, which it is hoped will make a wider appeal to lay readers than an annual volume could do. The number also includes reports of research committees to Sections D, H, a K, as well as the report of the Council to the Gene Committee for the year 1938–39, and the report the Division for the Social and International Relati of Science for the same period. Among the subje which have received attention by the latter Divisi other than those forming the subject of public me ings, are the incidence of taxation on scientific search; areas and objects worthy of protection scientific grounds; recommendations on details manded in census returns and their analysis; scient news in the Press; scientific exhibitions; co-ope tion with the International Council of Scientific Uni in relation to questionnaires on science and socie and assisting the Society for the Protection of Scie and Learning. The number also includes a f instalment of a scientific survey of Dundee a district.

Soil Problems in the Tropics

In the editorial article entitled "White Settlem in the Tropics" of Nature, July 29, 1939, refere was made to the insistence in the report of Commission appointed to inquire into the possibili of white settlement in British Guiana on the ' herent poverty of many, perhaps most, tropical so in contrast to earlier beliefs in their inexhausti fertility. Writing from the East African Resea Station, Amani, Mr. G. Milne foresees a danger t facile generalizations regarding tropical soils as s may result. He points out that "tropical soils t to be poor when the climate is very wet, when soils are of advanced maturity, when (like any ot soils) they have suffered from man-accelera erosion, or when their parent materials have b exhausted of plant nutrients by previous geologi processes". One or more of these factors has rende huge areas of East Africa infertile, but there are large tracts where pessimism on grounds of intri soil infertility alone is not justified. Recent w has made it clear that neither the luxuriance natural rain-forest cover nor of grassland vegetat affords a reliable guide to the agricultural value soils (Hardy, F., *Trop. Agric.*, 13, 315; 19 Walter, H., *Forstliche Wochenschrift Silva*, 22, 2 1936: Milne, G., *East African Agric. J.*, July 19 and that therefore an ecological survey cannot t the place of a soil survey. The fundamental princi seems to be that a high forest has matured al with the soil that nourished it; in the old age both, the forest comes to depend very little on furt material supplies from a highly leached and poverished soil. Two things seem clear: one that principles of good soil management in the tro have yet to be fully understood, the other t tropical soils are liable under improper managem

(*Continued on page* 901)

NATURE

SUPPLEMENT

Vol. 144 SATURDAY, NOVEMBER 25, 1939 No. 3656

SHORT REVIEWS

AGRICULTURE

Humus
Origin, Chemical Composition and Importance in Nature. By Prof. Selman A. Waksman. Second dition, revised. Pp. xiv+526. (London: Baillière, Tindall and Cox, 1938.) 30*s*.

THIS treatise, first published in 1936, is now recognized as the standard text-book of the cience of humus, or 'humology', as the science has been called. The literature of humus is so diffused hat the treatment of the subject in agricultural and soil science text-books must necessarily be somewhat superficial and inadequate to the importance of the subject. The fact that the chemistry, physics and biology of humus do not lend themselves to easy nterpretation in terms of orthodox science is the main stumbling-block to progress in knowledge of he soil.

The book is in three parts. The first deals with the historical development of humus studies, the changing conceptions of the origin and composition of humus, and the reasons for the highly confused state of our knowledge of it. The nine chapters comprising the second part begin with the more rational approach to the subject, adopted about the commencement of the present century, in which the study of plant residues and the processes of their decomposition led to the modern conception of humus as a highly complex and changing group of organic and mineral substances. The decomposition of humus and its functions and applications in agriculture and industry occupy the remaining five chapters of the book, including a new chapter on humus and soil conservation.

The bibliography of 1608 references indicates the immense amount of work that has been devoted both to the investigation of humus and to the compilation of the book. If the amount of definite knowledge gained is disproportionately small to the amount of labour expended, it is nevertheless some of the most significant in the whole realm of soil science, and Dr. Waksman is to be congratulated on his selection of relevant facts and their condensation into a very readable and intelligible form.

Ce qu'il faut savoir des plantes des montagnes
Par P. Du Manoir. (Savoir en histoire naturelle, Vol. 5.) Pp. 54+40 plates. (Paris: Paul Lechevalier, 1939.) 16 francs.

Ce qu'il faut savoir pour manger les bons champignons
Par G. Portevin. (Savoir en histoire naturelle, Vol. 6.) Pp. 94. (Paris: Paul Lechevalier, 1939.) 12 francs.

THESE two little monographs are attractive in design, but any botanist would take issue with the claim that the contents represent what it is necessary to know on the subjects dealt with. Rather are they harmful in suggesting that, in the case of the alpine plants, with an idea of colour and size and a few notes on habitat, plants may be recognized by comparison with a rather impressionist representation in colours, usually of the flowering shoot alone.

The monograph on fungi does not pretend that the amateur can be sure to collect edible fungi on the basis of the brief descriptions of the fungi that it contains; it contents itself rather with suggestions as to modes of preparing the edible forms for the table when they are collected. Emphatically, however, this restricted field does not include what it is necessary to know before collecting and cooking fungi for the table.

ARCHAEOLOGY AND ETHNOLOGY

Buried Empires
The Earliest Civilisations of the Middle East. By Patrick Carleton. Pp. 290+12 plates. (London: Edward Arnold and Co., 1939.) 10*s*. 6*d*. net.

MR. CARLETON has excavated in Iraq as a member of Sir Leonard Woolley's archaeological expeditions to Ur, and he is a student of cuneiform. He writes, therefore, with the authority of first-hand knowledge; and his narrative of Mesopotamian pre- and proto-history, intended primarily for the general reader rather than the expert, summarizes in a vivid and eminently readable form the results of archaeological research from the beginnings, so far back as present knowledge goes, down to the earlier half of the second millennium B.C. With commendable honesty, but also doubtless with results which will prove disconcerting to the novice in these studies, Mr. Carleton adds an appendix on the material in the tablets of Mari, discovered after the main body of his narrative was completed, and it was too late to make any drastic revision. Hence the chapters dealing with Hammurabi and the Babylonian dynastic history, at least in their chronology and its implications, must, he points out, be set aside as superseded.

A valuable feature of the book is an excellent summary of the evidence relating to the civilization of the Indus valley and discoveries at Mohenjo-daro and Harappa, a subject on which too little provision has hitherto been made for the interests of the uninstructed.

If Mr. Carleton's narrative, excellent as it is, is open to criticism, it is due to the fact that it follows closely the tradition of earlier writers in devoting a preponderating attention to the personalities and achievements of the rulers, and to dynastic history, whereas recent studies have tended to show that the vital importance of Mesopotamia in the history of civilization lies in its contribution to the development of culture, rather than as a series of phases of 'history' in the narrower sense generally adopted.

Monographie des Betsileo (Madagascar)

Par H.-M. Dubois. (Université de Paris: Travaux et Mémoires de l'Institut d'Ethnologie, Tome 34.) Pp. xviii+1510+10 plates. (Paris: Institut d'Ethnologie, 1938.) 275 francs.

M. DUBOIS' monumental study of the Betsileo of Madagascar, running to more than fifteen hundred pages, is the product of thirty years' patient and careful observation conducted while the author was resident among them. Not only is it encyclopædic in scope, but also it may be regarded, as one critic has said, as indeed definitive.

M. Dubois has divided his work into four parts. In the first part he describes the geographical setting and considers racial history. In the second he deals with the individual, his life and the family and social environment in which it is passed. In the third he describes religious belief; and in the fourth art, language and literature.

In his discussion of general conclusions, M. Dubois makes no claim to have solved finally the problem of origins. His racial analysis of the population of Madagascar distinguishes four racial groups or influxes—Negrillo, Negro, Negroid and Indonesian. The Betsileo are to be assigned to the Negroid; but there is in them a strong strain of the earlier Negro and Negrillo stocks. Their economy is one of rice cultivation combined with cattle raising. Descent is patrilineal; and the sense of family solidarity is strong, centring in the cult of the ancestors as the founders of the family group. In essentials, however, the religious beliefs are fundamentally a doctrine analogous to the *mana* of the Pacific, demonstrated most emphatically in their taboo practices and their relations to chiefs.

African Genesis

By Leo Frobenius and Douglas C. Fox. Pp. 26 (London: Faber and Faber, Ltd., 1938.) 12s. 6 net.

THIS volume contains a number of legends an folk-tales selected from the collections made b Dr. Leo Frobenius among the various peoples he ha visited in his numerous expeditions in Africa for th purpose of studying prehistoric rock-engravings an paintings. Hence in geographical distribution the cover a wide field, ranging from North Africa t Southern Rhodesia, and ethnically include Kabyl the Sudanese tribes, Hausa and in the south Wahung and Bathonga. Most, but not quite all, have bee selected for the light they may throw on the meanin and purpose of the rock-drawings and painting Thus in the Kabyle creation legends, the part played by bull and ram explain the prominence o these animals in the art, while the raised arms of human figure before the bull in a certain drawing i a sign of adoration, and not of panic as has bee thought. It is interesting to find what would appea to be a trace of the influence of Egyptian roya marriage custom in these legends.

The stories are sufficiently varied in style an subject to please all tastes, and their literary merit on the whole are high. The Kabyle tale of the jack and lambs, with the substitution of jackal for wol is identical with that in Grimm. "The Old Woman" a tale told by the Hausas, is a piece of stark realism but the legends of the Sudanese, especially "Gasera' Lute" of the Soninke, and "Blue Blood" of th Fulbe have the epic quality of European medieva romance.

The illustrations are drawn from the rock art an there is a praiseworthy liberality in the matter o sketch maps. The translation is excellent.

BIOLOGY

Flora of Assam

Vol. 3: Caprifoliaceæ to Plantaginaceæ. By U. N Kanjilal, A. Das, P. C. Kanjilal and R. N. De (Published under the authority of the Governmen of Assam.) Pp. x+578. (Shillong: Forest Offic 1939.) 12 rupees.

INDIA has need of provincial or regional floras, an the present volume is a welcome addition to th few existing ones. This is the third volume comprising the Gamopetalæ in the sequence of th "Genera Plantarum"; the previous volumes appeare during 1934–38.

The work has been carried out by four fores officers (the senior of whom was the author of "Fores Flora of the Jaunsar, etc., Forest Divisions", wh died some years ago), under considerable difficulties as they have access neither to a good herbarium nor to an adequate library. This handicap become evident when one turns to nomenclature. Th position is explained by the chief editor in th introduction. In some cases modern ideas have bee adopted, in others the older authors have bee followed. This will be confusing to users who canno efer to original works, particularly so as reference as not been made to the "Flora of British India" hen the combinations there used have not been etained; for example, unless one has access to Mez's onograph of the Myrsinaceæ there is nothing to ndicate that the genus Sadira was treated as Pime- ndra in the older work. Again (p. ix) it is stated hat Mez "calls *Embelia Nagushia* Don, *E. undulata* s he identified *E. Nagushia* Don with *E. vestita* Roxb. n this work Brandis has been followed." But a eference to Mez shows that it is *E. Nagushia* Clarke ot Don that is termed *E. undulata* (Wall.) Mez and hat *E. Nagushia* Don is sunk in *E. vestita* Roxb. he error is of Brandis but only detectable by a eference to Mez.

Descriptions of families, genera and species are iven, but the tendency is to pay greater attention plants of importance in forestry. There is no key the families (this may be deferred to the final olume), but keys are provided for genera and pecies when there are more than one of either, and ese in general are satisfactory.

There has been a steady improvement in the veral parts, but there are still shortcomings in the resent volume, especially in the matter of misprints.

It is not clear why certain species are treated ifferently from the rest in the same genus; for xample, under Agapetes sixteen species are included the key and are serially numbered, but seven rther species appear without numbers and with orter descriptions and in smaller type.

Despite the difficulties encountered, the authors e carrying out a task the fruits of which will rove of great assistance to all concerned with the hanerogamic flora of Assam.

he Comity of Spiders

y Dr. William Syer Bristowe. Vol. 1. (Ray Society, ol. 126, for the Year 1938.) Pp. x+228+19 plates. ondon: Bernard Quaritch, Ltd., 1939.) 25s.

THE first volume of Dr. Bristowe's "Comity of Spiders" deals mainly with the distribution of iders in Britain. Some seventy-five years have ssed since the publication of Blackwall's fine work, A History of the Spiders of Great Britain and reland", and meanwhile our knowledge of the ritish fauna has been much enriched, notably by e researches of the Rev. O. Pickard Cambridge and r. A. R. Jackson. Dr. Bristowe, himself an able d enthusiastic collector, has also made many teresting additions and these advances are incor- rated in the most useful section of his book, a list the 556 known British species under their presently cepted names. For each species the distribution ithin Britain is given by counties from records rgely made by the author himself, and the dis- ibution outside Britain, so far as known, is indicated general terms. One or two nomenclatorial changes e made, but synonyms are not otherwise listed.

The second half of the book examines the effect of vironment on distribution and, besides more neral considerations of climate, soil, and flora, it mmarizes the results of collecting in a wide variety of habitats, natural and artificial, from sewage works to Buckingham Palace gardens. Dr. Bristowe has already published much of the matter in this section during recent years in the form of short papers, but the repetition is justified in a general treatise of this nature.

The monograph includes a discussion of dispersal in which the author stresses the importance of transport by aerial currents, and the book ends with a short chapter on the relative abundance of the spider population in the few localities which have been investigated.

The plates are well reproduced from excellent photographs and, although photography is not the ideal method of illustration, they will be a useful supplement in the identification of British spiders. Printing and production reach the high standard expected of Ray Society monographs, and Dr. Bristowe is to be complimented on a clear and readable style which is all too rare in scientific writings.

R. J. W.

An Account of the Genus Dioscorea in the East

Part 2: The Species which twine to the Right; with Addenda to Part 1, and a Summary. By D. Prain and I. H. Burkill. (Annals of the Royal Botanic Garden, Calcutta, Vol. 14, Part 2.) Pp. 425–528. (Alipore: Bengal Government Press, 1939.)

PART I of this monograph, reviewed in NATURE of January 29, 1938, dealt with the species of Dioscorea which twine to the left. The distribution of Part 2, treating of those that twine to the right, has been delayed, and under existing conditions this delay is indefinite. The portion of it now under review contains only the final summary and no systematy. In view of the delay in publication, advance separates of this summary have been obtained by the authors for presentation to institutions specially interested in biogeography. It presents thirty-five tables analysing in detail the distribution of the species described (147 in all) over the oriental range of the genus. A short but necessary discussion on "the meaning of the word species" defines the position adopted by the authors towards this vexed subject. It is followed by an exhaustive 'retrospect' in which is expounded an account of the systematic study and exploratory research devoted to the genus in the past, with particulars of the authors and collectors who have contributed to knowledge of the group. That there is still much to be elucidated is evident from thorough investigations under the title "Estimate of the Imperfection of Present Knowledge".

Finally, we have a dissertation on the biology of the species concerned, concluding with an exposition of the phytogeographic scheme adopted. To many botanists, especially on the ecological side, and to biologists generally, this part will prove more interesting and valuable than the mere systematy. It contains ample evidence in its pages of the enormous amount of labour and research put into the work.

It is to be hoped that workers in the group and area will not be for long deprived of the remaining portion.

An Architect of Nature

Being the Autobiography of Luther Burbank. With Biographical Sketch by Wilbur Hall. (Thinker's Library, No. 76.) Pp. xvii+139. (London: Watts and Co., 1939.) 1s. net.

IN this autobiography Luther Burbank reveals what proved to be the driving force behind his amazing life when he wrote "Darwin made important and absolutely new findings with regard to pollenization and fertilization, but, when he made them and set them down, he left it to others to make the rules useful". Burbank took it upon himself to be a pioneer among those "others", and now "every schoolboy knows" how he rapidly built up new species of plants by selecting with a knife, a hoe, or a spade and bonfire rather than by allowing new forms to develop more slowly under the deadly environmental competition of Nature.

In an introductory biographical sketch to this little volume, Wilbur Hall describes how Burbank had reached the age of seventy years before he felt constrained to express on paper the more important thoughts, observations and philosophical speculations of his life. This book represents all that he limned in his own words, so that one would expect it to remain a fount of delight to all who are interested in the man who was "blasphemed, preached about, talked at, written to, telegraphed, scolded, abused, and even vilified" merely because of his attempts to speed up Nature's methods by making use of keen and discerning man-made selective processes in the production of new types of plants. T. H. H.

On Miasmata and Contagia

By Jacob Henle. Translated by Dr. George Rosen. Pp. 77. (Baltimore, Md.: Johns Hopkins Press, 1938.) 1 dollar.

THIS important essay by one whom Garrison describes as the greatest German histologist and one of the greatest anatomists of all time, was originally published in 1840 in Henle's "Pathologische Untersuchungen", and contains the first clear statement that living organisms are the cause of contagious and infectious diseases. Dr. George Rosen, who has provided an excellent translation, points out that Henle's theory was not based on any personal experiments but on the data collected by his predecessors, such as Athanasius Kircher and Leeuwenhoek in the seventeenth century, who described infusoria and other microscopic animalcules, Wichmann who discovered the *Acarus scabiei*, Agostino Bassi who found that muscardine, an infectious disease of silkworms, was caused by a fungus, Cagniard de la Tour and Schwann, who showed that fermentation was due to yeast, and Schönlein, who discovered the parasitic cause of favus. Henle maintained that in infectious disease the morbid matter increased from the time that it entered the body, and that it must be organic in nature as only living organisms were able to do this. His view that the organism probably belonged to the plant kingdom was confirmed by Robert Koch, one of the most eminent of his pupils, more than thirty years later.

A Manual of Practical Anatomy

A Guide to the Dissection of the Human Body. B Prof. Thomas Walmsley. Second edition. In Parts. Part 2: The Thorax and Abdomen. P viii+331+7 plates. (London, New York an Toronto: Longmans, Green and Co., Ltd., 1939 12s. 6d. net.

THE principal changes in the new and great enlarged edition of this work, of which the fir appeared in 1921, are the introduction of fulle accounts of the examination of the living body, an especially of parts important in clinical practice, short description of the action of muscles and th changes in the form of parts when they function, th incorporation of numerous new figures and skiagram of the stomach, intestines and urinary tract, and change in the nomenclature to that adopted by th Anatomical Society of Great Britain and Ireland.

The book may be warmly recommended as a excellent practical guide for the dissector.

General Science Biology

By A. Spencer White. (Dent's Modern Scienc Series.) Pp. vii+243. (London: J. M. Dent an Sons, Ltd., 1939.) 2s. 3d.

THIS work has been prepared as a companio volume to the already published "Gener Science Physics" and "General Science Chemistry by the same author. The text is largely based o the reports of the teaching of general science compile by the Science Masters' Association, and is intende to cover the biology section of the general scienc syllabus of the School Certificate examinations. T material is presented in quite an interesting manne great prominence being given to experimental work The inclusion of subjects which would involve t use of the microscope is questionable, although u might be made of them as demonstrations. There an abundance of supplementary line-drawings, whi possess a diagrammatic clarity and simplicity th might usefully serve as a model for pupils.

Reminiscences of Country Life

By James George Cornish. Edited by Vaugh Cornish. Pp. xi+147+8 plates. (London: *Count Life*, Ltd., 1939.) 10s. 6d. net.

THESE reminiscences cover a period of sevent years of life in rural England—country parish in the counties of Suffolk, Berkshire and Devo Their author, James George Cornish, was born 1860 and died in 1938. Throughout his life, as the records bear witness, he was gifted with an observa eye for the life of the countryside and individu traits in the character of the countryman. H reminiscences have been edited by his brother, D Vaughan Cornish. As he points out, they derive inconsiderable value from the fact that they preser continuity over a very considerable period of tim This is especially interesting as in these years cruc changes took place in English agriculture a modes of country life.

CHEMISTRY

elins Handbuch der anorganischen Chemie

te vollig neu bearbeitete Auflage. Herausgegeben der Deutschen Chemischen Gesellschaft. System- omer 63 : Ruthenium. Pp. xxvi+124. (Berlin : lag Chemie, G.m.b.H., 1938.) 6.50 gold marks.

HE section on ruthenium in Gmelin's "Handbuch" contains an account of the physical and nical properties of this polyvalent element and ts compounds. The sources and preparation of metal are being dealt with in conjunction with r members of the platinum group. No fewer seven isotopes have been detected by the mass- troscope, and artificial radioactivity has been ted by bombardment with slow neutrons and erons. Ruthenium is very resistant to atmo- ric corrosion and the attack of strong acids, but an be oxidized in the presence of potassium rate to the tetroxide and by fused alkalis to enates.

uthenium is an excellent catalyst, particularly oxidations, being superior to platinum in this ect. A list of references to this application as lyst is given. It gives rise to a large number of plex co-ordination compounds, including a stable, tile carbonyl $Ru_2(CO)_9$, a red pentanitrosyl and y ammines and derivatives of organic bases. ong these complex compounds is the deeply ured derivative of tervalent ruthenium called henium red', which has the power of dyeing ural silk. Morgan and Burstall have shown that a chloro-hydroxo-tetrammine monochloride with rdination number 6. They have prepared from dichlorotetrammine monochloride, which reacts ammonia to regenerate ruthenium red. The stitution of this derivative seems to be uncertain, e Gleu and Breuel have recently described both and *trans*-dihalogenotetrammine halogenides, ch do not react with ammonia. A list of deriva- s of organic bases containing ruthenium is given.

sico-Chemical Experiments

Prof. Robert Livingston. Pp. xi+257. (New k : The Macmillan Company, 1939.) 10*s*.

HEORETICAL introductions to physical chemistry are plentiful—practical books on the e subject are only too rare. Dr. Livingston's pact and informative book arrives at an oppor- e period. Physical chemistry has now become so e a subject, and uses such specialized technique, t it becomes increasingly difficult to write a ctical book which will include a selection of eriments illustrating new principles with suffi- ntly modest and fool-proof apparatus.

n the volume under notice, classical physical mistry is there with all up-to-date improvements. re are, however, many welcome innovations in mall a book. For example, some experiments in ioactivity are described, absorption spectra find seful place ; there is a good discussion of, and a ple experiment with, a plate still. Chemical etics is represented by more interesting types of reaction than are customarily found in practical books. The section on electrochemistry is equally good. Even simple photochemical and colloidal experiments assume their proper place in the volume. But especial commendation must be accorded to the author for his excellent chapter on measurements, errors and computations. This is a chapter which may be read with great profit by advanced students of physical chemistry. This apparently modest little book, full of relevant information, therefore puts modern physical chemistry within the reach of any laboratory.

H. W. M.

Factual Tests in Inorganic Chemistry

(Post School Certificate Standard.) By F. A. Philbrick. Pp. 80. (London : G. Bell and Sons, Ltd., 1939.) 1*s*.

Answers to Factual Tests in Inorganic Chemistry

By F. A. Philbrick. Pp. 13. (London : G. Bell and Sons, Ltd., 1939.) 6*d*.

THIS book of "Factual Tests" is designed to test the student's grasp of inorganic chemistry up to Higher Certificate and Intermediate B.Sc. standard. Each question is set in such a way that the student has merely to select the correct answer from five alternatives and write down its number. Thus to answer : "34. The ammonium salt used in the Leclanché cell is the 1 sulphate, 2 chloride, 3 nitrate, 4 carbonate, 5 phosphate" ; the student merely writes down the figure 342.

The questions are set out in 'papers' which cover the chemistry of either one element or a group of related elements, and the numbering is devised so that all answers require a three-digit figure. The correct answers are supplied in a separate booklet, as recorded above.

There are clearly many advantages in having a book which can be used by student and teacher to test rapidly and objectively the factual information which has been acquired, without always having recourse to the wearisome tasks of writing out and correcting answers to the conventional type of question. In the opinion of the reviewer, "Factual Tests" should also have included questions which require a one- or two-word answer, but in spite of this omission it should prove of use to both students and teachers.

A. C. C.

A Course of Study in Chemical Principles

By Prof. Arthur A. Noyes and Prof. Miles S. Sherrill. Second edition, rewritten. Pp. xxv+554. (New York : The Macmillan Company, 1938.) 21*s*. net.

THE subject-matter has been thoroughly revised in the second edition of this book. A considerable improvement has been made by dealing with the first and second laws of thermodynamics at the beginning instead of at the end of the book. The kinetic theory has been considered in greater detail, and the essential features of the Debye-Hückel ion attraction theory have been added. The text, as in the old edition, is interspersed with problems which should prove of considerable value to university students.

A. C. C.

ENGINEERING

Airplane Structures

By Prof. Alfred S. Niles and Prof. Joseph S. Newell. Vol. 1. Second edition. Pp. xv+451. Vol. 2. Second edition. Pp. viii+177. 13*s*. 6*d*. net. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.)

THE revised edition of this book, now expanded into two volumes, attacks the problem of aircraft structural design from the point of view of the designer who may wish to apply the advances that scientific thought have made available to his problem. It discusses all of the methods of design and analysis that have been used successfully, and by the use of illustrative examples endeavours to show the best uses and the limitations of each.

The introductory chapters are devoted to the aerodynamic questions from which the conception of the applied external loadings is derived, and although naturally not complete in their scientific discussions of these problems, they do define them sufficiently to make clear the loadings that the structural designer is called upon to resist. The bridging of this gap has been conspicuously absent from published works hitherto.

The main portion of Volume 1 is then devoted to the various accepted methods of structural analysis, with applications, and includes a chapter on the strengths of methods of joining structural elements together, such as are acceptable in the somewhat peculiar aircraft practice. A very useful chapter on deflection and stiffness treated as a design problem finishes off the first volume.

The second volume contains a discussion of indeterminate structures, and gives many excellently worked out examples occurring in aircraft problems. The treatment of stressed skin structures is the least satisfactory part of this work; but these are problems still in their infancy, and about which controversial views are necessarily held until the correct practices have been established by experience.

In general, it can be said that this is an excellent book for both students and designers. It contains an unusually large number of tables, charts, and such aids to routine design work not always found in textbooks; further, these are set out in a manner calculated to make them of greatest use to the practical designer.

Foundations and Earth Pressures

By C. Hyde Wollaston. Pp. 295. (London: Hutchinson's Scientific and Technical Publications, 1939.) 21*s*. net.

IN recent years, increasing attention has been given to investigation in that branch of science designated soil mechanics, which deals with the behaviour of soil when treated as a material of construction. An account has been given in the report of the Building Research Board of the advances made in this branch, and it is therefore of especial interest and value to have the views of an engineer as to the methods of putting into practice such information as is available. These have been expressed with clearness and a full force of conviction by C. Hyde Wollaston, late engineer in the Public Works Department of Bu His aim is to bring home to engineers the desirab and importance of treating soils as materials of struction and with the same attention as is give timber, steel, and concrete.

The author shows that soil mechanics provid far more reliable and certain guide than is gene supposed, and explains how soil testing should perly be conducted. A clay soil, hitherto the bug of engineers, need no longer be regarded with picion. Its 'water-content' is now known to b sure criterion of its strength against compression. the first part of the book foundations are dealt w and in the second part the author turns his atten to earth pressures and retaining walls. The pract application of the new ideas on these subject exhibited in some fifteen examples which consti the third part entitled "Designs and Calculatio Here are treated actual designs ranging from a sin column footing to a reinforced concrete retai wall and calculations of the stability of bridge p useful both to the student and the practitioner.

MATHEMATICS AND ASTRONOMY

The Theory of Functions

By Prof. E. C. Titchmarsh. Second edition. x+454. (London: Oxford University Press, 19 25*s*. net.

THE second edition of Prof. Titchmarsh's "Th of Functions" has been produced ph graphically from amended sheets of the first, w the transfer of the main account of the gam function to the chapter on analytic continuation the insertion at the end of the chapter on inte functions of two theorems on asymptotic values an introduction to the theory of meromorphic fu tions which will send the reader eagerly to Nevanlin The list of memoirs consulted is unchanged; the of books recommended is of a more useful kind tha the first edition, but in an epoch when every weak ing of international bonds is to be deplored, regret that anyone should decide to restrict suc list so far as possible to works in English; result in this case is that whereas in 1932 a tota 25 titles was composed of 16 in English, 11 French, 7 in German, and a translation, in 1 a total of 24 titles includes 19 in English and translations.

Page numbers have been preserved, at a co there is only one page between 255 and 265, this is numbered 256–64; on the other hand, 28 followed by seven pages numbered 284*a* to 284*g*, then odd numbers take the left hand and e numbers the right until a blank unnumbered p at the end of the chapter restores the usual locati Since references throughout are to sections, not pages, the economy seems petty.

The success which this book has achieved pro that Prof. Titchmarsh was right in anticipating th the collection which he describes too modestly consisting of "rather disconnected introductions us branches of the theory of functions" would service to students to whom the mass of existing ture appeared "rather formidable". It proves, that early reviewers were right in recognizing a ty of readability in his writing; in effect, the e given to students was: "This is a book from h you will be able to learn how to do mathe-cs", and we cannot do better than repeat this e with all the confidence that comes from ring that it has been endorsed by those best ted to discover that it was sound, namely, the ents who have followed it. E. H. N.

etary Co-ordinates for the Years 1940–60 referred e Equinox of 1950·0

ared by H.M. Nautical Almanac Office. Pp. 150. (London: H.M. Stationery Office, 1939.) 6d. net.

HE present work is a continuation of the previous volume published in 1933, which contained in ephemeral data up to 1940; it extends these 1940 to 1960. The general arrangement is the as in the first volume, but certain alterations been introduced which add considerably to the enience of the tables. As computing machines be used almost entirely in connexion with the , the logarithm of the radius vector has been ted and a column giving the Julian date has inserted.

ose who are engaged in the computation of tary perturbations will find a great convenience the method of arranging the planetary co-ates. The material for Venus and the Earth is ed on facing pages, and the same applies to er and Saturn, the ephemeris for the latter t being given for intervals of 10 days instead days as in the previous volume. The material ranus and Neptune is also printed on facing , intervals of 40 days being retained as before. attractions of the sun are given to an extra al, the last figure retained being the tenth al. This refinement is quite unnecessary for ts, but will have an important application in ase of the perturbations of minor planets. The Prof. Numerov and Dr. Bower outlined a scheme he computation of very accurate ephemerides rtain minor planets, from which systematic ctions to star places could be determined, the extra figure will serve a useful purpose

e first volume gave the spherical co-ordinates anus and Neptune from 1903 to 1940 at intervals 0 days, and the present volume includes these dinates from 1800 to 1903. Full details are of the application of Cowell's method for the utation of perturbations, Comet 1933*f* (Whipple) selected for the purpose. This particular part e work was done by Miss F. M. McBain under irection of the Superintendent. It is scarcely sary to add that the volume will be invaluable mputers in various branches of astronomical

M. D.

Astronomy

A Textbook for University and College Students. By Prof. Robert H. Baker. Second edition. Pp. xx+522. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1939.) 16s. net.

THE first edition of this work appeared in 1930 and the second edition in 1933. Two reprints of the later edition appeared in 1934 and 1935 and the present volume is a third reprint. While the book is excellent in many respects, it is regrettable that a third edition was not produced instead of a reprint. This would have brought it up to date and would have enhanced its value very much. As one instance of the necessity for a new edition, we may refer to the story of Galileo and the Leaning Tower of Pisa, repeated on p. 151. Prof. Lane Cooper has shown that there is no foundation for the story, and Prof. A. S. Eve, while not agreeing entirely with Cooper, nevertheless concludes that "definite historical evidence is lacking" (NATURE, 137, 8, Jan. 4, 1936). It is to be hoped that a new edition will be put in preparation. M. D.

MISCELLANY

Aequanimitas

With other Addresses to Medical Students, Nurses and Practitioners of Medicine. By Sir William Osler. Reprinted from the third edition. Biographical Note by Sir Walter Langdon-Brown. Pp. xiv+452. (London: H. K. Lewis and Co., Ltd., 1939.) 7s. 6d. net.

THIS book, which contains the best-known of Osler's minor writings, consists of twenty-two addresses, seventeen of which were delivered in various parts of the United States (New York, Boston, Philadelphia, New Haven and Baltimore) and five in Canada (Montreal and Toronto). The well-merited popularity of the work, of which the present edition contains a sympathetic preface by one whom Osler would have called his "brother Regius", is shown by the fact that three impressions were made of the first and nine of the second edition.

Though addressed primarily to medical practitioners and students, the work, owing to its cosmopolitan outlook, will appeal to a much wider circle of readers, especially at the present time. With a characteristic blend of ripe wisdom and playfulness, Osler discusses a great variety of subjects, such as the education of the medical student and post-graduate, the importance of foreign travel and avoidance of Chauvinism, the necessity of doing the day's work well and before the age of forty, and physic and physicians as depicted in Plato. A 'bed-side library' of books for medical students is appended, consisting of the Old and New Testament, Shakespeare, Montaigne, Plutarch's Lives, Marcus Aurelius, Epictetus, "Religio Medici", "Don Quixote", Emerson and Oliver Wendell Holmes' "Breakfast-Table Series".

A Bibliography of the Writings of Harvey Cushing

Prepared on the occasion of his Seventieth Birthday, April 8, 1939, by the Harvey Cushing Society. Pp. xv+108. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1939.) 5 dollars.

THIS book, the sale of which is limited to four hundred copies, contains the bibliography of a man who was equally well known as an eminent brain surgeon and the author of one of the most successful biographies of recent times. The work, which is preceded by a sympathetic and humorous note by Dr. Arnold Klebs, the well-known medical historian, entitled "Bibliographia Animata", consists of four parts and appendixes. The first part gives a short account of Dr. Cushing's life, degrees and honours bestowed upon him by more than twenty different nations. In the second part are listed his books, thirteen in number, of which the best known are "The Pituitary Body and its Disorders" (1912), the "Life of Sir William Osler" (1925), and "Intracranial Tumours" (1932), of which a German translation appeared in 1935 and a French one in 1937. The third part contains a list of his addresses, papers in journals, and reports published between 1898 and 1938 numbering 306, while the fourth part is devoted to papers emanating from Dr. Cushing's clinics and laboratories.

The appendixes contain the names of his assistants in neurological surgery from 1908 to 1932 and voluntary graduate assistants from 1920 to 1932, hailing from England, France, Germany, Belgium, Holland, Rumania and Esthonia, and a list of members of the Harvey Cushing Society.

German–English Science Dictionary

For Students in the Agricultural, Biological and Physical Sciences. By Prof. Louis de Vries, with the collaboration of Members of the Graduate Faculty. Pp. x+473. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 18s. net.

IT was Dr. Samuel Johnson who emphasized our indebtedness to the compilers of dictionaries when he wrote, "Every other author may aspire to praise, the lexicographer can only hope to escape reproach". Scientific men will indeed be grateful to Prof. de Vries for having brought together some half a million stock words which are representative of German scientific language. No attempt has been made to include all the names of animals, plants, chemical compounds, etc., since each subject would need a dictionary of its own. But since research in the various departments of science now extends into complicated inter-departmental problems, the author has included terms which enter into the chemical, physical and biological sciences. Further selection has made use of the fact that the compounding of words is such a characteristic feature of the German language, only sufficient basic information being included to permit of the building-up of composite words. The book is strongly and attractively bound, but still remains a very convenient size for purposes of frequent reference. T. H. H.

Physics

Cosmic Machinery in an Electro-Magnetic Univ

By Capt. H. A. Staples. Pp. vi+224. (Lonc William Clowes and Sons, Ltd., 1939.) 12s. 6d.

THE author of this work claims to have structed a magnetic machine which was ab produce motion 'similar to the motion of the and planetary bodies". As the sun rotates, field of radiation rotates with it, and this " sweep" is responsible for the forward motio the earth in its orbit. Capt. Staples state page 139 that, with reference to Kepler's T Law, "the reason for the application of the p of the cube in association with the power of square have [sic] remained obscure". Appare however, this obscurity disappears with his ele magnetic interpretation, planetary motions fa into line with the laws relating to wave m issuing from a radiant source. It is only neces to point out that there is nothing obscure a Kepler's Third Law, which is very easily der from the inverse square law. It may be added the electromagnetic field of the planets appea play an important part in their orbital mo according to the author, but he makes no att in this book to apply his theory to other bodi the solar system, such as meteor streams, comet even the minor planets. Quantitative results o motions of the satellites would have been usef verify or disprove the theory, but the figures explanations given on pp. 149–51 are too vag be applied.

Although the author has spent twenty yea research on his work, it will not yet be gene accepted. M.

Spontaneous Fluctuations of Voltage due to Brov Motions of Electricity, Shot Effect and Kin Phenomena

By E. B. Moullin. (Oxford Engineering Sc Series.) Pp. viii+252. (Oxford: Clarendon P London: Oxford University Press, 1938.) 17s net.

TO an engineer the result of the sponta fluctuation of voltage is a noise which is ge in his way, and which he calculates from for which give approximately the result he requires knows that he is up against a natural limitati what he wants to do. The author of the volume under review takes a novel view; he rather st the engineer by making the subject of philoso interest, and by showing that the physicist not know as much about the subject as the eng thought he did. The author does not think theory has caught up with the abundant e mental data, and he has done a remarkable serv collecting such information as is available in a able way, so that some super-mathematician m inspired to find a link between atomic data an nuisance being examined.

The text is produced with the care and c we have been led to expect from the Oxford Eng ing Science Series. L. E. C.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

deterioration at a rate almost unknown in tem- rate latitudes. A single rainy season can com- tely destroy the fertility of a tropical soil unwisely posed.

il Destruction in Malaya

THE damage done to agricultural land by various rms of mining is considered by Sir Lewis L. Fermor his exhaustive "Report upon the Mining Industry of alaya" (Kuala Lumpor : Gov. Press, 1939. 6s.). The struction of land by the stacking of waste rock and ngue is small because the prevalent forms of tin- ning result in floods of water, heavily charged with t, either as coarse as sand or as fine as mud. This t, carried by the effluent water, chokes streams d causes flooding to such an extent that silt- tention schemes, necessitating dams or weirs, are ligatory. But much damage has been done in the st, and some is still being done, especially in the ning process of destroying hillside by water under draulic pressure. Again, the removal of the top yers of soil and their mixing with lower layers, ich is unavoidable in the process known as dredging, nder the whole surface within a mining concession fertile by the time the land is returned to agri- ltural use. Against these objections to mining must placed the fertilizing value on flooded land of a in deposit of silt. The writer is insistent that bber cultivation is equally harmful, in fact more , in ruining land by encouraging soil erosion and ding to the removal of fertile surface layers. Clean eding, a fetish of the rubber planter, causes soil moval between the rows of trees, and can be pre- nted only by the wise use of cover crops. Sir wis estimates that rubber cultivation has caused e addition of 33,000,000 tons of silt to the river stems since 1905, while tin-mining has contributed ly 16,000,000 tons. The debris from the rubber nds is both coarse and fine, and does more harm an the fine silt from the mines, some of which is rried to sea, and some of which fertilizes the land.

ewton's Letters

IN *Osiris* (7, 523–555; 1939) M. Jean Pelseneer, ose interest in the subject is well known, has produced some nine letters from Newton's un- blished correspondence. Four documents are own in reduced facsimile, and all are accompanied explanatory notes. The first four letters, between ewton and Oldenburg, are taken from the Ports- outh Collection in the University Library, Cam- idge. The next two, between Newton and Hooke, e in the Library of the Historical Society of Penn- lvania at Philadelphia. Of all these the main theme optical. Two other letters between Newton and ooke come from the Pierpont Morgan Library in w York; their subject-matter is of very minor terest. For the period covered by these eight letters 672–78) little original material bearing on Newton's e has been published. The ninth document is a int report signed by Newton and Halley on the rformance of a magnetic needle. This is an official per dated 1712, and preserved in the Public Record Office. It is two years since M. Pelseneer, writing in *Ciel et Terre*, pointed out with a reference to Stukeley's Memoirs of Sir Isaac Newton's Life, edited by A. H. White and then lately published, that the story of Newton and the apple certainly did not originate in the fertile imagination of Voltaire.

Early History of Antarctic Exploration

THE criticisms levelled by Prof. W. H. Hobbs at certain English explorers of West Antarctica of the early part of last century (*Trans. Amer. Phil. Soc.*, 31, Part 1, Jan. 1939) were discussed in NATURE of April 29, 1939, p. 731. A much fuller and a most scholarly treatment by Mr. A. R. Hinks of Prof. Hobbs's strictures appears in the *Geographical Journal* of October under the heading "On Some Misrepresentations of Antarctic History". The title indicates the nature of the conclusions which Mr. Hinks reaches. From a study of relevant documents, including original maps, he shows conclusively that Prof. Hobbs's claim that Palmer and not Bransfield discovered the Antarctic continent is false and that there is no foundation for Prof. Hobbs's contention that the chart signed by Bransfield which is in the Hydrographic Office is not genuine, and that Prof. Hobbs has no justification for discarding the account of Bransfield's voyage which appeared in the *Literary Gazette* (vol. 5, November 1821). No argument that Prof. Hobbs brings to this discussion can shake the authenticity of the documents on which Bransfield's claim to the discovery of Trinity Land, the first sighting of the Antarctic continent, is founded. Mr. Hinks raises many other points in his articles, including Prof. Hobbs's aspersions on the good faith of J. Weddell, whose discoveries conclusively stand the test of any inquiry and criticism. The article may be accepted as a final reasoned answer to the attacks made by Prof. Hobbs on these English navigators of Antarctic seas.

Germany's Oil Supplies

IN a carefully reasoned article published in the November issue of the *Industrial Chemist*, Dr. A. J. V. Underwood explains why in his opinion it is unlikely that Germany's belligerent activities will be suspended owing to shortage of oil. The present rate of production of oil and alternative fuels in the German Reich is estimated as 4,300,000 tons. This figure includes potential production of plants expected to be in operation by the end of this year. If plants which are likely to be in production by the end of 1940 or beginning of 1941 are included in the estimate, the potential rate of production of oil from all sources becomes 6,550,000 tons per year. In addition, imports of oil are at present available to Germany from Estonia, Rumania and the U.S.S.R. These with home-produced oil bring her total resources to 7,000,000 tons a year. If home production is increased as is anticipated, Germany will have access to 9,300,000 tons of oil a year. In 1938 Germany, including Czechoslovakia, consumed 7,900,000 tons of oil. This is substantially less than the 9,300,000 tons per annum potentially available, but has reference to peace-time conditions. In war-time, consumption by the fighting services will obviously increase even beyond the figure for 1938 when Germany was mobilizing, but at the same time civilian consumption will drop on account of the stringent rationing schemes now in force; also less oil will be used by Germany's mercantile marine, the activities of which have been so severely restricted of late. It is probable, therefore, that Germany's potential resources of oil will be sufficient for her war-time needs, and as reserves are available to supplement home production until such time as all projected plants are in operation, it is unlikely that she will go short of oil, unless through drastic changes in the international situation.

Folsom Man: Further Investigation in Colorado

A FURTHER season of excavation on the Lindenmeier site in northern Colorado has again failed to produce any trace of skeletal remains of Folsom man. Until such evidence is forthcoming, and on the assumption that it will afford some certain indication of the relation of the authors of the culture to the Amerindian peoples, the Folsom industry, with its distinctive characteristics, hangs in the air. The geological interpretation of the Folsom deposits on the Lindenmeier site assigns them to the last phase of the glacial period at an approximate dating of 12,000–25,000 years ago, and an association with an extinct fauna including mammoth, camel and extinct forms of bison. In the course of excavations carried out by Dr. F. H. H. Roberts, jun., in the past summer, the fifth season of his investigations on the site, it is reported in a statement issued by the Smithsonian Institution of Washington, that among animal bones, which had been chopped and split by man, was found the skull of an extinct bison measuring 36 inches between the tips of the horn cores—fully a foot wider than the spread between the horns in the modern species. In four months' work Dr. Roberts opened up a new section of the site over an area of some 45 ft. by 60 ft. to an average depth of six feet. His finds, in addition to the characteristic projectile points and previously known artefacts, included new forms of knives and scrapers, two to three times as large as those found before. A new feature in the culture is the bone bead, not hitherto found in Folsom deposits. Of those found here, one shows definite ornamentation in the form of a simple geometric design scratched on the surface.

Mental Hygiene in Old Age

IN a paper on this subject read before the Section on Care of the Aged, Welfare Council, New York City (*Mental Health*, 23, 257; 1939), Dr. George Lawton, psychological adviser to the Andrew Freedman Home, New York City, maintains that there is no group of persons whose mental welfare is more neglected than that of old people. This indifference, he declares, is world-wide even in countries with advanced social services. Although there has been for many years a guidance clinic for the aged in San Francisco, no definite steps have been taken f establishing a similar one in New York. Dr. Lawt asserts that what little knowledge we have of o people is based on pathological material, while v possess very little information about non-psychot old persons. He suggests that the psychologic difficulties presented by aged people should classified as follows: (1) the problems of neuroti borderline psychotic, psychotic, feeble-minded, a deterioriated individuals; (2) the minor mal-adju ments of fairly adequate old people caused by e cessive economic pressures and inhibitory soci attitudes; (3) the stresses and strains of perso undergoing normal mental and emotional declin According to Dr. Lawton, the management of t problem of senescence should include the followi measures, among others: (1) intensive, systemat studies over long periods of time, of the ment abilities, interests, recreations, emotions and perso alities of larger groups of men and women in to and country in each decade from forty to sixt (2) when such facts have been collected, guidan clinics should be set up to function in a simil manner to child guidance clinics; (3) courses geriatrics should be established in the medical scho to give future physicians a better understanding the effects of mental attitudes on the bodily ailmen of the aged.

Wild-life Restoration in the United States

IN the United States, as in other progress countries, the existence of many wild creatures h been threatened by the appropriation of lands f farming and industrial purposes, the destruction living places and breeding places, and the gradu disappearance of natural food and cover. To che this decrease of wild-life, the Federal Governme passed two years ago one of the most benefic measures of recent years, the Federal Aid to Wil life Restoration Act, briefly known as the Pittma Robertson Act of 1937. The co-operative schem which it envisages is one that might well be adopt in other countries, and a summary of its provisio and explanation of the co-operation which it see are now given by Albert M. Day (*U.S. Dept. Agr Misc. Pub.* No. 350; 1939). The Act recognizes t fundamental principle that wild-life is linked wi the land, and aims at the restoration of suitab environment in which wild birds and mammals m live and multiply. The Federal Government is willi to contribute materially towards this restorati programme, since it is known that individual Stat have been unable to cope with the situation becau of lack of funds. But a State to qualify for a sha of the grant—up to 75 per cent of the cost of wo performed on approved projects—must have pass laws for the conservation of wild-life, which sh include a prohibition against diverting fees paid hunters to any other purpose than the administrati of the State fish and game department. Already t Act appears to be working effectively. The gra total allocated for conservation projects in 19 was 1,186,666 dollars, of which State legislatur ntributed 296,666 and the Federal Government 0,000 dollars. Some time must elapse before the fect of these widely distributed schemes shows elf on the wild-life population, but there is every ason to think that the result will be gratifying to e naturalist as well as to the sportsman.

elevision Transmission over Telephone Cables

In the *Record* published in October by the Bell lephone Laboratories, Inc., L. Weis gives a helpful scussion of the problem of transmission signals over lephone cables. Most radio broadcasts originate in e studios of the broadcasting companies, and are ansmitted thence to the radio stations over high-ality programme circuits. Not infrequently the ick-up' point is at a distance from the studio and cuits to the studio must be provided over telephone ble pairs' not normally employed for broadcasting. ith television broadcasts such remote pick-up points e also required, but the utilization of ordinary teleone circuits to link them to the television studio more difficult because of the much wider band of quencies employed, besides certain exacting requireents for television transmission. Because of the perimental state of television broadcasting at the esent time, no arrangements for transmitting om these remote pick-up points have as yet been andardized.

Last May an experimental circuit of this nature as provided for the National Broadcasting Comny. More recently a somewhat similar one was ovided for the Columbia Broadcasting System. r ordinary telephone circuits a frequency band of out 3,000 cycles is sufficient, while for both these cent experiments the band extended from 45 to more an three million cycles—a range a thousand times eater than the voice band. When we consider the ses, we find that the loss in a co-axial cable at ree million cycles is only one millionth that in a ble-pair of equal length. For satisfactory television ansmission, equalizers must be provided to make e overall loss essentially the same for all frequencies. addition to the variation in loss with frequency ere is also a variation in the time of transmission. television transmission, if this is not kept extremely all the detail of the picture will be blurred, and urious transients and 'ghosts' will appear. Before cable pair can be used for television, it is necessary know the transmission time and then to provide ase equalizers to correct it. In the experiments e equalized line maintains the same transmission ne to within plus or minus one tenth of a microond, and this can be measured.

raffic Signals at 'Bank Complex'

A description is given in *Roads and Road Conuction* of November 1 of the 'electromatic' vehicle-tuated system operating on the 'flexible-progressive' stem. Automatic traffic signals outside the Bank England and on several important roads in the ality are to be installed as early as possible. It s been found that the signals in other parts of the City have proved of such value during the black-out that police officers have been able to concentrate on other important duties, and it is only at a few intersections that it has been necessary for them to control traffic by hand signals. The name 'Bank Complex' has been given to the area which is the junction of Threadneedle Street, Cornhill, Lombard Street, King William Street, Princes Street, Queen Victoria Street, Poultry and Mansion House Street. A specification for traffic signals to control the heavy and complicated traffic at this junction was prepared by the Ministry of Transport in collaboration with traffic officials of the City of London Police.

A scheme to meet the requirements of the specification was prepared by Automatic Telephone and Electric Co., Ltd., using electromatic vehicle-actuated signals. As traffic is approximately equally heavy in all directions, the problem is mainly concerned with ensuring the most rapid transit of vehicles through the thoroughfares converging on the area of the Bank Complex. Traffic increases to a maximum at morning and evening periods, and, if congestion and traffic blocks are to be avoided, the available road space must be used with the greatest efficiency. The whole system will be 'electromatic', operating on the flexible progressive system, under the control of a 'dual master-timer', and vehicle detectors will be used in each approach to the 'Bank Complex'. Signals are actuated by a special control unit divided into seven sections, which are linked together to coordinate the signal phases. It is important to notice that right-of-way is given to an approach only if there is a demand, and the length of this right-of-way period depends, up to a predetermined maximum, on the volume of the traffic. A novel feature of this system is provision of accommodation for traffic assessors in Cornhill and Poultry to determine the volume of traffic entering the complex on these approaches, so that variations of the right-of-way time can be made automatically.

The International Seismological Summary

The International Seismological Summary for October, November and December 1933 has just been received. It deals with 123 epicentres for earthquakes which occurred during that quarter, of which 47 were new epicentres and 76 repetitions of earthquakes from old epicentres, thus again confirming the knowledge that earthquakes tend to recur from the same epicentres. The five earthquakes with abnormal focus during the quarter all had deep foci. The first was on October 25, with epicentre in the Andes north-west of Jujuy (Argentine) with focus 0·03 of the earth's radius below normal. The second was on November 14 with epicentre north-east of Santiago on the borders of Chile and the Argentine with focal depth 0·02 of the earth's radius below normal. The third was on November 19 in the Pacific Ocean off the Japanese coast nearly south of Tokyo with focal depth 0·035 of the earth's radius below normal. The fourth and deepest was on December 1 with epicentre in the Pacific Ocean immediately to the south of the island of Aneityum (Loyalty Islands, Melanesia) with focus 0·09 of the earth's radius below normal. The fifth was on December 4 with epicentre in the Sea of Okhotsk to the east of Odomari with focus 0·040 of the earth's radius below normal. In continuation of the "Catalogue of Earthquakes 1925–1930", by Miss E. F. Bellamy, it has been decided to publish annually indexes to the International Seismological Summary. The first three of these for the years 1931, 1932 and 1933 arrived with the International Seismological Summary for the last quarter of 1933 and they form a very valuable addition to the summary for quick reference. The indexes are on a time basis, whereas Miss Bellamy's Catalogue 1913–1930 was on a geographical basis. The geographical basis is in many respects the better owing to the tendency mentioned above for earthquake shocks to recur from the same epicentre.

'Vibrated' Concrete

It is generally known that within certain limits the drier the concrete when it is mixed, the stronger it is when set. But it is not generally known, even among engineers, that it has been the practice for some years to contrive by mechanical means to produce super-compacted and hence super-strong concrete from materials which, treated in the normal way, would give normally strong results. A paper by R. F. Irving in the *House Journal of the Bournemouth Gas and Water Company* of October 2 gives the history and methods of manufacture of 'vibrated' concrete. In 1917, vibration of concrete was started in France on a commercial scale, and these machines have been extensively developed in America. Originally, the machines were driven by compressed air. The vibrating unit consisted of a freely moving piston, reciprocating as a shock producer, striking blows at a speed of 5,000–9,000 blows per minute. More modern machines, driven either by electric or petrol motors, have a rotor shaft provided with an unbalanced weight producing vibrations from 6,000 up to 21,000 per minute, the size of the motor unit varying from ½ to 1½ h.p. With the construction of No. 5 Reservoir at Alderney, the opportunity arose of taking advantage of the great developments in concrete construction. Preliminary tests of the relative strengths of unvibrated and vibrated concrete fully justified this procedure. Further, the vibration method led to a shortening of the time required for setting of the concrete and the consequent rapid release of the shuttering for use on new sections.

Earthquakes registered at Kew during October 1939

Fourteen earthquake shocks or earth tremors were registered on the seismographs at Kew during the month of October 1939. Four of these are reported to be very small, and some others have been confused by microseisms. The best seismograms obtained were for the earthquakes of October 10 and 17. That on October 10 had a probable epicentral distance of 88° from Kew and a depth of focus of 75 km. The earthquake of October 17 was again a deep focus shock, being thought provisionally from Kew records to have had a focal depth of abo 150 km. It was probably situated in the Ne Hebrides and was strong enough to give a f complement of pulses, including *ipPPP*, a lon tudinal body-wave reflected three times at t earth's surface, coming to the surface for the four time at Kew where it was registered.

Earth Tremor in New England

An earth tremor was felt on Tuesday nigh November 14, in the New England States of Pen sylvania, New Jersey, Maryland and Delaware. Th epicentre of the shock was probably very close Philadelphia, and in Baltimore pictures were knock off walls and furniture overturned, which indicat at this place a probable intensity of IV on t Rossi-Forel scale. Damage was not serious and the were no casualties. Although earth tremors are n unknown in New England, it is unusual to have o so strong as this. California and the western Stat are much more liable to shocks than the easte States.

Earthquakes in Central America and Canada

Using instrumental reports from Georgetow Fordham, Philadelphia, Weston and Guatemala, t United States Coast and Geodetic Survey in c operation with Science Service and the Jesuit Seism logical Association has determined the epicentre the earthquake of September 20, 1939, to be betwe Corquin and Ocotepeque on the mountainous bord between Honduras and Guatemala in Central Americ From readings of seismograms obtained at Pitt burg, Tucson, Ottawa, St. Louis and Fordham, t provisional epicentre of the earthquake of October 2 1939, has been determined to have been some twen miles south-west of Tadoussac in the Province Quebec. Both districts are liable to small eart quake shocks, though those in Central America a usually somewhat more intense than the Canadi shocks. Further news of these shocks is await from the observatories at Guatemala and Ottawa.

The Polarograph

Fifteen years ago Prof. J. Heyrovský, of the Char University of Prague, described a polarograph apparatus with the dropping mercury cathode whi he used for showing the presence of certain met in solution by the position of 'waves' produced the deposition potential curves automatically record as 'polarograms'. Since that time, Heyrovský a his co-workers have carried out many academ physico-chemical researches with the polarograp and in recent years it was beginning to find applic tion for other purposes in pure and applied scienc ranging from its use in examining sera for the diagno of cancer (Nature, 142, 316; 1938) to, say, t estimation of iodine in Chile saltpetre. The genui apparatus has hitherto been difficult to obtain, sin it was only made in Czechoslovakia, and resear workers and others will be interested to learn th although instruments are no longer obtainable fro Czechoslovakia, an improved model, complete wi f-contained recording equipment, of British design, ow being manufactured by the Cambridge Instru- nt Co., Ltd.; it is anticipated that the polaro- ph will find still wider uses in the near future, ecially in analytical and electrochemical work.

roleum

THE first number of *Petroleum*, a monthly magazine evoted to the essential interests and needs of the roleum industry", was published in October onard Hill, Ltd., 17 Stratford Place, London, W.1. nual subscription, 10*s*. post paid. Abroad, 12*s*. 6*d*.). e sponsors of this journal are to be congratulated launching this new venture scarcely a month after beginning of war, and on the way in which they ve interpreted the Prime Minister's admonition to ry on. Naturally the outbreak of war materially set carefully laid plans for the first number. ghly specialized articles had to be omitted and otographs discarded lest they should fall into my hands. Moreover, many potential contributors re called away on national service and were ordingly not in a position to submit articles. vertheless, in spite of these handicaps, the first mber is full of interest and it may be its lack of highly technical contributions will prove an asset the long run. The question raised as to whether ncrete or steel should be used for underground rage, the description of some lesser known uses petroleum and the notes on petrol rationing in eat Britain and other countries, to cite a few amples, should appeal not only to petroleum hnologists but equally to a far wider public.

tomology in South Africa

THE appearance of volume 2 (dated October 30, 39) of the *Journal of the Entomological Society of uth Africa* will be welcomed by workers in this nch of zoology. Some seventeen papers are in- ded within a compass of 262 pages and their great ersity of character may be gathered from the fact t they include descriptions of new Thysanoptera, tudy of body temperature in *Samia cecropia* and investigation of the chromosomes in some of the nsvaal Acrididæ. We wish every success to this periodical and trust that it will be assured of equate support during these critical times. The ce of the volume is £2, and European readers may tain it from N. V. Swets and Zeitlinger, Keizergracht , Amsterdam, Holland.

oks on Gardening and Botany

MESSRS. DULAU AND COMPANY, LTD., of 29 Dover eet, London, W.1, have issued a catalogue of books botany and gardening. Several volumes of ndard journals, many of which are out of print, offered, notably *Curtis's Botanical Magazine* 42), the R.H.S. Daffodil Year Book for 1913–15, first 22 volumes of the *Transactions of the Edin- gh Botanical Society*, the *Journal of Botany*, and *Kew Bulletin*. The remainder of the list covers better-known classics of a wide range of horti- tural activities. Seventeenth-century herbals appear to be represented mostly by later reprints, though one or two originals are also offered. A number of first editions and association books of general literary significance occupy the main part of the catalogue.

Centenary of Pulkovo Observatory

THE centenary of the Pulkovo Observatory, one of the oldest scientific institutions in the U.S.S.R., will be marked by a special jubilee session of the Academy of Sciences to be held in Leningrad on December 25. The papers of a scientific and historical character to be read at the session will show in historic retrospect the century of endeavour of the Pulkovo Observatory and its role in world science. The centenary will also be marked by the issue of a comprehensive symposium and the opening of an exhibition dealing with the work at the Observatory.

Announcements

PROF. E. D. ADRIAN, professor of physiology in the University of Cambridge, has been appointed a member of the Medical Research Council in the vacancy caused by the death of Prof. John Mellanby.

THE following officers for 1940 of the Institute of Metals have recently been elected: *President*, Lieut.-Colonel the Hon. R. M. Preston; *Vice-Presidents*, Dr. S. F. Dorey, Engineer Vice-Admiral Sir George Preece, Mr. A. J. G. Smout; *Honorary Treasurer*, Lieutenant-General Sir J. Ronald E. Charles.

THE Institution of Automobile Engineers is holding a special general meeting to which other institutes have been invited on December 12, at the Institution of Electrical Engineers, Victoria Embankment, W.C.2, at 6 p.m., when Dr. J. S. Clarke of the City of Birmingham Gas Department will read a paper entitled "The Use of Gas as a Fuel for Motor Vehicles".

THE Hunterian collection of surgical specimens at the Royal College of Surgeons of England has been removed to a bomb-proof vault in the College basement. All the more important manuscripts, books, and pictures in the College library have been moved to the country.

The Universities of Breslau, Erlangen, Marburg and, with the exception of the medical faculty, Königsberg, which were closed at the beginning of the war, have reopened.

PROF. GERMANO SOLLAZZO has been nominated director of the new hospital at Milan named Ospedale del Perdono, which is to take the place of the famous old Ospedale Maggiore.

THE second Argentine Congress of Ophthalmology will be held at Rosario in October 1940, under the presidency of Prof. Esteban Adrogué. Further information can be obtained from the Sociedad Argentina de Oftalmologia, Santa Fé, 1,171.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 911.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

An Inhibitor of Growth Extracted from Pea Leaves

RECENTLY, Stewart, Bergren and Redemann[1] and Stewart[2] have extracted from the leafy cotyledons of radish seedlings a substance which retards the growth of oat coleoptiles. They extracted by a method devised by van Overbeek[3] for extracting auxin, leaving the material in purified ether without grinding it up, and then drying the extract by distillation and evaporation; and they tested the extract on decapitated coleoptiles by Went's method. Since it is an interesting question how widely growth inhibitors may be distributed in plants, I have made extracts from various parts of pea seedlings by the same method. The dried extracts were dissolved in a few drops of water, slightly acidified with hydrochloric acid, and the solutions, at about *p*H 5·5, were tested by being taken up in little strips of blotting-paper, measuring 8 mm. × 2·5 mm., which were then applied to *intact* dark-grown oat coleoptiles, lengthwise along one of the narrow sides and reaching to the top. The strips stood on little ledges of vaseline placed to support them. As a rule the dried extract from each gram of fresh plant material, weighing about 11 mgm., was dissolved in one drop (50 cmm.) of water, and each drop of solution sufficed for three strips of paper and so for three coleoptiles.

The extracts made from mature pea leaves together with 3 or 4 cm. of stem to each leaf caused the coleoptiles to curve positively, that is, towards the side to which they were applied, showing that they retarded growth on that side. The curves were quite strong after 1 hour or less at about 19° C., and they usually increased up to 1½ or 2 hours and then diminished and sometimes reversed. They varied surprisingly in amount, but often reached 20° and sometimes 25° or 30°. Other tests showed that the curves could not be due to the *p*H or to the osmotic value of the solutions, so that they must have been due to an inhibiting substance or substances. The curves started close to the extreme tip and spread downwards very slowly, reaching a level 10–12 mm. below the tip, and 2–4 mm. below the base of the strip of paper, after 2–3 hours. So this inhibiting substance differs from that obtained by Stewart and others, which travelled much faster. It is not the same as the wound substance, which had no effect in the same test. Extract from stem alone caused no curves, so that the inhibitor is presumably contained in the mature leaves. Extracts from growing apical buds caused only few positive curves, or sometimes none. But they often caused negative curves which developed later and at a lower level, and may possibly have been due to auxin. Extracts from correlatively inhibited leafy lateral shoots caused positive curves, indicating inhibitor.

These results suggest the question whether this inhibitor is involved in correlative inhibition. If so, it should disappear after several days from decapitated disbudded shoots: for in such shoots a lateral bu if allowed to remain, grows out rapidly after abo 3 days, showing that inhibition has practically ceas But actually in some experiments (though not all) the leaves of such decapitated shoots were fou still to contain abundant inhibitor after from 4 t days. However, this objection is perhaps not qu conclusive.

The inhibitor when contained in the dried extr was found to be insoluble in dry ether. So it mu have diffused out from the etherized plant mater in the water which was present: for a little wa was, of course, introduced in the plant material its and also the ether used in the extraction was quite dry. Accordingly, in order to collect the wh of the inhibitor, the distilling flask was rinsed with 2 or 3 c.c. of water after the ether had be distilled off (at 60° C.): this water was added ju before the distillation.

R. SNOW.

Magdalen College,
Oxford.
Nov. 4.

---

[1] Stewart, W., Bergren, W., and Redemann, C. E., *Science*, N.S., 185 (1939).

[2] Stewart, W., *Bot. Gaz.*, 101, 91 (1939).

[3] Overbeek, J. van, *Proc. Nat. Acad. Sci.*, 24, 42 (1938.)

Utilization of Carbohydrates in Leguminous Sy biosis

EXPERIMENTS carried out in this department dur the past summer may be of interest in connexi with a recent letter from Allison and his collaborato in which they conclude for field-grown legumino plants that the associated nodule bacteria consu only a relatively small proportion of plant carb hydrates in their respiration. In these experimen determinations have been made of the rate of evo tion of respiratory carbon dioxide from the r systems of two series of soya bean plants growing water culture (Crone's solution), one series (of fift plants) being nodulated, the other (of ten plan being kept free of infection by the nodule organi and supplied with sodium nitrate. During the det minations, which were made at the flowering st and at a temperature of 20°–21° C., air initially f of carbon dioxide was bubbled through the cult solution in which the root systems were growing a then passed into absorption towers containi standard baryta. For the nitrate plants the evoluti of carbon dioxide was of the order of 0·8 c.c. N.T.P.) per hour per gm. dry weight of root tissu Allison *et al.* report an average Q_{O_2} of 2·2 for detac root fragments, equivalent to an absorption of 2·2 of oxygen per hour per gm. dry weight. They u young roots only, whereas the figure of 0·8 c.c. an average for the whole root system: again, it bable that the Washington experiments were con- ted at a higher temperature.

From the results with the nodulated plants, it ears, assuming the respiration per gm. dry weight the root tissues of these plants to be similar to t of the nitrate plants, that the evolution of carbon xide from the nodules themselves was of the order 2·5 c.c. per hour per gm. dry weight.

In comparing this with the corresponding figure of given by Allison *et al.* for oxygen absorption by dules (detached), consideration must be given to sible differences of temperature and also to their ding that the respiratory quotient of nodules in is considerably above unity. Since in the Glasgow eriments the dry weights of roots and of nodules re as 2·8 : 1 in the nodulated plants, it appears t during a given time the total carbon dioxide lved from the nodules of a plant was slightly ater than that from the roots alone. If, as Allison d his co-workers conclude, the respiration of dules is partly anaerobic, it is possible that in these ticular plants the amount of carbohydrate utilized nodule respiration (presumably chiefly by the teria) exceeded appreciably that used by the roots mselves, though no doubt it was still small com- ed with the total carbohydrate synthesized by the nt. The dry weight of roots and tops together pared with that of the nodules was as 12 : 1; so far no figures have been obtained for the res- tion of the aerial organs of plants of this type. experiments will be continued.

.G. BOND.

Botany Department,
University of Glasgow. Nov. 4.

---

son, Ludwig, Hoover and Minor, NATURE, 144, 711 (1939).

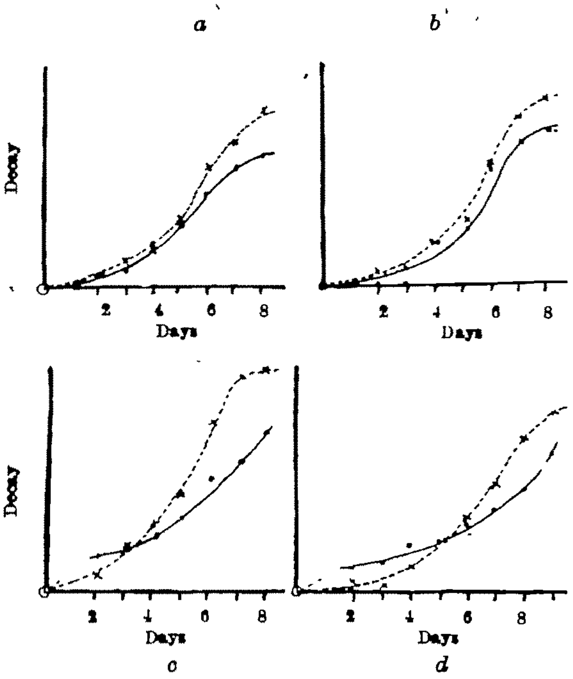
Humoral Immunity among Plants

PREVIOUS investigators[1,2] have concluded, after a nber of attempts to produce some measure of moral immunity in plants towards fungal and terial diseases, by various methods of 'vaccina- n', that there is no trustworthy evidence for any orted case of such immunity, despite earlier claims the contrary[3,4]. Manil[5], however, reports a very lized and temporary immunity produced in acco by vaccination with *Bact. tabacum*.

The principal reason why plants cannot be expected exhibit immunitary phenomena like those of the her animals is due to their lack of a circulatory tem, as pointed out by Chester[6]. For this reason, immunitary humour which may be formed in a t cell attacked by a parasite will probably be troyed on the death of this cell, unless it is able move out by diffusion beforehand into living ue ; but in the course of this process, the humour l become so diluted that any immunitary effect erved will be quantitatively much smaller, and s perhaps qualitatively different from those erto looked for.

In order to demonstrate such an effect, it would necessary to carry out experiments designed to ow the course of development of the post-parasite plex, and to compare this with the course of elopment of a suitable set of controls.

uch experiments have been performed by me at Station, using wheat seedlings as host plants, the rusts *Puccinia graminis tritici* and *P. rubigo- triticina* as parasites. Host leaves were inoculated the usual way, and two or three days later severed from the plant and the rust destroyed by placing them in a water bath at 40° C. for 15 minutes. They were afterwards inoculated with either the same, or the other, rust species, and kept under observation in plugged test-tubes for up to 10 days. In control tests, either the first or the second inoculation was omitted, or both, but the warm-water treatment was given in every case ; all possible combinations of the two rusts were used. All the host varieties used gave a fully susceptible reaction to both rusts.



COURSE OF DECAY, OBSERVED (FULL LINE) AND CALCULATED (DOTTED LINE) IN LEAVES CURED OF:

(*a*) *P. rubigo-vera* and re-inoculated with *P. graminis* ;
(*b*) *P. graminis* and re-inoculated with *P. rubigo-vera* ;
(*c*) *P. rubigo-vera*, and re-inoculated with the same ;
(*d*) *P. graminis*, and re-inoculated with the same.

In all graphs, ordinates represent degree of decay on an arbitrary scale, and abscissæ represent days from the application of the curative treatment.

The course of decay of the experimental leaves was followed by noting the degree of decay (that is, flecking, chlorosis, sporulation, withering, etc.) on an arbitrary ten-point scale. Observations were made daily, and the results plotted as the whole-line curves on the accompanying graphs. These are shown alongside the dotted curves, which were calculated by adding the two corresponding curves for the single-inoculation controls. Each point represents the mean of from six to twenty observations.

It will be seen that whereas the curves of decay of leaves inoculated and cured of one rust, and re-inoculated with the other (*a* and *b*), were nearly the same, both in form and magnitude, as the calculated curve, those for leaves re-inoculated with the same rust (*c* and *d*) were both retarded and enhanced relative to the calculated curves, and did not begin to bend over sigmoidally like the others within the space of eight days from treatment. This suggests that, whereas in the former case no appreciable interaction took place between the two dissimilar inoculations, in the latter the two like inoculations did so interact, and in view of the fact that the rust of the first inoculation was in every case completely destroyed by the curative treatment, this interaction was most probably due to the production of some specific humour by the first inoculated rust.

A full account of this work is to be published elsewhere in due course.

A. F. Parker-Rhodes.

Agricultural and Horticultural
Research Station,
Long Ashton, Bristol.
Oct. 7.

---

[1] Carbone, D., and Alexandri, E., *Bol. Sez. Ital. Soc. Int. Microbiol.*, 7, 221 (1935).

[2] Baldacci, E., *Nuov. G. Bot. Ital.*, 43, 599 (1936).

[3] Frémont, T., *Ann. Inst. Past.*, 58, 581 (1937).

[4] Carbone, D., and Kalajev, A., *Phytopath. Z.*, 5, 85 (1932).

[5] Manil, P., *Mem. Acad. Roy. Belg. Cl. Sci.*, Sér. 2, 15 (1936).

[6] Chester, K. S., *Quart. Rev. Biol.*, 8, 129 and 275 (1933).

Heterosis in Lycopersicum Crosses in Relation to Seed Weight

In a recent communication Ashby[1] has criticized certain conclusions which I have drawn from an experiment[2] dealing with the problem of heterosis in Lycopersicum crosses. It was shown in this experiment that, in general, there is little correspondence between the presence of heterosis, measured as increase in fresh weight, in the seed and in the mature hybrid 145 days after sowing, and various possible reasons for this were discussed. Ashby suggests that there is another possible explanation which has been overlooked, namely, that correlations between seed weight and 'final weight' had been destroyed by the process of transplantation which took place in the 47th day after sowing, and he produces evidence to support this possibility. This evidence is in itself of great interest, but I consider that it in no way invalidates my conclusions, for the following reasons:

(1) My published data show that any correlations which might have existed between seed weight and weight of plant had already disappeared before transplantation took place (r between seed weight and dry weight of plant on 29th day $= -0\cdot160 \pm 0\cdot236$). Evidently this lack of correlation must be due to causes other than transplantation.

(2) In spite of marked differences in growth-rate between certain lines there is still a significant correlation ($r = 0\cdot488 \pm 0\cdot160$) between the dry weight of the plants before transplanting (29th day) and fresh weight after transplanting (145th day), so that, in this experiment, correlations were not destroyed by the process of moving the plants from pots in the greenhouse to a bed in the garden.

The problem of the relationship between seed or embryo weight and the size of the plant after a given period of growth is evidently a complex one, the full elucidation of which must await the accumulation of further experimental evidence. Investigations along these lines are at present in progress.

L. C. Luckwill.

Department of Botany,
University,
Manchester. Oct. 26.

---

[1] Ashby, E., Nature, 144, 712 (1939).

[2] Luckwill, L. C., *J. Gen.*, 37, 421 (1939).

A Light-sensitive Strain of *Pseudomonas ærugin*

A strain of *Pseudomonas aeruginosa* (*B*
pyocyaneum), isolated from a milk factory efflue
was found to be affected by daylight in two differ-
ways. In the first place, the formation of pyocya
in young cultures was diminished in daylight. C
tures on a glycerol-peptone agar[1], grown at ro
temperature in the dark, developed an intense b
colour in two weeks (Ridgway's Dark Delft Blu
while parallel cultures in a north window showe
transient green colour (Russian Green) one week af
inoculation but had faded to a dirty green-bro
by the second week. Growth was apparently equa
good in both sets of cultures.

The second effect of light was to cause a mar
acceleration in the appearance of a red-brown col-
in old cultures. *Ps. aeruginosa* cultures kept c
tinuously in the dark undergo an almost impercepti
and very slow colour change from dark blue thro
plum colour to dark brown, which takes ab-
eight weeks to complete at 20° C. But dark-gro-
fortnight-old blue cultures changed to dull brown
a week, and to bright red-brown (Russet) in a fc
night, when kept in a north window. This ra
change of colour in daylight was also observed
cultures killed with formalin.

The view that the red-brown pigment in old cultu-
of *Ps. aeruginosa* is an oxidation product of pyocyar
is supported by the fact that, when blue cultu-
were exposed to daylight inside an anaerobic chaml
fading was seen, but no change to red-brown
visible in two weeks.

The red-brown pigment is therefore an oxidat
product of pyocyanin; its formation is accelera
by daylight, and is independent of the presence
living bacteria.

Jane Meiklejohn

Department of General Microbiology,
Rothamsted Experimental Station,
Harpenden. Nov. 3.

---

[1] Turfitt, G. E., *Biochem. J.*, 30, 1323–8 (1936).

[2] Ridgway, R., "Color Standards" (Washington, D.C. (1912)).

[3] Sullivan, M. X., *J. Med. Res.*, 14, 109–60 (1905).

Influence of Age upon the Requirement of Vitami

During the course of experiments in which r
were given graded amounts of vitamin A, it v
noticed that by 50 days the incisor teeth of anim
on daily doses of from ¼ to 1 I.U. had lost the d-
orange pigment in the enamel, the teeth of anim
receiving larger doses being at this stage norm
But, if these latter rats were allowed to live long
it was found that daily doses of 2–3 I.U. of vitamin
which were adequate to produce normal teeth
50 days, appeared insufficient when the animals w
older, since later their teeth also gradually lost th
pigment. It was therefore decided to investig
this point more closely and to examine the te-
histologically.

The changes in the rat's incisor tooth in vitami
deficiency have been already described by Wolb-
and Howe[1]. The earliest effect is upon the odon-
blasts, which show irregular downgrowths into
dentin, leading ultimately to the complete disappe
ance of predentin. In advanced cases the odon
blasts show marked atrophic changes or disapp-
completely. This is particularly marked on the ling
side of the tooth, where in extreme cases the format
of dentin completely ceases and the odontoblasts
entirely lacking. As a result of the continued grov
of dentin on the labial side, the pulp cavity is pusl

one side of the tooth, and the pulpal slit at the ›tal end is displaced to the lingual side in a most riking manner. This inequality of dentin growth vitamin A deficiency has also been noted by hour, Smith and Hoffman[2]. Islets of osteoid tissue ıy be found in the pulp. In early stages the enamel gan appears relatively normal but later a progressive rophy is seen. The epithelium becomes flatter and e epithelial papillæ shrink, and in extreme cases e entire structure is replaced by a fibrous band which epithelial papillæ occur irregularly.

Groups of animals consisting of litter mates were t on our vitamin A-free diet (Irving and Richards[3]) weaning (23 days) and given dosages of vitamin A rying from ¼ to 3 I.U. daily. They were killed different ages and their teeth examined. An bitrary scale given in the accompanying table was ıployed for assessing the degree of histological normality found.

)EGREE OF SEVERITY OF CHANGES IN THE TEETH OF RATS ON VARYING DOSES OF VITAMIN A

Days on diet	Daily dose of Vitamin A (I.U.)						
	0	¼	½	1	1½	2	3
28	0	—	—	—	—	—	—
38	1	—	—	—	—	—	—
42	2	—	—	—	—	—	—
49	2,2*	1	?1	0	0	0	0
52	2,1*	2	1	1	1	1	0
54	1	—	—	—	—	—	—
66	2	1	1	0	0	0	—
119	—	—	—	4	—	—	—
148	—	—	—	4	—	—	—
180	—	—	—	—	4	4,3*	1,1*

he severity of the lesions is indicated by a number according to following scheme: 0, normal; 1, slight changes in the odontoblasts dentin; 2, marked changes in the odontoblasts and dentin; 3, formation of dentin on the labial side togrther with the previous ages; 4, atrophy of the enamel organ together with the previous ages. * Two animals.

In this experiment more particular notice was taken the changes in tooth colour. It was found in neral that by 66 days on the diet, the teeth of › negative controls were quite white and those of s getting ¼ and ½ I.U. were very pale yellow. higher doses the colour became gradually deeper d the 3 I.U. dose gave teeth almost normal in pearance. When the animals were allowed to live ger, the teeth of rats on the higher dosages like- e faded in a progressive manner. After 105 days the diet, the teeth of animals getting 1 and 1½ I.U. re quite white; after 135 days, those of rats ting 2 I.U. were completely colourless, and by) days those of rats getting 3 I.U. had only a faint low tinge.

The degree of histological change at different dosage els and times is shown in the table. It will be ted that the negative controls showed the first normal signs after 38 days on the diet. The changes worse with time but the animals died before very rked effects could occur, the longest survival on › vitamin A-free diet being 66 days. In two groups animals killed and examined after 49 and 66 days the diet, slight changes were seen in rats on ¼ and .U. daily, but the teeth of rats on the higher levels re normal. In a group killed at 52 days, the teeth wed changes up to an intake of 2 I.U. daily, .U. being adequate.

In comparison with these, a group of animals itinued longer on the experiment showed very vanced changes in the teeth. Two rats each re-ving 1 I.U. daily died after 119 and 148 days pectively and both showed extreme changes in the th. The other animals were killed after 180 days. Those getting 1½ and 2 I.U. daily showed very marked changes and even those getting 3 I.U. had teeth not entirely normal.

It should be noted that the time taken for the incisor tooth to be replaced by continual growth is about 40 days, so that the changes found in the teeth of all rats save the first listed occurred in teeth entirely formed while the animals were on the deficient diet.

The post-mortem findings in these animals followed in a striking manner the teeth changes. Of animals killed up to 66 days on the deficient diet, the negative controls showed the usual pathological changes such as keratosis of the stomach, and the improvement induced by even the smallest dose of vitamin A was very marked. Of the animals killed after 49 and 66 days on the diet, those getting 1 or more I.U. per day were quite free of pathological change; of those killed after 52 days, all showed some slight abnormality save the one getting 3 I.U. All the animals allowed to survive to later times had keratosis of the stomach, and several had this change in the bladder as well. This was most extreme in those getting 1 and 1½ I.U., was still present in marked amount in those getting 2 I.U. and was found in some degree even in those getting 3 I.U.

It appears from these results that the requirement of the animal for vitamin A increases with age, not only for tooth formation, but also to avert the other pathological changes associated with vitamin A deficiency. This is in somewhat surprising contrast with the requirements of other dietary factors, such as calcium and phosphorus, which are not supposed to increase in this manner. Guilbert and Hart[4] have suggested that the requirements of vitamin A are a function of the body weight, and our results would seem to confirm this.

Rowett Research Institute,
Aberdeen.

J. T. IRVING.
M. B. RICHARDS.

---

[1] Wolbach, S. B., and Howe, P. R., *J. Exp. Med.*, 42, 753 (1925); *Amer. J. Path.*, 9, 275 (1933).

[2] Schour, I., Smith, M. C., and Hoffman, M. M., *Proc. Soc. Exp. Biol.*, 39, 447 (1938).

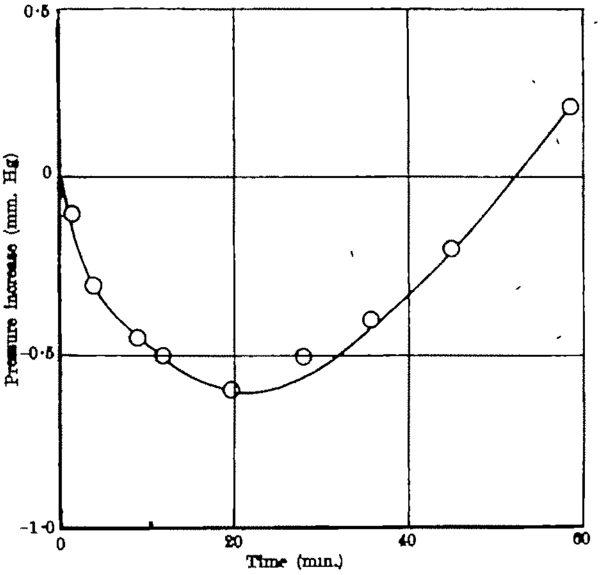
[3] Irving, J. T., and Richards, M. B., *J. Physiol.*, 94, 307 (1938).

[4] Guilbert, H. R., and Hart, G. H., *J. Nutrit.*, 10, 409 (1935).

Thermal Decomposition of Acetone

THERE has been much discussion and experiment about the question whether the thermal decomposition of various organic vapours under prescribed conditions occurs predominantly by way of free radicals or not. For the decomposition of acetone in a reaction of measurable rate in the neighbourhood of 500°–630°, all the existing evidence is against the radical mechanism, except that advanced by A. O. Allen[1], who found that on reducing the reaction temperature to 462° an 'induction period' was observable. He regarded this as evidence for the existence of chains which required time to develop.

Quite apart from the fact that the time taken to establish the stationary state in a radical chain reaction of the kind postulated for acetone would be expected to be immeasurably small, it seems that the experimental evidence may have a very different interpretation. The length of the 'induction period' corresponds to the time normally required for a fraction of one per cent only of the acetone to decompose: and any abnormal pressure changes during this time are in all probability due to secondary causes, since we find that instead of a simple delay in the pressure increase (the 'induction period') there may equally well be an actual *decrease* in pressure.



This is shown by the accompanying graph, which refers to an experiment with 300 mm. acetone in a 250 c.c. silica bulb at 460° C. Such a decrease cannot be due to a simple delay in the development of chains. It must be due to some cause such as an adsorption effect or to initial polymerization of ketene formed from the acetone. This possibility being recognized, the phenomenon observed by Allen, and in the modified form by ourselves, is too uncertain to weigh against other evidence, and on too small a scale to have influenced any of the rate determinations made at the higher temperatures.

J. G. Davoud.
Oxford. C. N. Hinshelwood.

---

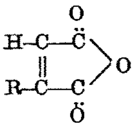
[1] *J. Amer. Chem. Soc.*, 58, 1052 (1936).

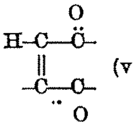
A Colour Reaction of Maleic Anhydride, *p*-Benzoquinone and their Partially Substituted Derivatives

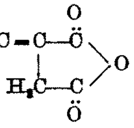
When a trace of maleic anhydride (I) is added at room temperature to a colourless solution of triphenylphosphine (P Ph_3) in chloroform or benzene (for example, 1 drop of 1 per cent maleic anhydride solution to 1 c.c. of a 1 per cent solution of triphenylphosphine), a permanent orange-red colour is produced immediately.

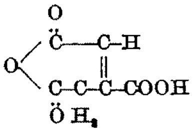
The same effect is observed with *mono*substituted derivatives of maleic anhydride, for example, citraconic (II), monochloromaleic (III), and *cis*-aconitic (IV) anhydrides:

R = H– (I), R = CH_3– (II), R = Cl– (III),
R = HOOC.CH_2– (IV. m.p. 74°)




(V)


(VI)


(VII)

On the other hand, no colour is developed wi *di*substituted derivatives, for example, dimethy diphenyl- and diacetoxy-maleic anhydride. Male acid, its dimethyl ester, succinic anhydride and *tran* aconitic anhydride (VII. m.p. 134–135° C.) fail give this reaction; but the phenomenon is show by *p*-benzoquinone and those of its derivatives which not all the hydrogen atoms are substitute for example, 2 : 6-dichloroquinone and thymoquino (2-methyl-5-*iso*propyl-*p*-benzoquinone).

It seems, so far as it could be ascertained, that th colour reaction is characteristic of the grouping (when forming a part of the above-mentioned ri systems. The observation that the solution of itacon anhydride (VI) gave the colour reaction positive co be explained by the known fact that in solution isomerizes to (II).

Amongst the various substances investigated whi gave no colour reaction, we may mention anthr quinone, 2 : 3-dichloronaphthoquinone, phenanthr quinone and 2 : 6-dimethylpyrone.

Alexander Schonberg.
Fouad I University, Abdel Fattah Aly Isma
Abbassia,
Cairo.

Difference in Odour of *d*-, *l*- and *dl*-Derivatives Amino- and Bisamino-Methylenecamphors

It is well known that optically active isome despite the fact that they are identical in structu differ from one another in those physical properti which are of the directional (vectorial) nature, su as, for example, direction of rotation of the plane polarized light, unsymmetrical distribution of t hemihedral facets in their crystal forms, etc. T magnitude of these vectorial properties is, howev identical for the enantiomorphous forms. T optically active forms differ also in other respec namely, in their action on micro-organisms, enzym and in their physiological behaviour towards high organisms. In 1886 Piutti[1] observed that *d*-asparagi had a sweet taste, whereas the naturally occurri *l*-asparagine was insipid. Cushny[2] found th *l*-hyoscyamine was twice as powerful in paralysi the vagus as the racemic form, atropine, while t *d*-form was twenty times weaker in this action. O of the most striking examples of different phys logical activity recently observed is vitamin C ascorbic acid[3]: the dextro-rotatory acid is acti the lævo-rotatory form being physiologically inacti

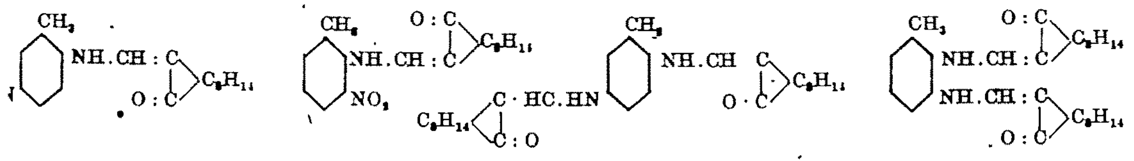
These differences in the physiological action of t optical antimers and their racemic forms are al associated with other properties, such as odo J. von Braun[4] has observed a few cases in which noted differences in odours not only among t optically active forms, but also in their inacti isomerides. The object of this communication is record differences in the intensity of odour of seve new derivatives of amino- and bisamino-methyler camphors in their *d*-, *l*- and *dl*-forms. The odour w

Name of the compound	Order of intensity of odour	Number o observer
5.nitro-*o*-toluidinomethylenecamphors. (I)	*l*>*dl*>*d*	10
3.nitro-*o*-toluidinomethylenecamphors. (II)	*l*>*dl*>*d*	13
2 : 5-toluylene bisamino methylenecamphors. (III)	*l*>*dl*>*d*	11
2 · 3-toluylene bisamino methylenecamphors. (IV)	*l*>*dl*>*d*	11

ved by different observers independently, and st invariably the order of the intensity of odour ticed by them was $l > dl > d$ in the four series of ers. These results are summarized in the above.

react differently towards the right- and left-handed forms of physiologically active isomerides.

Porter[6] was able to effect separation of racemic dyestuffs into their optically active components by differential adsorption of one of the isomers by wool.



I II III IV

e colour and odour of 3.nitro-o-toluidinomethyl-dl-camphor resemble those of saffron; the rs of the optically active isomers of this substance ell as of the remaining compounds in the table e have not been identified with that of any n substance. The odours are, however, pleasant. e position of the nitro group in the nitro-o-dinomethylenecamphors has a marked effect on intensity of their odours: the odours of these ounds, which are dyes with the nitro-group in 3-position, are more intense than those of the sponding forms with the nitro-group in the ition.

veral hypotheses have been put forward to unt for the different physiological activities of ptically active compounds. Pasteur[5] explained differences in action by supposing that the -substances and the tissue-substances of the als are themselves asymmetric. They therefore

King[7], arguing from these observations, attributed the difference in the physiological action of optically active forms to physical rather than chemical causes.

A fuller account of this work will appear elsewhere.

Bawa Kartar Singh.
Awadh Behari Lal.

Department of Chemistry,
Science College,
Patna.
Sept. 24.

---

[1] Piutti, *C.R. Soc. biol.*, 103, 137 (1886).

[2] Cushny, "Biological Relations of Optically Isomeric Substances", 39 (London: Baillière, Tindall and Cox, 1926).

[3] Demole, *Biochem. J.*, 28, 770 (1934).

[4] Braun, *Ber.*, 56 (B), 2268 (1923); *Ber.*, 58, 2210 (1925); *Ber.*, 60 (B), 1438 (1927).

[5] Pasteur, *C.R. Acad. Sci.*, 103, 138 (1886).

[6] Porter and Ihrig, *J. Amer. Chem. Soc.*, 45, 1990 (1923).

[7] King, *J. Chem. Soc.*, 125, 46 (1924).

Points from Foregoing Letters

Snow has extracted from leaves of pea plants d in ether a water-soluble substance which its the growth of oat coleoptiles.

comparing the evolution of carbon dioxide from root systems of nodulated and nodule-free, te-fed soya bean plants growing in water culture, ond concludes that the amount of carbon dioxide uced by the nodules of a plant of the former type slightly greater than that from the roots alone. other workers have concluded, the respiration of les is partly anaerobic in nature, then it is possible in these water-culture plants the amount of hydrate utilized in nodule (presumably chiefly rial) respiration exceeded appreciably that used e roots themselves.

F. Parker-Rhodes describes experiments from h it appears that some degree of acquired resist- can be demonstrated in wheat plants against two e Puccinia rusts. This acquired resistance shows in an enhancement and a delay of the course cay of cut leaves infected with the rusts, cured eir infection, and reinoculated, as compared suitable controls. The magnitude of the effect wever, small.

C. Luckwill observes that in a series of pure lines F_1 hybrids of Lycopersicum correlation between weight and plant weight had disappeared by the day, but points out that this lack of correlation not due, as Ashby had suggested, to trans- ation, because this did not take place until 7th day.

Jane Meiklejohn describes a strain of *Pseudomonas aeruginosa* which forms less pyocyanin in daylight than in the dark. Light also accelerates the oxidation of pyocyanin to a red-brown pigment.

Small doses of vitamin A which are adequate to keep rats free from pathological change at early stages of the deficiency are not sufficient for this purpose as they grow older. It is inferred by J. T. Irving and M. B. Richards that the requirement of vitamin A increases with age.

The evidence, based upon certain abnormal pressure changes observed in the initial stages at low temperatures, that the thermal decomposition of acetone is a chain reaction is called in question by J. G. Davoud and C. N. Hinshelwood. Fresh evidence indicates that the effects are of a secondary nature.

A. Schönberg and A. F. A. Ismail describe a colour reaction between maleic anhydride and triphenylphosphine. The same effect is observed with mono- but not with di-substituted derivatives of maleic anhydride. The phenomenon is shown by *p*-benzoquinone and those of its derivatives in which not all the hydrogen atoms are substituted.

The intensity of odour of the optically active forms of several new derivatives of amino- and bisamino-methylenecamphors has been examined by Bawa Kartar Singh and Awadh Behari Lal. They find in each series that the lævo form has the most intense odour, followed by the racemic and dextro forms, in that order.

RESEARCH ITEMS

Early Islamic Decorative Technique

The first occasion on which it has been possible to analyse early Islamic niello is recorded in connexion with a group of objects in the precious metals said to have been dug up at Nihavand, a city of Persian Iraq, by Mr. Basil Gray (*Brit. Mus. Quarterly*, 13, 3; 1939). The group in question has recently been acquired by the British Museum, (Bloomsbury). Apart from its value as an addition to the collections, its importance is the greater because of the extreme scarcity of objects with precious metals from Islamic lands, where there are no tomb burials, and successive invasions caused widespread destruction. The find consisted of forty pieces, of which thirty-nine are of silver, nearly all enriched with gilding and niello, while one, the most considerable in size, is of gold. This latter is a wine bowl decorated with engraved roundels and an inscription in Arabic around the outside of the lip. Among the silver pieces are two series of plates which formerly decorated leather belts, two beads, a small circular plaque, a butt of a halberd possibly, and four other inscribed objects, as well as some fragments of buckles. The style unmistakably points to the Seljuk period. Epigraphic and stylistic evidence alike suggest the latter part of the twelfth century. Dr. Plenderleith reports after examination that there are microscopic particles of white metal embedded in the gold of the bowl; no iron is present and the particles are non-magnetic. They are extremely hard and there is good reason to regard them as iridium. Spectrographic examination of the niello indicates the presence of copper, silver, gold, tin, lead, with traces of aluminium, potassium, magnesium and boron. Analysis of filling taken from one of the small fragments of silver reveals the presence also of sulphur. The composition of this niello is, therefore, probably the same as Western niello, in antiquity according to Pliny, in the Renaissance period according to Cellini.

Cattle and Marriage among Southern Bantu

Among the Lovedu of the north-eastern Transvaal marriage, being patrilocal, involves, as among other Southern Bantu tribes, the transfer of *munywalo*. The nature of this institution has been analysed by J. D. Krige (*Africa*, 12, 4; 1939), who points out that the various interpretations in which it is regarded as the legalization of marriage, as a guarantee of a wife's status or good behaviour, and in terms of compensation, economic or ritual, are in the nature of parodies. To discover the real place of *munywalo* in the social system, it is necessary to appreciate the relation of the cattle exchanges to the social structure, as cattle constitute the essence of *munywalo* and the exchanges are the most important use to which cattle are put. The people do not rely on cattle raising. Milk is not used at all; the meat of cattle which die is much appreciated as a relish; the skins are used or discarded indifferently. Ploughing has added to the uses of the cattle, but social values centre in agricultural productivity rather than the role of cattle in contributing to this result. Cattle constitute no great standard of the kind of affluence that is important, this being based on maize. It is hidden rather than displayed, and gives no man the privil of rank. Yet like other Bantu tribes, the Lov have a strong emotional attachment to their ca though they are not regarded as sacred. Neverthe they are not sold or slaughtered, though there i taboo against it. This is neither economic nor economic, but *sui generis*. The chief functio cattle is in *nywalo* exchange, which accounts more than 95 per cent of all transfers of cattle, only other occasion being when judgment debts paid. There are about 330 marriages each year which the theoretical minimum number of c needed is about 2,600—only 400 short of the in the society. A distinction is drawn between c which have become involved in *munywalo* exch and those which are unencumbered. Thus a 87 per cent of the cattle are held in a chain of ri and restrictions which the temporary owner ca ignore. The exchange conditions, and is conditi by, two main social arrangements, cross-c marriage, and the allocation of a sister's *munywa* her brother. Hence arise series of cattle linkage which social groups, originally unrelated, are b together in a close network of social interests responsibilities.

Increased Mutation due to Hybridization

Hybridization leads to increased variability the mechanical recombination of genes present i parents, followed by segregation. A. H. Sturte (*Proc. Nat. Acad. Sci.*, 25, 308–310; 1939) has sh that inter-racial hybridization also may lead t increased mutation rate. By crossing marked *A* and *B* of *Drosophila pseudoobscura* and b crossing to race *A* or race *B*, he found that a 8·5 per cent lethal and about 0·5 per cent sex-li visible mutations were obtained. This is a n higher mutation frequency than usually foun intra-racial crosses, and has important implica regarding the evolution of new forms.

Development of Wings in Drosophila

C. H. Waddington (*Proc. Nat. Acad. Sci.*, 299–307; 1939) has made a study of the develop of the wings of normal and mutant Drosophil order to investigate the times and modes of effe different genes upon wing formation. The no wing expands rapidly until about seventeen h after pupation. At about twenty hours, contra takes place from the periphery inwards, and veins make their appearance first as broad b which rapidly narrow. At about twenty-five h the wing is a thin blade, and at forty hours the is fully formed and hairs appear. This defin wing stage is followed by folding accompanied second expansion. At emergence, drying out o wing leads to the second contraction and obliter in the internal structures. The effects of twenty genes affecting the wings were studied. These r to shape, size, vein breakage and additions, bli and wing-curvature. The first visible effect of is seen in the prepupal stage (*dy* and *m*), whil visible effect of others is not seen until unfoldi the young imago.

Oriental Peach Moth in Australia

oriental peach moth (*Cydia molesta*) has d serious damage to the fruit industry of the burn Valley, Victoria, during the past few years. tations which had occurred in this region for y years had been attributed to the codling moth *ia pomonella*) whereas, in so far as peaches are erned, the most damage was caused by *C. ta*. The degree of infestation varies seasonally, in 1933–34 this insect caused damage to orchard- amounting to about £70,000. The losses are iently serious to threaten the canning industry to call for a thorough study of the problem. H. Helson, of the Commonwealth Division of omic Entomology, gives an account of the lem in Pamphlet No. 88 (1939) of the Council cientific and Industrial Research for Australia. ppears that little good can be expected from ing as a method of control, and this has caused attention to be concentrated on biological means pression. Nine species of parasites are known to imary agents attacking the insect in Australia. hese the chalcid wasp *Dibrachys boucheanus* is nost effective: it parasitizes larvæ up to ninety ent at the latter end of the season. Since this t sufficient to ensure an economic degree of rol of the oriental peach moth, it was considered the introduction of parasites attacking the spring summer generations of this insect might prove ntageous. The result has been that four species rval parasites and one species of egg parasite introduced into Australia during 1935–38. veries made in the field show that the Braconid *ocentrus ancylivorus* is the most promising of parasites, and it is proposed to make further ductions of this insect.

rhinum Rust

RUST disease of the antirrhinum made a lightning nt upon Great Britain in 1934, but has not troubled our gardens. The causal fungus, *inia Antirrhini*, appeared in Egypt in 1936, how- and as it has since occurred rather frequently, Amin Fikry has made a study of the malady its control (*Min. Agric. Egypt, Tech. and Sci. ice Bull.*, No. 223. Govt. Press, Bulaq, Cairo, . P.T.4). Many interesting features of the se which were not apparent in the temperate te of Great Britain are described for Egypt. ications of various sulphur fungicides made at vals of two or three weeks, for example, can ol the disease most effectively, and it appears the beneficial effect of this treatment is de- ent upon a temperature higher than 22° C. All ties grown in Egypt appear to be susceptible e disease, and teleutosori have even been found he roots of some plants. Larvæ of species of lomyidæ were obtained from the rust pustules, do not appear to diminish the effects of the us. Several plates illustrate this account of the se, which also contains good descriptions of the us symptoms, and a short summary of previous ledge about the malady.

e Canker

canker disease of apple trees is still a very us malady. It is caused by the fungus *Nectria ena*, and though it has been controlled to a large it by correct pruning, present-day knowledge of lisease is not very detailed. Two recent papers in the *Annals of Applied Biology* (26, No. 3, August, 1939) describe investigations into the discharge and determination of spores (by R. G. Munson, pp. 440–457), and into the incidence and control of shoot infections (by R. W. Marsh, pp. 458–469). Perithecia are formed in the cankers, and the ascospores are forcibly ejected throughout the year, when atmospheric humidity is sufficiently high. Ascospore discharge is at a minimum in summer, however, but attains a maximum in January and February. Conidia are liberated during the wet periods in spring and autumn, and germination of both kinds of spore can take place between 2° C. and 30° C. The fungus therefore appears to be well equipped for parasitism, so far as its reproductive bodies are concerned.

Recent Volcanic Activity in Japan

ACCORDING to H. Tanakadate, volcanic activity in Japan during the period November 1935–December 1938 (*Jap. J. Astro. and Geophys.*, 16, Nos. 2–3, 93–121; 1939 Tokyo) may be divided into four groups: (1) Secondary phenomena having no direct connexion with deep-seated magma; (2) the Volcanian type of explosive eruption; (3) the Strombolian type of eruption; (4) the formation of a new volcano. Of the latter there were two: (*a*) Taketomi islet near Alaid Island (1934), which was of the homate type, and (*b*) Iōzima–Sintō, south of Kyūsyū (1934–36), which was of the tholoid type. What may be regarded as a typical volcano-tectonic earthquake occurred in part of the Kuttyaro Caldera, which is one of the largest in the world and noted for its sulphur production, on May 29, 1938, at 1.42 a.m. The top surfaces of both domes of Noboriondo and Maruyama fractured in the direction of the chain (N. 60° W.), the dormant fumerole on the northern side of the Oakota became active and the lake coast of the region rose about one metre in the north. It is believed that the earthquake was caused by movement of lava still in the molten state in the deep-seated root of the three domes. The most active volcano in Japan is that of Asama-yama, which is subject to frequent explosive eruptions of the Volcanian type. In the volcano observatory at Mine-no-Tyaya, 4 km. east of the crater, constant observations are carried out with seismographs, tiltmeters, earth current meters, magnetometers and other instruments. According to Minakami, the accumulation of ejectamenta on the crater rim reached 18 m. thickness from 1917–35.

The Goose Lake Siderite

PROF. F. C. LEONARD has a short account of this siderite in *Popular Astronomy* (47, 6; June–July, 1939). It was discovered on October 13, 1938, was removed a year later, and is now the property of the Smithsonian Institution and the United States National Museum. Its weight is 2,573 lb. (1,167 kgm.), and on etching the polished surface of a small fragment with dilute nitric acid, the characteristic Widmanstätten figures were seen, indicating that the specimen is a medium octahedrite. As all the original fusion crust is missing, it is thought that the meteorite is a very old fall. When the body was found about two miles west of the western shore of Goose Lake, it rested in the centre of a saucer-like depression about five feet in diameter and one foot deep. It is considered to be the fifth largest meteorite known to have fallen in the United States and the third largest on record for the three Pacific Coast States.

FUNCTION OF THE ELECTRICAL SUPPLY ENGINEER IN WARTIME

In the War of 1914–18 the supply engineer put to the service of the State his knowledge of the habits and business of those who lived and worked within his area of supply, not only as an individual but also backed by all the resources of his undertaking. Faced to-day with a similar crisis, Mr. J. W. Beauchamp, of the Central Electricity Board, recalls in an article published in *Electrical Industries* of November, what the supply engineer did during 1914–18. His main object was to assist the Ministry of Munitions and the Coal Control by pooling stocks, giving help in repairing damage or speeding up power supplies and dealing with the more difficult problem at that time of retaining skilled staff. All these were the subject of collective action.

The work was done with few formal meetings, but a large amount of personal effort and attention was given on the part of the staff. To-day the maintenance of supply and safety of the staff offers a much greater preoccupation. There is little time for discussion or inclination to go far from one's base, but the industry possesses a central development organization uniting all together, and able to pool ideas and unify action. The Commissioners and the Central Board in their respective spheres have formed a bond between the undertakings, and the Ministry of Supply itself includes the first chairman of the Central Electricity Board, a man whose work has left a great mark on the electrical industry of Great Britain.

Although reticence has become a virtue, few can fail to realize the great difference now governing the supply of lighting material and those which had to be met and remedied in the early years of the last war. Great factories created solely for defence can be supplemented by many but little smaller, which can be quickly turned from their peace-time activity to the production of the commodities required to keep a fighting force in action and make up its wastage. Much of the remarkable improvisation of 19 can be avoided, but if and when it becomes desi to enlist still more and perhaps smaller industrie it should be easy for authority again to utiliz local knowledge of the supply engineers and staffs. In most cases they have the entrée to v of every kind in their areas and the confiden the owners, and can often without delay su sources of supply and existing plant and labour to adapt to the mass production of simple iten components for use by more specialized man turers. The parcelling out of such work is not wit benefit as it stimulates local interest, holds tog business valuable in peace-time, reduces disloc of local labour and trade, bringing with it o tunities of training unskilled persons, and as often happened in the past, introduces into works methods of production and degrees of acc which prove of value when normal labou resumed.

In 1914 we had no experience of a contest bet highly mechanized States. A thousand devic attack and defence had been as yet unborn. A all, there is the air menace which makes fro a plane rather than a line. In the electrical indu the interval covers many changes, notably collective control, administration by the Con sioners, operation by the Board, development research by associations, and a close co-oper amongst those who produce and instal elec appliances.

The outlook of the public towards electrici now quite different. To-day all branches o industry in combination provide the greatest p utility in the modern State, and the one in v the operators and their staffs have the most c and frequent contact with the millions who electricity for personal service or as a compone their trade or industry.

TRIBAL ORIGINS AND CULTURE AMONG THE FOX INDIANS

An ethnographical account of the Fox Indians has recently been issued by the Smithsonian Institution. It has been edited by Margaret Welpley Fisher, and is based upon material which has an exceptional claim to authority. The author, William Jones, was born on the Sauk and Fox Reservation in Oklahoma in 1871. His mother was English, but his father was the son of a white man and an Indian mother. Up to the age of nine years, Jones was reared by his Indian grandmother, living the life of an Indian boy. On her death and after a period as a cowboy, he entered the Hampton Institute, passed to Andover and Harvard, taking the degree of M.A. at the latter in 1900 and Ph.D. in 1904. His intention had been to study medicine ; but under the infl of the late Prof. Putnam he turned to anthropo spending his vacations in field work among A quian tribes and making a comparative stud Algonquian religions. This field, however, aff little hope of a career in research ; and in 190 Field Museum offered him the choice of three ex tions, of which he elected for an expedition t Philippine Islands. In the spring of 1909 he murdered by the Ilongots.

Before his departure for the Philippines, had already published some of the material he collected in the field, while other studies were i posthumously. The greater part of his papers, ever, and that containing what now appears to been the more valuable results of his inquiries, missing. Its whereabouts was unknown until, o

---

[*] Ethnography of the Fox Indians. By William Jones, edited by Margaret Welpley Fisher. (Bureau of American Ethnology, Bull 125) Pp. iv+156. (Washington, D C.. Smithsonian Institution, 1939)

ath of his father a few years ago, it was disclosed the family lawyer, who forwarded the papers to Smithsonian Institution, that the father of 'lliam Jones had kept the existence of these papers ecret, as he had felt that much of the information ulged to his son had been due to his own friend- p with the Foxes and, therefore, had been un- 'ling that it should be published during his lifetime. A sealed packet said to have contained an account "ancient mysteries" never previously revealed to vhite man, to which reference is made in "William nes" by Henry Rideout, has not yet been identified th certainty, although its existence has been con- ned by inquiry. Certain passages in the present ount are indicated tentatively as possibly em- dying this material.

he Fox Indians are of particular interest as turally intermediate between the tribes of the stern woodlands and those of the Great Plains. eir language is the most archaic of the Algonquian gues; and with the Mexican Kickapoo, their dred, they rank among the most conservative of Indians. Hence until a few years ago, they were garded as representing in their culture an archaic x pattern, and considered types of the "Central gonquian". Examination of their history has akened this view and indicates that there is no ans of knowing how far it represents the truth. culturation has been carried to such lengths that would be remarkable if many specifically Fox its remained.

Knowledge of Fox history begins in 1640, when Huron map was drawn up for the Jesuits. They d then been driven westward by hostile tribes, th whom they continued in conflict until the ival of French traders in 1665. From that time ward, the French waged a war of extermination ainst the Foxes, whose country on the Fox-Wisconsin waterway was a preferred route to the Mississippi and a strategic point for trade. Failure to secure their adhesion to a French scheme of pacification of Indian tribes with Detroit as the concentration point embittered a struggle which culminated in the virtual extinction of the Foxes in 1728, when they were intercepted while trying to escape into Iroquois country. After a conflict lasting twenty-three days, only some fifty or sixty got away alive, or as it was expressed afterwards by a member of the tribe, in speaking of the wars with the French, "once there were only 3 lodges of the Fox Indians left".

However, in the winter following the massacre, the membership of the Fox tribe had risen again to 250. This and previous regenerations of the tribe had been effected in two ways. Prisoners were captured in war for the purpose of adoption into the tribe—the Pawnees, in particular, had been the victims of such attacks; and through the good offices of western allied tribes, Foxes who were held prisoners by hostile tribes were released and allowed to return to augment the tribe. These two elements, though politically all members of the Fox tribe, culturally had wide and various roots.

In the numerous vicissitudes and migrations of the tribe, in which they suffered severely from cholera and smallpox, settlements were formed in Kansas, Iowa and Oklahoma. The records show a close and prolonged association with the Sauk, and the incorporation of elements from Potawatomi and Winnebago. A tribe thus many times depleted and restocked, although strongly resistant to white culture, is scarcely likely to have escaped the cultural influence of the many and intimate relations with other tribes. Hence at the time information was collected by William Jones, any assumption of the archaic and original pattern of Fox culture had become hazardous.

GRASSLAND AND FORAGE CROPS IN THE UNITED STATES

NFORMATION with regard to forage crops, range management and the botanical aspects of soil nservation in the United States is either not ailable in published form or is scattered among a ge number of reports. The Imperial Bureau of Past- s and Forage Crops at Aberystwyth has accordingly pared a bulletin, compiled by R. O. Whyte, entitled esearch on Grassland, Forage Crops and the Conser- tion of Vegetation in the United States of America" erbage Publication Series, Bulletin 26. 5s.).

The bulletin deals first with the work of the Division Forage Crops and Diseases, each of the five crop oups being studied from the point of view of culture d production, breeding and improvement, and eases. An important recent development has n the organization of the U.S. Regional Research boratory, State College, Pennsylvania, which uld become one of the leading world centres for study of problems connected with humid tem- ate pastures. The range investigations of the rest Service are then described. These are intended to supply basic information for the intelligent utilization of the land, the field work being organized into six regional forests and range experiment stations, covering the western United States. The research of the Soil Conservation Service deals with many aspects other than the use of grassland and forage crops as a protective cover for soil, and some account is given of the terms of reference of the eight branches of the Division of Research in the S.C.S., information not already published in Bulletin 25 being included.

Brief reference is made to the studies in progress under the auspices of the U.S. Golf Association, and details given of the ecological research at the Carnegie Institution of Washington regarding factor and function in adaptation, climax, succession and conservation.

The remainder of the bulletin contains relevant extracts from the most recent annual reports from practically all the agricultural experiment stations in the United States.

TRANSITION FROM CHARCOAL TO COKE IN IRON SMELTING IN BRITAIN

RATHER more than a year ago, the secretaries of the Royal Society of Arts discovered several bundles of old letters written to the Society between 1750 and 1800. The find is rich in information relating to the then manifold activities of the Society and to the inventors of those days. The careful study of the letters by appropriate experts may be expected to throw much light on an all too little known aspect of history, that of technical progress.

Unfortunately, the disturbed state of the world made it advisable to place the letters in safe keeping before the plans for their investigation could materialize. A beginning, however, had been made, and one letter by J. Wilkinson, probably the same Wilkinson who produced cannon during the Napoleonic wars, formed the *raison d'être* of a paper by Mr. H. Gwynn Jones on the charcoal iron industry, delivered before the Royal Society of Arts on November 15

Iron was at first smelted with charcoal by the direct process, wherein furnace and forge were under one roof. As the amount of charcoal within economic range became exhausted, the indirect method came into vogue in which pig iron was made in one locality and forged in another. The metal was run into a bed of sand furrowed-herring-bone fashion, and when cool broken into the 'sow' or central furrow and the 'pigs' or offshoots.

The evidence afforded by the location of the early iron works, which demanded a supply of wood for charcoal, of iron ore, water transport and swift-flowing streams for power, gives an indication th the scarcity of charcoal was wide in its influence the iron industry. The search for a substitute beg before the eighteenth century; the first patent coke was taken out in 1627, and apparently t Darbys of Coalbrookdale had established oc smelting of iron on a commercial scale by 1709, but was thirty years or more later before a method of usi coke in all the processes of smelting was discovere

The long letter to the Society of Arts from Wilk son written in 1761 makes it clear that at that d iron was produced mainly with charcoal. He sugge that the Society should consider how to make co pig iron as good as that made with charcoal, ne how to make tough bar iron from the coke pigs, a finally how to convert these into steel equal in goo ness to that made from Swedish bar iron. He write "this Kingdom has materials enough to make all t iron that is consumed provided the coke scheme c be established in the making of pig iron equal goodness to those made with charcoal".

His remarks, besides showing that the ir industry was tied to charcoal in 1761, foreshad the changes which were to take place in the Brit iron industry when iron and coal were finally wedd causing it to lead the world for at least a centu

As a result, the industry abandoned its scatte homes and became established in localities wh coal and iron were found side by side; a wood district with rapid streams was no longer necessa

E. F. A.

TORSIONAL EFFECTS OF TORSIONAL OVERSTRAIN IN MILD STEEL

A PAPER by Prof. H. W. Swift on the torsional effects of torsional overstrain in mild steel, which had been prepared for presentation at the cancelled Cardiff Autumn Meeting of the Iron and Steel Institute, has been abridged and is published in *Engineering* of October 20. The usefulness of a material for manipulative processes in which severe plastic deformation is involved, depends primarily on the range of elastic flow to which it can safely be subjected. This depends in turn on, first, the stress-strain characteristics for the material within the elastic range; secondly, the stress-strain characteristics for the material within the plastic range; and thirdly the cohesive properties of the material which resist rupture.

The conditions of elastic breakdown have been the subject of much study and discussion. Some theories still have their champions, but most engineers regard maximum stress as the criterion of breakdown for brittle materials and shear strain energy (or shear-stress on the octahedral planes to which this is implicitly related) for ductile materials. In a ductile material it is generally thought that rupture occurs by shear. In a tensile stress the familiar cup and cone fracture indicates sliding at the instant rupture, and in torsion the surface of rupture is transverse plane of maximum shear stress. But has been proved that the process of rupture at t neck of a ductile bar in tension always commen inside the material across what is substantially plane of maximum tensile stress. Shear sliding the cup and cone basis sometimes occurs to measurable extent after fracture has been initiat

Simple tension and simple shear are the t simplest methods of making exploratory tests. addition, measurements of hardness are taken on t surface of tension of torsion bars at various sta of overstrain, and plotted in diagrams. Tables shown of the principal test data relating to t tensile properties after torsional overstrain. It w found that after fracture had commenced (internall which was proved by the sudden drop of the be of the testing machine, a certain amount of draw continued in the unbroken outer angular ring, a the diameter at the neck after complete separati was measurably less than that when the fracture co menced. It was found that neither strain energy hardness was a controlling factor in regard to ruptu

CIENCE NEWS A CENTURY AGO

nch's Explorations in Mesopotamia

AT a meeting of the Geographical Society on ovember 25, thanks to the president of the India oard, a communication was read from Lieutenant enry Blosse Lynch (1807–73) of the Indian Navy lating to his survey of the River Tigris between esiphon and Mósul. "Chains of triangles," said nch, "covered Nineveh to Baghdád, Baghdád to bylon, Babylon to Ctesiphon, Ctesiphon to Baghd, and the mountains of Hamrín in two points, mely, where the Tigris bursts through them in the ., and Wiyálah to the north-eastward; most of the incipal points within the range of these are fixed her by an extension of the trigonometric chains, or latitudes and true bearings checked by longitudes; e great canals also have been touched by our work fficiently to show their direction and position. As work, the field, instead of being diminished, pears to extend; and I have been obliged to leave th regret the tracing of the splendid canals and ers, and the filling in of the villages and ruins, for re favourable times. . . ."

niversary Meeting of the Royal Society

IN his address at the anniversary meeting of the yal Society on November 30, 1839, the president, e Marquis of Northampton, said that "the past ar has indeed been to that portion of the Royal ciety which takes an active part in its affairs, one more than usual labour and exertion—of labour d exertion, destined, as I hope, to produce rich d ample fruit. The great and marking peculiarity ich has attended it, has been the sailing of the tarctic Expedition. . . . The Expedition has w sailed, amply provided with the best scientific truments and furnished with ample scientific tructions. . . . I have stated, Gentlemen, that ur Council had recourse to the Scientific Committees assistance in drawing up instructions for the pedition in different branches of knowledge; ose committees, who were named only two years o, were at first apparently more a matter of form an substance; they have now been capable of ing excellent service".

The Royal Medals for 1839 were awarded to Dr. rtin Barry (1802–55) for his researches in embryoy and to Sir James Ivory (1765–1842) for his estigations on astronomical refraction, while the pley Medal was awarded to Robert Brown (1773–58) for his "Discoveries during a Series of Years the Subject of Vegetable Impregnation". Humdt. denominated Brown "botanicorum facili prins". The son of a Scottish clergyman, Brown, after ending the Universities of Aberdeen and Edinburgh, s made an army surgeon. At the age of twentyen he became known to Sir Joseph Banks, through om he was appointed naturalist to the expedition t to Australia in 1801 under the command of ptain Matthew Flinders. When Brown returned England four years later he brought back a lection of 4,000 plants. Soon after his return he s made librarian to Banks and in 1823 became sessed of both his library and herbarium. The lection of plants he offered to the British Museum, l in 1827 he became keeper of the botanical department in the Museum, a post he held until his death. was admitted F.R.S. in 1811, in 1833 was elected a eign associate of the Paris Academy of Sciences, and 1849 was chosen president of the Linnean Society.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TEMPORARY ASSISTANT LIBRARIAN—The Registrar, University College, Southampton (December 6).

NUFFIELD PROFESSOR OF ORTHOPAEDIC SURGERY—The Registrar, University Registry, Oxford (December 16).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Memoirs of the Royal Meteorological Society. Vol. 4, No. 40: Correlations between Monthly Rainfall at Eleven Stations in the British Isles. By D. A. Boyd. Pp. 143–160. (London: Royal Meteorological Society.) 2*s*. 6*d*. [3010

Institute of Metals. Industrial Applications of Spectrography in the Non-Ferrous Metals Industry. By F. Twyman. With a Report of a General Discussion on the Subject, held in London on March 9, 1939. (Reprinted from the *Journal of the Institute of Metals*, Vol. 64, No. 1, 1939.) Pp. 38+2 plates. (London: Institute of Metals.) 2*s*. 6*d*. net. [3010

Air Ministry: Meteorological Office. The Weekly Weather Report for the Period February 27th, 1938, to February 25th, 1939. Sixty-first Year, Vol. 55 (New Series): Particulars of Temperature, Rainfall and Bright Sunshine for each Week. (M.O. 439). Pp. 72. (London: H.M. Stationery Office.) 7*s*. 6*d*. net. [3010

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 3, No. 30: Actiniaria and Zoantharia of the Scottish National Antarctic Expedition, 1902–1904. By Prof. Oskar Carlgren. Pp. 791–800. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1*s*. 3*d*. [111

Ministry of Health. Report on the Work of the Central Midwives Board for the Year ended 31st March 1939. Pp. 24. (London: H.M. Stationery Office.) 4*d*. net. [111

Vitamin E: a Symposium held under the auspices of the Food Group (Nutrition Panel) of the Society of Chemical Industry on Saturday, 22nd April, 1939, at the London School of Hygiene and Tropical Medicine. Pp. viii+88. (London: Society of Chemical Industry.) 5*s*. [211

London Shellac Research Bureau. Bulletin No. 5: The Hot Spraying of Shellac; a New Method of Coating Surfaces. Pp. 22. (London: London Shellac Research Bureau.) [911

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended March 31, 1939. (M.O. 438.) Pp. 52. (London: H.M. Stationery Office.) 9*d*. net. [911

Imperial Bureau of Dairy Science. Technical Communication No. 1: The Phosphatase Test for Control of Efficiency of Pasteurization. By H. D. Kay, R. Aschaffenburg and F. K. Neave. Pp. 56. (Shinfield, Reading: Imperial Bureau of Dairy Science.) 2*s*. [1011

Medical Research Council. Nineteenth Annual Report of the Industrial Health Research Board to 30th June 1939. Pp. iii+34. (London: H.M. Stationery Office.) 6*d*. net. [1311

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 11, No. 1, June 1939. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+111. (London: H.M. Stationery Office.) 4*s*. 6*d*. net. [1311

Proceedings of the Royal Society of Edinburgh, Session 1938–1939. Vol. 59, Part 3, No. 23: Genetic Algebras. By Dr. I. M. H. Etherington. Pp. 242–258. (Edinburgh: Robert Grant and Son, Ltd., London: Williams and Norgate, Ltd.) 1*s*. 6*d*. [1311

Milk and Nutrition: New Experiments reported to the Milk Nutrition Committee. Part 4: The Effects of Dietary Supplements of Pasteurised and Raw Milk on the Growth and Health of School Children (Final Report); Summary of all Researches carried out by the Committee and Practical Conclusions. Pp. 70. (Shinfield, Reading: National Institute for Research in Dairying.) 2*s*. [1411

A Lecture on Magnesite. By A. W. Comber. (Twenty-second Streatfeild Memorial Lecture, 1939.) Pp. 26+4 plates. (London: Institute of Chemistry.) [1511

Lily Year-Book 1939. (No. 8.) Pp. iv+183+17 plates. (London. Royal Horticultural Society.) Paper, 5*s*.; cloth, 6*s*. [1611

Preliminary Report on the Problems of Evacuation. Pp. 32. (Liverpool: University Press of Liverpool; London· Hodder and Stoughton, Ltd.) 1*s*. net [1711

Other Countries

Publications of the Dominion Observatory, Ottawa. Vol. 18: Bibliography of Seismology. No. 1: Items 4260–4378, January, February, March, 1939. By Ernest A. Hodgson. Pp. 22. (Ottawa: King's Printer.) 25 cents. [3010

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1933–34. English Version. Part 1. Pp. 178. (Cairo: Government Press.) P.T. 50. [111

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 183: Note on the Effect of Boundary Walls of a Stream upon the Circulation round a Plane Aerofoil. By Susumu Tomotika, Kô Tamada and Yukimasa Saitô. Pp. 363–394. 45 sen.

No. 183: On the Deformation of Free Boundary due to Line Vortices. By Isao Imai. Pp. 395–438. 60 sen. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) [111

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 11: Metabolic and Storage Investigations on the Banana. By C. W. Wardlaw, E. R. Leonard and H. R. Barnell. Pp. iv+61+19 plates. 3*s.* 6*d.* net. Memoir No. 12: Storage Investigations with Trinidad Grapefruit, 1938–39. By C. W. Wardlaw and E. R. Leonard. Pp. 20+3 plates. 2*s.* net. (Trinidad: Imperial College of Tropical Agriculture.) [111

Queen Victoria Memorial, Salisbury, Southern Rhodesia. Annual Report for the Year ended 31st March, 1939. Pp. 8. (Salisbury: Queen Victoria Memorial.) [211

Bulletin of the American Museum of Natural History. Vol. 76, Art. 5: The Mammals of the Guiana Region. By G. H. H. Tate. Pp. 151–230. Vol. 76, Art. 6: Studies of Birds from Eastern Brazil and Paraguay, based on a Collection made by Emil Kaempfer. By Elsie M. B. Naumberg. Pp. 231–276. (New York: American Museum of Natural History.) [311

Reports of the Japan Institute for Science of Labour, Inc. No. 42: Temperature and Humidity in various Workshops of the Textile Industry in Japan. By Dr. Simzi Katuki and Dr. Hirosi Sukegawa. Pp. ii+23. 50 sen. No. 43: Volksernährung in Japan. By Dr. Gito Teruoka. Pp. 14. 40 sen. (Tokyo: Japan Institute for Science of Labour, Inc.) [311

Bernice P. Bishop Museum. Bulletin 160: Review of the Fauna of the Marquesas Islands and Discussion of its Origin. By A. M. Adamson. (Pacific Entomological Survey: Publication 10.) Pp. ii+93. (Honolulu: Bernice P. Bishop Museum.) [311

India Meteorological Department. Scientific Notes, Vol. 7, No. 81. Vertical Currents in the First Few Kilometres over Poona and their Possible Effect on the Measures of Upper Winds made by Pilot Balloons assumed to rise at a Known Constant Rate. By K. P. Ramakrishnan. Pp. 233–242+5 plates. 9 annas; 10*d.* Scientific Notes, Vol. 7, No. 82: An Analysis of Indian Rainfalls using the Median as a Statistic. By L. S. Mahalingam. Pp. 243–254+4 plates 12 annas; 1*s.* (Delhi: Manager of Publications.) [611

Twenty-first Annual Report of the National Research Council of Canada, 1937–1938. Pp. 178. (Ottawa: National Research Council of Canada.) 75 cents. [611

U.S. Department of Agriculture: Weather Bureau. Monthly Weather Supplement No. 41: Meteorological Results of the Byrd Antarctic Expeditions, 1928–30, 1933–35, Tables. By G. Grimminger and W. C. Haines. (W.B. No. 1270.) Pp. iv+377. (Washington, D.C.: Government Printing Office.) 1 dollar [611

Bulletin of the American Museum of Natural History. Vol. 85: The Birds of the Belgian Congo, Part 2. By James P. Chapin. Pp. vii+632+21 plates. (New York: American Museum of Natural History.) [611

Department of Agriculture, Straits Settlements and Federated Malay States. Scientific Series, No. 22: The Identification of Grubs from Rubber Estates. By G. H. Corbett and N. C. E. Miller. Pp. 7+4 plates. (Kuala Lumpur: Government Press.) 50 cents. [611

University of Toronto Studies. Mathematical Series, No. 7: Some Integrals, Differential Equations, and Series related to the Modified Bessel Function of the First Kind. By Dr. A. H. Heatley. Pp. 32 (Toronto: University of Toronto Press; London: Oxford University Press.) 4*s.* 6*d.* net. [711

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 49: Technological Reports of Standard Indian Cottons, 1939. By Dr. Nazir Ahmad. Pp iv+106. (Bombay: Indian Central Cotton Committee.) 1 8 rupees [811

Bulletins of Indian Industrial Research. No. 15: Recovery of Titanium Oxide as a By-Product in the Manufacture of Alumina-Ferric from Bauxite. By Sudhir Chandra Chakravarty. Pp. iv+10. (Delhi: Manager of Publications.) [811

Year-book of the Royal Asiatic Society of Bengal. Vol 4, 1938. Pp. 138. (Calcutta: Royal Asiatic Society of Bengal.) 3.8 rupees. [811

Indian Science Abstracts (Being an Annotated Bibliography of Science in India). 1936, Part 2. Pp. 62+68+35–45. 8 rupees. 1937, Part 1. Pp. 18+38+46+64. 10 rupees. (Calcutta: National Institute of Sciences of India.) [811

Union of South Africa: Department of Mines, Geological Survey. Memoir No. 36: The Mineral Deposits of the Murchison Range, East of Leydsdorp. By O. R. Van Eeden, F. C. Partridge, L. E. Kent and J. W. Brandt. Pp. 172+10 plates. (Pretoria: Government Printer.) 7*s.* 6*d.*, including Map. [811

Ministry of Public Works, Egypt: Physical Department. The Nile Basin. By Dr. H. E. Hurst and the late Dr. P. Phillips. Second Supplement to Vol. 3: Ten-day Mean and Monthly Mean Gauge Readings of the Nile and its Tributaries for the Years 1933–1937 and Normals for the Period 1912–1937. (Physical Department Paper No. 37.) Pp. 291. (Cairo: Government Press.) P.T. 50; 10*s.* [811

International Institute of Agriculture. Documentation for the European Conference on Rural Life, 1939. Pp. 370. (Rome: International Institute of Agriculture.) 25 lire. [811

Six Lectures on *Sinanthropus pekinensis* and Related Problems. By Prof. Franz Weidenreich. (Reprinted from the *Bulletin of the Geological Society of China*, Vol. 19, No. 1.) Pp. iv+110+9 plates. (Peiping: Peiping Union Medical College.) [911

Palaeontologia Sinica. New Series D, No. 7 (Whole Series No. 118): Le rôle des animaux et des causes naturelles dans la cassure des os. Par Dr. Pei Wen-Chang. Pp. 64+21 plates. (Peiping: The French Bookstore.) [911

League of Nations: Economic Intelligence Service. Urban and Rural Housing. (II. Economic and Financial. 1939. II. A.2.) Pp. xxxvi+160. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 3*s.* 6*d.* [1011

South Australia. The Institute of Medical and Veterinary Scienc First Annual Report of the Council, July 1938—June 1939. Pp. 1 (Adelaide: Institute of Medical and Veterinary Science.) [12

Department of Agriculture, Straits Settlements and Federated Mal States. Economic Series No. 10: Malayan Agricultural Statistics 193 By D. H. Grist. Pp. xi+102 tables. 1 dollar. Annual Report on th Departments of Agriculture, Malaya, for the Year 1938. Pp. iv+9 1 dollar. (Kuala Lumpur: Department of Agriculture.) [13

Department of Public Instruction, Technical Education Branc New South Wales. Technological Museum: Curator's Annual Repo for Year ended 31st December 1938. Pp. 6. (Sydney: Governme Printer.) [13

Smithsonian Miscellaneous Collections. Vol. 98, No. 24: T Ptarmiganis Strata of the Northern Wasatch Mountains. By Charl Elmer Resser. (Publication 3550.) Pp. ii+72+14 plates. (Was ington, D.C.: Smithsonian Institution.) [14

Proceedings of the United States National Museum. Vol. 87, N 3072: A Study of Leconte's Types of the Beetles in the Genus *Monoc* with Descriptions of New Species. By Doris Holmes Blake. P 145–172+plates 18–19. (Washington, D.C.: Government Printi Office.) [14

Field Museum of Natural History. Botanical Series, Vol. 17, No. Genus Labordia, Hawaiian Euphorbiaceae, Labiatae and Composit By Earl Edward Sherff. Pp. 445–612. 1.25 dollars. Zoological Seri Vol. 24, No. 5: Eight New Bats of the Genus Rhinolophus. By Col Campbell Sanborn. Pp. 37–44. 10 cents. Zoological Series, Vol. 2 No. 6: A New Coral Snake from British Guiana. By Karl P. Schmi Pp. 45–48. 10 cents. Zoological Series, Vol. 24, No. 7: Reptiles a Amphibians from Southwestern Asia. By Karl P. Schmidt. Pp. 49– 30 cents. Zoological Series, Vol. 24, No. 8: Malacological Notes. Fritz Haas. Pp. 93–104. 15 cents. Zoological Series, Vol. 24, No. Carcinological Notes. By Claire Nemec. Pp. 105–108. 10 cen Zoological Series, Vol. 24, No. 10: Three New Birds of the Ge Stachyris. By H. G. Deignan. Pp. 109–114. 10 cents. (Chicag Field Museum of Natural History.) [14

Suomen Geodeettisen laitoksen julkaisuja (Veröffentlichungen d Finnischen Geodätischen Institutes). No. 28: Verbesserung d horizontalen Winkelmessungen Wegen der Seitenrefraktion V T. J. Kukkamäki. Pp. 18. No. 29: Ergebnisse der astronomisch Ortsbestimmungen im Jahre 1938. Von Ilmari Bonsdorff. Pp. (Helsinki: Finnischen Geodätischen Institutes.) [15

Publications of the Isostatic Institute of the International Associ tion of Geodesy. No. 6: On the Upheaval of Land in Fennoscand By Erkki Niskanen. Pp. 30+2 plates. (Helsinki: Internatio Association of Geodesy.) [15

Publications of the Astronomical Institute of the University Amsterdam. No. 6: A Photometric Study of some Stellar Spect (δ Cephei, ν Cygni, κ Cephei, δ Equulei). Part 1: Catalogue of Li Intensities. By A. Pannekoek and G. B. Van Albada. Pp. iv+ (Amsterdam: Stadsdrukkerij.) [15

Meddelelser om Grønland udgivne af Kommissionen for Vide kabelige Undersøgelser i Grønland. Bd. 105, Nr. 4: The Scores Sound Committee's Second East Greenland Expedition in 1932 King Christian IXs Land. The British East Greenland Expediti 1935–36. Geological Investigations in East Greenland. Part 3: T Petrology of the Skaergaard Intrusion, Kangerdlugssuaq, East Gree land. By L. R. Wager and W. A. Deer. Pp. 352+27 plates. (Købe havn: C. A. Reitzels Forlag.) 20.00 kr. [16

Osiris. Vol. 6: Societatum Eruditarum Concilio Americano Fave Iosepho Bidez Oblatum. Edited by George Sarton. Pp. x+8 (Bruges: Saint Catherine Press, Ltd.) [16

Bulletin of the Buffalo Society of Natural Sciences. Vol. 19, No. The Butterflies of the Niagara Frontier Region and Beginner's Gu for Collecting, Rearing and Preserving Them. By William W Pp. 55 (8 plates). (Buffalo, N.Y.: Buffalo Museum of Science Pre 1 dollar. [16

Supplement to Root Nodule Bacteria and Leguminous Plants. Edwin Broun Fred, Ira Lawrence Baldwin and Elizabeth McCoy. 40. (Madison, Wis.: University of Wisconsin Press.) 50 cents. [17

New Zealand: Department of Lands and Survey. Annual Report Scenery Preservation for the Year ended 31st March 1939. Pp. 6*d.* Annual Report on Public Domains and National Parks of N Zealand. Pp. 13. 6*d.* (Wellington: Government Printer.) [17

Memoirs of the American Philosophical Society. Vol. 11: T Composition of Ancient Greek Bronze Coins. By Prof. Earl Radcl Caley. Pp. viii+203+4 plates. (Philadelphia, Pa.: Americ Philosophical Society.) 2.50 dollars. [17

Monografia de la Universidad de Puerto Rico. Serie B, Núm. Enfermedades de la plantas economicas de Las Antillas. Por Melville Thurston Cook. Traducido directamente del manusc original por José I. Otero. Pp. 530. (Puerto Rico: Universidad Puerto Rico.) [17

Agricultural Experiment Station: South Dakota State College Agriculture and Mechanic Arts. Bulletin 311: Alkali Disease Selenium Poisoning. By Alvin L. Moxon. Pp. 91. Technical Bulle No. 2: Selenium in Rocks, Soils and Plants. By Alvin L. Mox Oscar E. Olson and Walter V. Searight. Pp. 94. (Brookings, S. State College of Agriculture and Mechanic Arts.) [17

Mémoires de la Société de Physique et d'Histoire naturelle Genève. Vol. 42, Fasc. 1: Magnitudes bolométriques, diamèt masses et densités d'étoiles. Par Paul Rossier. Pp. 96. (Gen Georg et Cie.) 8 francs [17

Catalogues

Royal Worcester Laboratory Porcelain. Pp. 8. (London: Gallenkamp and Co., Ltd.)

Books on Various Subjects. (Catalogue No. 641.) Pp. 54. (Lond Francis Edwards, Ltd.)

Films about Oil: a Catalogue of 35mm. and 16mm. Films ab the Oil Industry and the Uses of Oil which may be Borrowed F Pp. 20. (London: Petroleum Films Bureau.)

ditorial & Publishing Offices:
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON
Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, DECEMBER 2, 1939 No. 3657

SCIENCE AND THE NEW EUROPE

OR some weeks past, much paper and ink have been expended in discussing the war aims of Allies. Although the British and French miers and others have declared repeatedly l on various occasions that the purpose of Allies is to put an end to the constant gressions of Germany, in the interests of peace ong the European peoples, there are those who l that, as thus stated, Allied aims are not ficiently defined. Hence there is frequent ference of opinion as to whether, in arriving at terms of a peace, it will be possible to dis-minate between the Nazi Government and the rman people. In this connexion, Mr. Chamber-n's restatement of the aims of Great Britain and Allies in his broadcast of November 26 as "the eat of that aggressive, bullying mentality which ks continually to dominate other peoples by ce, which finds a brutal satisfaction in the secution and torture of inoffensive citizens, and the name of the interests of the State justifies repudiation of its own pledged word whenever inds it convenient" should allay all doubt.

So clear and comprehensive a summing up of forces to which the Allies are opposed, and which they are determined to put an end, be y Nazi or characteristic of the German people large, leaves no room for ambiguity or extenua-n. In the pages of NATURE, however, and with advancement and interests of scientific truth re especially in view, it is permissible to phrase objective in even more precise terms without ential modification of substance, yet at the ne time clarifying the issue. To every man of ence it should be an article of faith that any w of the State and of the duty of the citizen that State which require from the research worker, the man of science, or the teacher the distortion of scientific evidence, the suppression of any scientific truth, and the elimination of all freedom of thought which runs counter to the prevailing political theory, are abominations which must be destroyed, root and branch. Continental commentators on the war aims of the Allies, who are close observers of the German scene both at the moment and in historical perspective, have pointed out that while the German philosophy and mentality function in terms of 'power', Great Britain and France are thinking in terms of 'liberty'. Although the German people have been moulded by the Nazis to the ends of 'power politics' more drastically than ever before, it is no doctrine of to-day or yesterday. It goes far back in the history of the German people. How this should bear upon the attitude of those who have at heart the true interests of scientific thought and the advancement of scientific knowledge it is perhaps unnecessary to inquire. The moral is obvious.

Contributions to the recent discussion of war aims have brought to light many interesting differences of opinion and diversity of view. The 'New Europe' of which Mr. Chamberlain spoke is not one in which the map has been redrawn according to the ideas of the victors, but a Europe in which "the nations which inhabit it will approach their difficulties with good will and tolerance". Mr. Chamberlain went on to define the conditions of lasting peace as involving in the first place a full and constant flow of trade between the nations concerned, with an increased interchange of goods and services by which the standard of living could be improved; secondly, that each country would have the free and unfettered right to choose its own form of internal government, so long as that government did not pursue an external policy injurious to its neighbours; and thirdly, that in Europe armaments should be dropped as a useless expense, except in so far as needed for the preservation of internal law and order. As a corollary, he contemplated as necessary some machinery capable of conducting and guiding the New Europe in the right direction. Not unnaturally, Mr. Chamberlain did not feel called upon, nor indeed did he think it possible at this stage, to specify the kind of machinery which should be established for this purpose.

Although Mr. Chamberlain's foreshadowing of the possible course of post-War events must be still fresh in the minds of all, it is perhaps not superfluous that it should be recapitulated here. For the man of science this forecast bears a special significance. To him as a citizen it carries—as indeed it does to all—a message of promise and hope at a time when the very foundations of honour and decency of life in a civilized community are under grave threat. But for the man of science in the exercise of his special function as one whose work directly or indirectly comes ultimately to bear on the better organization of civilized life and its amenities, Mr. Chamberlain's words convey a deeper implication, and in a twofold sense. Of all the forces which in the interval between the last and the present War have made for international co-operation and mutual understanding between peoples—an essential condition of lasting peace—few have been more effectual than science. This has been due not merely to the effect produced by co-operation in research and the pooling of results, but it has arisen also out of the manner in which science has devoted itself to a world-wide, objective and impartial study of certain facts, and the application of the results of such study in efforts to raise the general standard among peoples in such matters as nutrition, personal and social hygiene, conditions of labour, production and exchange, and a hundred and one other problems which vitally affect the well-being of communities and the happiness of their members. As must be inevitable after a great war, the need for these services will be intensified at the close of hostilities, and it may be assumed that to cope adequately with the conditions which will then prevail will demand a gigantic effort in which international co-operation alone will be equal to the strain.

More immediately, however, in Mr. Chamberlain's New Europe it will be incumbent u
science, and more especially the biological
humanistic sciences, to place their knowled
their methods of inquiry, and the results of th
research at the disposal of the friendly conferen
of which Mr. Chamberlain spoke, when they m
to adjust boundaries, to discuss the econo
problems of productions, currency and exchan
and to consider those other problems with wh
they will have to deal to ensure the lasting pe
for which we hope. It is equally essential that t
body of specialized scientific knowledge should
at the service of that body, or machinery, wh
is to guide the development of the New Euro
whatever may be its form and whatever
authority which it may carry to enable its ruli
to prevail. Only on this condition and by
utilization of such specialized knowledge to
full will it be possible to avoid the mistakes o
second 'Versailles'.

Political philosophies have alternated betw
'force' and 'consent' in their analyses of the for
which contribute to the origin and growth
societies. Possibly a happy compromise betw
the two has in most instances brought about so
state of equilibrium, a generally acceptable w
of living. If force—the big policeman—is necess
to coerce the criminal, the perverse, and
members of an intractable minority, it is a fo
wielded in the interests of, and with the consent
the majority. The preponderance of that major
and the unanimity of its consent to the exercise
force both as an instrument of, and as embodi
in, law and order, must depend upon the recogniti
of a number of common aims among the memb
of the community and the extent to which e
individual is prepared to curb his idiosyncrasi
should there be any to which the curb should
applied in the interests of other members. T
same applies, or perhaps it would be more corr
to say it is an ideal which should apply, in t
relations between States and peoples. For it
the teaching of anthropology that each peop
each national group, has its idiosyncrasies, li
an individual—idiosyncrasies which are the produ
of a long history of cultural development
Europe going back to the Dark Ages, and inde
far beyond. Further, we learn from such stud
that such a cultural heritage in the long run nev
submits to force, but itself vanquishes force in t
end. Such modification as the cultural herita
may undergo in the course of development—a
it is unquestionable that such transformations

ethnic group have taken place on many asions—this is brought about by cultural con-t and cultural exchange no less than by the rse of an internal cultural evolution (to use the m evolution in its more popular sense). Is this solution of the German problem, the problem ich to some seems insoluble without a change the heart of that people as a whole, but of which present there seems little prospect ?

The major problem of the post-War world will the reconciliation of the cultural heritage, national spirit of each ethnic group, with the mmon aim of a New Europe. If the guiding body or machinery of which Mr. Chamberlain spoke is to avoid the error of an earlier settlement, study of the problem which respects cultural and ethnic history must be invoked toward a solution. Then it may be possible to ensure international co-operation in a maximum of joint effort towards those common aims to which science, among other social forces, will point the way. The greater the common field in which co-operation can be brought about, the less the need is likely to arise of coercing the recalcitrant and the aggressor by the threat of the big policeman—a major European war.

AMERICAN MINERAL DEFICIENCIES

ategic Mineral Supplies
G. A. Roush. Pp. xvii+485. (New York and ndon : McGraw-Hill Book Co., Inc., 1939.) 33s.

S a by-product of recent discussions about resources in essential raw materials, the rd 'strategic' has acquired a specially limited nificance in the United States. It refers to those terials which are not obtainable from within national boundary in sufficient quantities to et current industrial needs and therefore, in es of emergency, military necessities as well. e peace-time and war-time requirements of modern State now differ quantitatively rather n qualitatively, and so the list of contraband terials has become extended very widely by all tes.

The political atmosphere of the last six years undoubtedly stimulated a specially intense mination of this subject, and study of the blem of self-sufficiency is naturally not an un-asing theme to Americans ; for no other political it has so few gaps in its defences to repair ; has h small difficulties in securing supplementary plies from outside ; or is so well developed in industrial configuration to absorb and turn to rketable or military account these imported ategic raw materials. For an industrialized ntry deficiencies in a few minerals are more ious than any shortcomings in vegetable pro-cts, because the former are distributed over the be in workable deposits without regard to mate or political boundaries ; they cannot be de artificially ; they cannot be transplanted ; d only to a very limited extent, and then with ne loss of efficiency, can the abundance of e material be made to make up for shortage another.

In the United States ten minerals are listed by the War Department as 'strategic' ; these are not, and are not likely, to be found there in quantity or quality to meet the demands which would certainly occur during war with any great Power. There are others officially classified as 'critical' which can probably be assembled in sufficient quantities by conservation and distribution control ; they are not, as Mr. Roush says, likely "to give rise to many headaches". Then there is the much longer pleasing list of 'essential' minerals which occur in obvious abundance in the States, some with a surplus for export.

With the exception of a short final few pages on the deficiencies of the other six great Powers, this volume is limited to a study of the American ten strategic minerals—manganese ore, nickel, chromium, tungsten, tin, aluminium, antimony, mercury, platinum and mica—in addition to iodine and nitrogen, which are essential but can easily be obtained when necessary. This list also shows roughly the order of importance of these minerals for war purposes, and involuntary emphasis on the meaning of the word 'strategic' is shown by giving full consideration, in the first place, to manganese ore, the substance which gave the American steel-makers serious cause for anxiety during the War of 1914–18.

Very full data, graphically illustrated, are given for each of these minerals—the amounts required, their uses and ways of utilization, their occurrences, the partial substitutes obtainable for some of them, their outputs, prices, import tariffs and forms of control, followed in each instance by an appreciation, as the tactician would say, of the resultant domestic situation. As the editor, since 1914, of the annual publication well known as the *Mineral*

Industry, Mr. Roush has acquired a position of special authority, which his own Government has turned to further account by his appointment to the Staff Specialist Reserve of the United States Army.

The information packed by the author into 485 pages cannot be further condensed. That is one of the disconcerting features of all discussions on mineral raw materials; each mineral has its own special importance; and in an emergency, the want of any one of them may render ineffective the value of all the others. The politician's satisfaction in "looking at the question as a whole" is here of no practical value. "The problem," as Mr. Roush says in his general summary, "is not only a different one for each individual metal, but for each separate use of the metal." He takes the metal platinum as an illustration and points out that, whilst general substitutes are quite unobtainable, some cheaper substitutes can to a limited extent be used to reduce the demand for the expensive metal: fused silica can partly replace platinum in the chemical laboratory; a nickel-iron alloy can be used as a lead-in wire in electric-light globes; vanadium oxide is used instead as a catalyst in sulphuric acid manufacture. But no material has ever been found which can take the place of platinum in all its wide variety of uses. In other words, an industrialized nation *must* have platinum, for one thing; and each country has its own special list of other strategic deficiencies.

Among the alloys, however, substitution is possible to a greater extent; but again either at a higher cost or with some loss of efficiency. The institution of new alloys is now nearly a monthly occurrence, each in turn putting a predecessor out of the field under conditions of keen competition, commercial or military. So, within the territory of a highly industrialized great Power at war, the progress of scientific and technological research is more significant now than it ever was before; even from the purely military point of view it is short-sighted of any nation to decrease, for ideological reasons, its list of 'strategic' men of science.

We must, however, resist in this short review the temptation to follow up this line of thought, and refer now very briefly to some of the more direct lessons which Mr. Roush discovers in his study of the few American mineral shortcomings. He realizes that in general it is useless to encourage an increase of a peace-time production when, as in the instance of nickel and tin, there are practically no domestic natural resources to develop; that artificial efforts of the sort may add another danger if the small natural reserves are likely thereby to become exhausted. He points out the advisability, however, of a very limited peace-time activity in producing those minerals which cou when necessary, be produced in quantities s stantially sufficient to reduce the dangers o shortage during a sudden emergency. He wo encourage the use, in recoverable forms, of i ported metals as one way of building up stock for he realizes the financial burden of artificia creating stocks sufficient to cover one or two ye war supply. But this plan nevertheless seems be the only safeguard which he can recomme and it is apparently gaining favour in the Uni States since it was proposed by the Leith Co mittee some fifteen years ago to meet the dan of a manganese ore famine. Other than th direct measures, Mr. Roush points out the necess of instituting a systematic and continuous accu lation of information regarding foreign sources nearby supply, some of which might be accessi in time of war.

This leads Mr. Roush to point out the seri nature of the dangers to his own country wh would follow from a war with Great Brita but he nevertheless derives some comfort fr the well-founded assumption that any such disas is very unlikely. Great Britain too might v take note of the same danger, and for a simi reason derive the same degree of comfort; whilst the British Empire as a whole has a sho list of strategic minerals than any single politi unit, the sources of supply are widely separa from the chief industrial area, and are now un the control of free and politically independ States which still maintain tariffs for their o immediate needs.

One lesson, often mentioned by others befo peeps out occasionally in this work—the impo ance, both economic and military, of smelting a refining at home, whatever be the source of t ore. As an example of the way in which the Brit Government learned some wisdom from the co mistakes of the War of 1914–18, Mr. Roush quo the subsequent action of British Guiana in gra ing a concession to an American company to m bauxite, on the condition that it should be smelt within British territory, one result being the bui ing in the Province of Quebec of the largest sin aluminium plant in the world, in spite of the f that its location is remote from the chief mark for the refined metal.

Although this volume is devoted admittedly a entirely to the consideration of direct Americ interests, the mass of trustworthy informati which it contains indicates lessons of vital inter to those British public leaders who seem to thi that as Providence has endowed the British Emp with unequalled natural resources, Providence w also arrange for their easy assembly and utilizati in times of need. T. H. HOLLAND.

PROTEIN CHEMISTRY

Chemistry of the Amino Acids and Proteins
ed by Prof. Carl L. A. Schmidt. Pp. xxiv+
. (Springfield, Ill., and Baltimore, Md.:
·les C. Thomas, 1938.) 7.50 dollars.

OM the time of Osborne's pioneer researches on the plant proteins, American chemists biologists have shown the liveliest interest in field of investigation, and it can safely be that in no country to-day is a greater pro-ion of the total researches concerned with ein problems. Not only do American names e prominently in the history of protein dis-ries, but also for convenient accounts of the : of many European investigators, such as nsen and Svedberg, we are indebted to rican enterprise in arranging lecture visits to American publishers for issuing the lectures onograph form.

e present volume represents a courageous t by sixteen contributors, who with the ption of Prof. Gorter and his assistants Drs. kant and van der Dusen are all American, to , world-wide need for a reference book on the o-acids and proteins. It is in no sense a book he beginner—but fortunately there are many . It should be acquired by most libraries and esearch workers in the protein field because it cts in the scope of one volume so much that cattered and inaccessible, and because it odies a wider review of the literature than hitherto available.

one important respect it fails, however. reas the individual contributions are excellent, ther, they make an ill-assorted collection with ble omissions which fails to convey a sense of perspective of the protein field as a whole. example, Dr. Michael Heidelberger contributes ost informative chapter on proteins in im-ity, but there is no adequate supporting on in the book dealing with the compounds roteins with carbohydrates and lipoids so rtant in immunity phenomena. The role of eins in nutrition receives 20 pages; their roles spiration, and in preserving the water balance e organism, on the other hand, are not dis-d. The latest views on protein structure iated with the names of Astbury, Wrinch, mann and Niemann all receive ample atten-, but the chemistry of the enzymes and nucleo-ins, two fields which have developed out of ognition in recent years, is omitted altogether.

The section dealing with the preparation of the proteins is quite inadequate. A scant 8 pages is devoted to this, which stand in marked contrast to a comprehensive description extending to 47 pages on the isolation and preparation of the amino-acids. Casein receives a paragraph in which no mention is made of Van Slyke and Baker. There are no references at all to Palmer's crystalline lactoglobulin or to Kekwick's diffusible protein in milk, or to the preparation of insulin or thyroglobulin. While the physical properties of myosin are adequately described, there is no mention of its preparation or of the other proteins in muscle.

The book is strongest in its treatment of the amino-acids and the physical chemistry of the proteins. Dr. John Edsall contributes an outstanding section extending to 80 pages on dipolar-ionic structure and the solubility relationships of the amino-acids and proteins. The section on the molecular weights of the proteins is valuable only in relation to osmotic methods of measurement. In the section on diffusion the obsolete fluorescence method of studying diffusion is described and illustrated, whereas the later technique and results of Lamm and Polson are not mentioned. The description and illustration of the Svedberg equilibrium centrifuge refers to the original model built in 1924, which was radically altered a few years later. The sedimentation velocity centrifuge is represented as improving and supplanting the equilibrium centrifuge, whereas in fact the two measure different constants and are complementary. It is a pity that in an otherwise exhaustive section on the electrochemistry of the amino-acids and proteins the new electrophoresis technique described by Tiselius early in 1937 has not been included.

The reviewer is fully conscious of the immense difficulties which face anyone courageous enough to attempt the production of a comprehensive text-book on such a rapidly developing and many-sided subject as protein chemistry. The example before us must be judged in the light of these difficulties. Whereas the book is defective in many respects and may not be compared with numerous classical works of reference in other subjects, it must be acknowledged and welcomed among protein chemists as the best available to meet their needs at the present time.

A. S. McF.

WOOD AS A RAW MATERIAL

Das Holz als Rohstoff
Seine Entstehung, stoffliche Beschaffenheit und chemische Verwertung. Von Dr. Reinhard Trendelenburg. Pp. 435. (München und Berlin : J. F. Lehmanns Verlag, 1939.) 14.50 gold marks.

FROM the earliest days of civilization, wood has ranked as an important constructional material on account of the ease with which it is obtained and worked with the simplest tools, and because it combines in a striking degree a relatively high strength with moderately low density. The wide, and only partially controllable, variations in properties which it shares with other natural products have tended in recent years to place timber at a disadvantage in competition with a number of highly standardized constructional materials now on the market. Any decline in consumption due to this circumstance has, however, been more than offset by the development of new methods of manufacture which promise to overcome the difficulties caused by variation, and by the increasing use of wood in the preparation of paper pulp, cellulose, charcoal, and other substances. The more intensive utilization in these directions calls for a fuller understanding of the origin, composition and structure of wood, and Dr. Trendelenburg's book supplies an excellent introduction to the present state of knowledge in these fields.

Most text-books of wood anatomy include detailed accounts of the microscopic structure and the preparation and examination of material, and they are designed to meet the requirements of readers primarily concerned with the identification of specimens of timber or with the grading and use of timber in situations demanding good appearance or high strength. Dr. Trendelenburg's book is largely supplementary to these ; general structure and laboratory methods are dismissed in a few pages which are perhaps included merely as a matter of form, since they are probably beyond the grasp of readers not already familiar with their import, and the major portion of the book discusses structure and physical properties more particularly in relation to the use of timber in the production of secondary materials.

Two brief introductory sections describe the composition and distribution of the German forests, and give a general account of the production of timber for the benefit of readers who are not foresters ; the final section has brief notes on the production of pulp, cellulose, sugar, cha wood gas, wood wool, and fibre board.

The third section has descriptions of the ch teristic elements and tissues, and discusses causes and significance of variations in size o elements and proportions of the tissues. Cu methods of dealing statistically with variatio recommended by the International Associati Wood Anatomists, are given. Reference is to the principal chemical constituents an recent work on the fine structure of the cell The keynote of the fourth section, which with the gross anatomy of the stem, is given quotation from Nordlinger to the effect that the cell is to the physiologist, so is the gr ring to the scientific forester". Developme the growth ring throughout the year is traced the various factors influencing ring width examined. Nearly half the section is conce with sapwood and heartwood, and the accou the best yet published.

The fifth and sixth sections, together compr nearly half the book, are devoted to problem moisture content and specific gravity. Both perties have an important bearing on the yiel the products listed in the closing section of the b Variations in moisture content in different of the living tree are described in relation to se of the year, locality, and species. The conce of fibre saturation point as the moisture con at which the cell walls are saturated while no water is present in the cell spaces is mere convenient assumption for practical purposes, reference to the recent work on the subjec Barkas would have made this interesting se more nearly complete. It may be mentioned 'collapse' is not confined to dense timbers, as m be inferred from the text ; several light, soft timbers are very prone to collapse in drying, with some of these reconditioning appears t impracticable. The treatment of specific gra is equally full and interesting.

In addition to descriptions of extensive ori work, Dr. Trendelenburg refers to more tha hundred papers, more than half of which appeared since 1930 ; some four hundred and are in German, and the references to a volume of early German literature are particul valuable to English readers.

The book is well indexed, having catalogue literature, authors, species, and subjects occup 45 pages.

S. H. CLARK

NEW TECHNIQUE IN PHYSICAL CHEMISTRY

BY DR. H. W. MELVILLE, DEPARTMENT OF PHYSICAL CHEMISTRY, CAMBRIDGE

ODERN physical chemistry has now such wide ramifications that it is not easy to ımarize compactly its recent endeavours. A ınber of the newer aspects of the subject were ussed from the point of view of the invention new technique at a meeting of Section B emistry) of the British Association held at ndee on September 1. The development of such hnique is a vital part of physical chemistry, and ny recent discoveries are a direct consequence these advances.

here are in chemistry innumerable problems, n concerning well-known and simple systems, ich have formed bones of contention for many rs. No amount of theoretical treatment will vide a solution. What is needed is a simple and ıclusive experiment to settle the question once l for all. The region for inventiveness is thus wide scope. The problems which have arisen mainly those having to do with the mechanism hemical reactions, and there are essentially two sons for this state of affairs. What may be ed 'classical chemistry' has established the ds of molecule which enter into reaction and what sorts of products emerge therefrom. But ould only surmise what happened in the interliate stage of events. Certainly it was known t some kind of chemically reactive molecules k part in the reaction. The trouble is, however, t the fraction of molecules involved is generally minute that no method of analytical chemistry ensitive enough to detect their presence, apart gether from determining their nature. Thus rder to discover how reaction occurs, essentially erent methods have to be developed to perform difficult task. These problems only arise, of rse, in relatively slow reactions; very fast ctions are still outside the scope of experintal inquiry, although progress is being made selected cases. Another problem often arises e the general question of mechanism is settled. en a polyatomic molecule containing a number similarly disposed atoms undergoes reaction, it lso necessary to know what particular atom is ually involved. This question is now settled h great success by isotopic methods when nples of relatively pure isotopes are available. he first part of the general problem is by no ans solved at present. In dealing with such ute quantities of various molecules, any hod used to measure their concentration must , of course, alter that concentration significantly, otherwise the mechanism may be so much disturbed that the results obtained are invalid. One of the best examples of the development along these lines is the use of *para*-hydrogen for the measurement of hydrogen atom concentrations, in those processes where atomic hydrogen is believed to play a part, as for example in the heterogeneous and homogeneous reactions of hydrides. The method has the great merit that since conversion is brought about by exchange of atoms thus:

$$\mathrm{H} + p\text{-}\mathrm{H}_2 = o\text{-}\mathrm{H}_2 + \mathrm{H},$$

the hydrogen atom concentration is not disturbed. It may be mentioned that atomic concentrations as low as 10^{-7} mm. of mercury may be so measured.

Naturally the method is a comparative one in that the reaction being investigated is really compared with that of conversion. Suitable conditions can, however, be chosen to cover a very wide range of concentrations. One example must suffice to indicate the kind of problems that can be solved. Ammonia is decomposed by light of wave-length 2000 A. to nitrogen and hydrogen, only one molecule decomposing out of four absorbing radiation. Admixture of *para*-hydrogen shows that the primary dissociation is to H and NH_2, but only about one half of the molecules decompose in this way. This alone does not explain the low quantum yield. Another technique shows that part of the inefficiency of the gross process is due to some recombination of H and NH_2 to form NH_3, for the decomposition is inhibited by atomic hydrogen produced at a controlled rate and checked by the *para*-conversion.

Similar methods with many ingenious modifications may be applied to all homogeneous hydride reactions in which atomic hydrogen is presumed to play a part. Although the same technique may be employed in heterogeneous reactions, the addition of *para*-hydrogen sometimes alters the character of the adsorbed layer on the catalyst, and therefore makes the results more difficult to interpret.

In reactions involving halogens, atomic halogen frequently is the active species concerned, whether the reaction be induced thermally or photochemically. Fortunately, in view of the comparatively low energy of dissociation, the equilibrium constants for dissociation are known accurately, and thus stationary atom concentrations are easy to compute. If, however, there is a disturbance of the stationary concentration by any competing reaction, then both rate of production and rate of removal of atoms must be known. It is the latter quantity that is the more difficult to measure. Two methods have been developed. One consists in actually measuring the decrease in the number of halogen molecules on illuminating the system, by an optical differential technique. The other consists in a proper examination of the expansion halogen vapour undergoes on illumination, that is, the Budde effect.

The behaviour of other reactive chemical entities such as OH, NH_2, CH_3, C_2H_5, and so on, have been examined with similar but less refined methods, and there is here much work to be done before a complete correlation of all the data can be effected. For example, the life-time of these radicals can be determined by producing them photochemically and allowing their concentration to fall in the period of darkness succeeding illumination. Again, owing to the minute concentration, the chemical result in any one dark period cannot be measured. But by employing rotating sectors a large number of identical decay periods may easily be integrated to provide the information required.

The labelling of atoms in a molecule by using isotopes—radioactive and non-radioactive—has now assumed a familiar place in chemical laboratories. Deuterium is employed in all suspected cases of hydrogen atom lability and for acid-b catalysis, enolization, mutarotation and the li Isotopic oxygen, though less plentiful, provides key to debated mechanisms of hydrolysis and constitution of bound oxygen atoms in molecu Already nitrogen isotopes have indicated the r at which nitrogen molecules are severed synthetic ammonia catalysts. In fact, progress this field is only limited by the rate at wh isotopes may be produced, and the variety reactions by the kinds of isotopes available.

In principle, radioactive indicators are used the same way. They have the advantage of be easy to detect in small quantity, but often h practical limitations in their short life-times. T practical disability, however, can be overcome using more powerful neutron generators. T question of the ionization of carbon-halogen bo has been tackled in this way, and the biologi applications of radio-phosphorus are becom widely known

Thus within a matter of a few years a n branch of physical chemistry has come into bei The principles of the subject are now well est lished, and it will not be long before every bra of chemistry will derive benefit from these advan in physico-chemical technique.

THE RELATIONSHIP BETWEEN PITHECANTHROPUS AND SINANTHROPUS

By Dr. G. H. R. von Koenigswald, Bandoeng, and Prof. Franz Weidenreich,
Peking Cenozoic Research Laboratory, Peiping Union Medical College, Peking

DAVIDSON BLACK had remarked on the great similarity between the first skull of Sinanthropus to be found and the Pithecanthropus skull of Trinil, a condition which induced him to see in Pithecanthropus a Hominid form closely related to Sinanthropus (1931). The additional finds of the latter, unearthed in the interval, have confirmed Black's interpretation in every respect. But on the other hand, since the Pithecanthropus finds remained restricted to that rather incomplete specimen of Trinil, absolute evidence for his true Hominid character was lacking. In such circumstances, there was no other way open but to await the discovery of additional Pithecanthropus material before definitely solving this problem.

These discoveries materialized. Following the recovery of a rather primitive infantile skull (*Homo modjokertensis*) in 1936 and of a lower jaw of an adult individual, one of us (G. H. R. von K.), during 1937, discovered a skull in the undoubted Trinil deposits of Sangiran. This skull, preserved up to the basal region, conforms in every resp as to size, shape, and details to Dubois's Tri specimen. Dubois, however, opposed the attri tion of this skull to Pithecanthropus. Nevert less, the details of the interior, as well as exter surfaces of the skull, and also the skiagra delineating the otherwise indistinct sutures a breakage lines, show not the slightest trace irregularity or deformation, such as would unavoidable if the assembly of the fragments h been artificially adapted to a particular form. this skull of Sangiran was added another sk fragment derived from the same deposits and of t same site during the summer of 1938, brie described in NATURE of October 15, 1938, p. 7 by us. We are now in a position to report on additional Pithecanthropus find made this ye It concerns the lower part of an upper jaw unusually large dimensions, comprising the p cessus alveolares of both sides with complet preserved nasal floor and palate, the complete l ıtal arch with all the teeth leading from the ıine backward, and a part of the right dental h up to the first molar. The incisors were lost, t their alveoli are preserved (see accompanying roductions, *a* and *c*). Afterwards the skull longing to this jaw was also found. It comprises posterior third of the brain case, including the tire basis.

Morphologically and geologically, we believe we justified in attributing all these finds to hecanthropus. This type is thus represented by following finds:

(1) Skull of Trinil (Dubois, 1891): Pithecan-opus skull I.

(2) Mandible of Kedung Brubus (Dubois, 91): Pithecanthropus mandible A.

(3) Juvenile skull of *Homo modjokertensis* eol. Survey 1936)*.

(4) Mandible of Sangiran (v. Koenigswald, 36): Pithecanthropus mandible B.

(5) Skull of Sangiran (v. Koenigswald, 1937): thecanthropus skull II.

(6) Skull fragment of Sangiran (v. Koenigswald, 38): Pithecanthropus skull III.

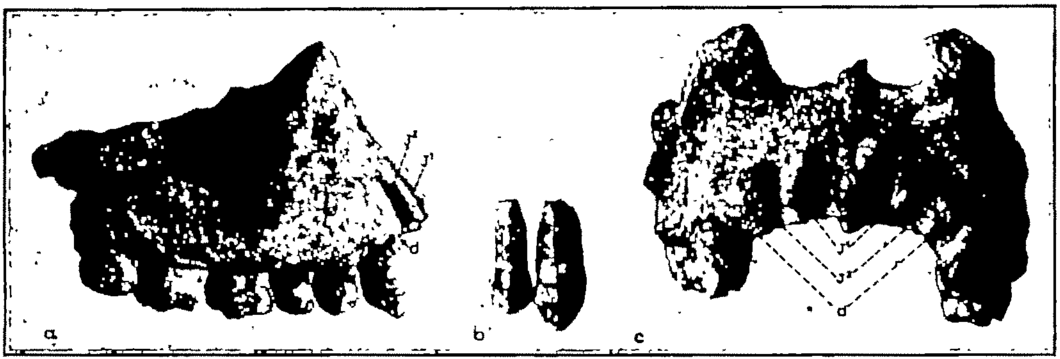
(7) (*a*) Maxilla of Sangiran (v. Koenigswald, 39); (*b*) Skull fragment of Sangiran (v. Koenigs-ld, 1939): Pithecanthropus skull IV.

The Sangiran skull (Pithecanthropus skull II) embles the Trinil skull as closely as one egg other. The former (skull II) is only slightly aller than skull I—its capacity being 835 c.c. as mpared with 914 c.c. of the Trinil skull—but its rietal and occipital parts are relatively broader. e Sangiran fragment (Pithecanthropus skull III) in its preserved part, not so flat as the other o (skulls I and II), but otherwise resembles them every detail. In addition, it bears a distinctly onounced crista sagittalis.

Of the Sinanthropus cranial material, skulls E and II of Locus L are most suitable for a comparison, having capacities of approximately 915 c.c. and 1015 c.c., respectively. These skulls are slightly larger than the Pithecanthropus skulls, but they are the same in general form and particularly in height.

The main differences so far as the skull cap is concerned consist in that in Pithecanthropus (skulls I and II) the supraorbital tori pass directly over to the extraordinarily flattened forehead, whereas in Sinanthropus the supraorbital ridges are much more demarcated from the tuber-like vaulted but otherwise also strongly receding forehead. On the other hand, the obelion region in Sinanthropus is flat, while in Pithecanthropus it is rounded off. The greatest similarity is seen in the general form and structure of the temporal and occipital bones, and there is absolute conformity in some special details of these bones. The Pithecanthropus fragment III and Sinanthropus skull E show identical features even in apparently unessential structures. Beside the first mentioned sagittal crest, there is in the obelion region on each side of the sagittal suture a short groove which Black described and illustrated in Sinanthropus skull E.

With regard to the lower jaws, that from Kedung Brubus is characterized as representing Pithecanthropus by the exclusively basal location of a broad digastric fossa—the only usable criterion. This mandible corresponds in size and proportions to the small female Sinanthropus jaws A and H, and the mandible M II, more recently discovered, and not yet described. The jaw from Sangiran (Pithecanthropus mandible B), on the other hand, is large, and corresponds to the large male Sinanthropus jaws G I and K I, with the exception that the frontal section is considerably thicker than in the latter.



(*a*) UPPER JAW OF A MALE PITHECANTHROPUS (SANGIRAN, JANUARY 1939), VIEWED FROM THE RIGHT SIDE *d*, DIASTEMA; J^1, ALVEOLUS OF J^1; J^2, ALVEOLUS OF J^2. ½ NAT., SIZE.

(*b*) UPPER RIGHT CANINE AND FIRST PREMOLAR OF A MALE INDIVIDUAL OF SINANTHROPUS (*F*IV), SO AS TO DEMONSTRATE THE PROTRUSION OF THE CANINE. ½ NAT. SIZE.

(*c*) THE SAME AS (*a*) BUT VIEWED FROM IN FRONT. ½ NAT SIZE.

On the basis of my study of the original, I have now come to the clusion that this infantile skull really represents a Pithecanthropus d. I shall report on this elsewhere.—F.W.

The upper jaw from Sangiran (see reproductions) has as yet nothing comparable among the Sinanthropus specimens, for the two upper jaw fragments of the latter known up to the present have much smaller dimensions and proportions, implying that they belong to female individuals, while the upper jaw from Sangiran must be ascribed to a male.

The differences in size and proportions of the upper and lower jaws of both Pithecanthropus and Sinanthropus, apparently chiefly due to sexual differences, also serve as a criterion of the cranial conditions in this respect. The lower and upper jaws from Sangiran are much too large for the small Pithecanthropus skulls I and II, whereas the lower jaw fragment of Kedung Brubus would seem to fit them better. It may be concluded, therefore, that the two Pithecanthropus skulls, regardless of their minor differences in size and thickness, must have belonged to female individuals, whereas the rather heavy Pithecanthropus skull IV represents undoubtedly an old male individual.

With respect to the dentition, the Pithecanthropus molars are larger than those of Sinanthropus available so far. But the lower incisors—so far as the size of the crowns can be estimated from that of the alveoli—and especially the lower canines of Pithecanthropus, are decidedly smaller than those of Sinanthropus. The canines of the Pithecanthropus upper jaw (see reproduction *a*) protrude considerably beyond the premolars, despite the fact that both are much worn. They conform in this respect to the Sinanthropus canines (see *b*) so far as male individuals are concerned. The pattern of the Pithecanthropus canine resembles that of Sinanthropus, but is less complicated by lacking the cingulum so characteristic of the latter. These differences are also true for the premolars and molars, in so far as no one of these teeth in Pithecanthropus shows such primitive characteristics as are found in Sinanthropus. Pithecanthropus, therefore, undoubtedly stands in this respect at the upper limit of the range of variation approaching the Neanderthal types. On the other hand, in respect to other features, Pithecanthropus is of a more primitive nature than Sinanthropus: for example, the second molar of both upper and lower jaw of Pithecanthropus is distinctly larger than the first, and the third lower molar the longest of all three. In addition, it is evident that—the first example of a fossil Hominid known hitherto—the upper canines of both sides are separated from the lateral incisors by a broad diastema, the width of which amounts to 6·2 mm. on the right side (*d*, in reproductions *a* and *c*). This width comes close to the average width known for male gorillas and corresponds to that of the male orang (average width, according to Remane, 6·8 mm. and 6·2 mm. respectively).

The dental arch of the Pithecanthropus up
jaw is long and relatively narrow. The front tee
according to the alveoli, were ranged within
curved line and directed forward, whereas
molars form two straight and backwardly diverg
rows. Thus, all the skeletal remains and teeth
Pithecanthropus and Sinanthropus so far availa
prove the close general relationship between
two types.

With respect to the affinity of the Pithec
thropus femora—that is to say, the so-called Tri
femur, and the five femora afterwards recovered
Dubois and also attributed to Pithecanthropu
it must be taken into consideration that the se
femora of Sinanthropus, most of them represent
only by shafts, show significant differences w
compared with those femora. All of the Sin
thropus femora display, among other characte
tics, a marked degree of platymeria, and at
same time a very low pilaster index; while
supposed Pithecanthropus femora show no indi
tion of this kind, and are in all respects identi
with those of modern man. All this points against
probability of their belonging to Pithecanthrop

Pithecanthropus and Sinanthropus undoubte
represent the most primitive Hominid forms kno
hitherto, which, according to Boule, may be rang
collectively under the name Prehominids. Which
the two types must be taken as the more primiti
cannot be decided with absolute certainty for
present. Fragments of Sinanthropus skulls sugg
that this type includes also specimens the ca
cities of which did not exceed that of Pithec
thropus II—as, for example, Sinanthropus skul
—and, on the other hand, those with a very lo
and rather low cranium, as the Sinanthrop
skull fragment H III. Nevertheless, it is cert
that Pithecanthropus shows some significa
characteristics which must be considered m
primitive than those evident in Sinanthrop
especially the presence of a diastema in the up
jaw.

Considered from the general point of view
human evolution, Pithecanthropus and Sin
thropus, the two representatives of the Prehomi
stage, are related to each other in the same way
two different races of present mankind, which m
also display certain variations in the degree
their advancement.

The Prehominids are separated from the Ne
derthal group by a considerable gap. On the oth
hand, an apparently close relationship exi
between Pithecanthropus and *Homo soloensis*,
skulls of the latter appearing like an enlarg
form of the former. Certain peculiarities
Pithecanthropus reappear in exactly the sa
form in *Homo soloensis*. Those traits which su
gest an already more advanced type, like

ter cranial capacity, and several other struc- l features, can be derived directly from ecanthropus, and correspond to the condition he Neanderthal stage already attained by o *soloensis*. The two available fragments of tibia of *Homo soloensis* show no special liarities, with the exception of a pronounced ymeria, exhibiting only recent human char- rs in their general form and in details.

ne finds reported herein show that Java has me the most important centre for the study rehominid forms. Not only Prehominids, but the following evolutionary stage, *Homo nsis*, are represented there. Furthermore, we know that the Wadjak man of Java represents another early form of recent man, whose upper jaw (Wadjak II) displays in some respects a most surprising resemblance to the Pithecanthropus upper jaw.

In conclusion, we wish to express our gratitude to the officers of the Government of the Netherlands East Indies, and the Carnegie Institution in Washington for their generous support, which made possible not only the more recent investigations in Java itself, but also our joint study, conducted in the Cenozoic Research Laboratory, Peiping Union Medical College, Peking, of recently obtained Pithecanthropus material.

A NATIONAL ATLAS OF BRITAIN

By Prof. E. G. R. Taylor, Birkbeck College, London

ROPOSALS for a National Atlas of Great Britain and Northern Ireland were first put for- l from Section E (Geography) of the British ociation at the Cambridge meeting in 1938. They with a warm response from several other ions, with the result that a representative mittee got to work and was able to present a iminary plan for the Atlas in the form of a rt to the Association at its Dundee meeting, h has been already noticed in NATURE*. Just re the break-up of the meeting, a joint dis- ion of the report by interested sections took e, and it is here proposed to outline the ideas erning the Atlas which emerged during this ussion. As will presently appear, many blems still await solution, but these can fruit- y be examined during the period in which e active steps must wait upon the national rgency.

ut in the briefest possible terms, a National s aims at the cartographical representation of physical circumstances of the national territory h as surface configuration, structure, hydro- , mineral deposits, animal life and plant cover), by side with the circumstances of human ipancy (such as land use, fisheries, mining and istrial enterprises, lines of communication, ribution of population, of occupations, of ndaries, of amenities). Neither physical nor ian phenomena are static, and many present- distributions bear the imprint of the past. ice the plan necessarily embraces a certain iber of historical maps, and even pre-historical, ı, for example, as the map of Roman Britain, the map of Pleistocene Glaciation.

While the term 'National' as used in the title carries in the first instance the obvious meaning that the maps are limited to national territory, it possesses also a secondary but very important significance. A National Atlas, if it is to justify publication, must be national in its appeal and in its use. The selection of material and the choice of cartographical technique must be made with the intelligent citizen as well as the scientific investigator in mind. This does not imply a so-called 'popular' style of presentation, for fortunately the last twenty-five years have seen a great advance in the general appreciation of maps. At one time only the gazetteer type, limited to the expression of location, was understood. To this was later added the map showing local conditions: the topographical map, or the daily weather map. More recently still, as may be observed from the appearance of examples in the daily press, distribution maps, usually statistically based and limited to a single phenomenon, have become acceptable; such, for example, are maps of agricultural output, of population density, or of ethnic elements. In brief, the language of the map has become a familiar one.

It is well to remark, however, that Government departments lag far behind the general public in this respect. The enormous volumes of statistics which they collect are rarely, if ever, illuminated by being plotted in map form. Indeed, they are often summarized and tabulated in ways that obscure geographical facts of great significance. It is, in fact, true of statisticians and economists as a body that, up to the present, they have neglected or even rejected the use of maps, and it will be very regrettable if their co-operation is

---

TURE, 144, 702 (1939).

not secured in the proposed Atlas. The contention that the map can show nothing that the column of figures does not already reveal is easily refuted, although it may readily be admitted that the measure of interpretation and interpolation involved in drawing a map results in a loss of rigid mathematical accuracy. The subjective element is, however, being steadily reduced as cartographic technique advances, and all scientific workers who make customary use of distribution maps are aware that these can prove richly suggestive of new lines of investigation. Among such workers the economic historians appear as recent recruits, and the maps compiled from the statistical records of Domesday Book will provide not the least striking plate in the National Atlas.

It will be a very real gain and a very real economy to find within the pages of a single folio or pair of folio volumes the results of work in widely different fields, geological, meteorological, ecological, economic, and so on, uniformly displayed in such a way as to assist comparative study. Facts that must be sought in a score of publications, maps that, if they exist at all, are drawn on every possible projection and scale, will here be made immediately accessible, and such an Atlas, besides providing an instrument of research, will also serve as an indispensable work of reference, affording material information to the industrialist, to the social worker, to the administrator, to the regional planning authority, to the man of affairs.

The usefulness of the National Atlas will not, indeed, be called in question. Doubts may arise as to whether the material is available for so comprehensive and so complex a publication. In fact a very great body of material, very diverse in character, already exists in map form, and only awaits transference to uniform base maps. A further great body exists in statistical shape, and its actual mapping demands no more than the services of a trained cartographer. There remain, however, a number of desirable maps which must be the subject of research: a lithological map, for example, a water supply map, a smoke pollution map, maps of accessibility of individual town road and rail. Yet others depend upon data are only very slowly accumulating: a map o distribution of soils, for example, or, in another field, a map of the distribution of names, which throw so clear a light on settlement. Many such maps, if they ca drawn at all, must be partial and tentative, in an Atlas intended for general as well a specialist use, they will demand very ca cartographical treatment if they are to be from *suggestio falsi*.

Of quite another character is the diffic arising from the territorial division of the is of Ireland into two separate political unit which only one is part of the national terri of Britain. The unit of area for topograph climatological, and many biological map obviously the British Isles, but official statis and certain official maps (those of the Ordn Survey, for example), stop short at the boun of Northern Ireland. It is too early to say whe some form of co-operation with Eire may eventually be achieved.

In very many cases, of course, separate m of England and Wales as one unit, and of Scot and Northern Ireland as another, will be ap priate, and the basic scale of one to a mil (1/*M*), involving a page size of approxima 21 in. × 14 in., has been chosen with this p in view. The use of an identical base map, suit enlarged or reduced in scale, for every map in Atlas, intended to facilitate rapid and exact c parisons between one distribution and anothe a cardinal feature of the plan.

It will be abundantly clear that only by wil co-operation among scientific workers wh material lends itself to cartographic exposi can a worthy National Atlas be eventu achieved. Pending the reorganization of Atlas Committee, which it is hoped will be long delayed, the present writer will be ha to act as a clearing house for suggestions ideas.

OBITUARIES

Prof. R. A. Sampson, F.R.S.

WE regret to record the death of Prof. Ralph Allen Sampson, Astronomer Royal for Scotland and professor of astronomy in the University of Edinburgh during 1910–37, which took place at Bath on November 7.

Sampson was born in County Cork in 1866. From the Liverpool Institute he entered St. John's College, Cambridge, graduating in 1888 as third wrangler. Two years later he was awarded a Smith's Prize, and a fellowship of his College followed immediat Between 1889 and 1891 he was a lecturer in ma matics at King's College, London, returning in latter year to Cambridge as the first holder the newly-endowed Isaac Newton studentship. 1893 he went to Newcastle-on-Tyne as professo mathematics in the Durham College of Science, two years later he succeeded to the chair of mat matics in the University of Durham, which bec in 1908—a restoration after some years of abeya he chair of mathematics and astronomy. In 1910 npson migrated still farther north, succeeding Sir nk Dyson, on the latter's transference to Green- h, as Astronomer Royal for Scotland and professor astronomy in the University of Edinburgh.

ampson's greatest work was his theory of the r great satellites of Jupiter. This immense under- ing, which involved the discussion of thousands clipses of the satellites and demanded qualities of severance and patience in addition to mathe- tical powers of the highest order, engrossed his ention for more than a quarter of a century. The ervational material he used fell into two categories: old observations made visually, and (2) the tometric observations of the gradual disappear- es of the satellites in eclipse, made at Harvard ween 1878 and 1903. Although the general thematical theory did not appear until 1921 (*Mem.* *. Astr. Soc.*, 63) the University of Durham under- k in 1910 the publication of the "Tables of the ur Great Satellites of Jupiter", and in the previous r Sampson's discussion of the photometric ervations appeared in vol. 52 of the *Harvard* *nals*. For these researches he was awarded in 1928 Gold Medal of the Royal Astronomical Society.

ampson's first research (1894) was on the "Rota- n and Mechanical State of the Sun". At an early ge he became convinced that a satisfactory theory the distribution of temperature in the interior of sun was essential to his purpose. He discarded principles of convective equilibrium and at- pted a discussion of temperature conditions by ans of simple hypotheses governing radiation and orption—twenty years before the foundations of mic physics were laid. In this work Sampson was rue pioneer. In 1900, he edited J. C. Adams's ctures on the Lunar Theory" and, later, the Adams nuscripts relating to the discovery of Neptune.

ampson's most valuable contribution to astronomy ing his directorship of the Royal Observatory in inburgh was his work on measuring the effective peratures of the stars. During this period, too, was greatly interested in the performance of clocks l he contributed many papers on this subject to Royal Society of Edinburgh.

ampson was elected to the Royal Society in 1903. m 1915 until 1917 he was president of the Royal ronomical Society and for many years he acted secretary of the Royal Society of Edinburgh. He d the honorary degrees of Sc.D. and LL.D. of rham and Glasgow respectively, and in 1921 he s elected a corresponding member of the Bureau Longitudes (Paris). He is survived by his wife, son and four daughters. W. M. Smart.

Prof. R. V. Wheeler

ichard Vernon Wheeler, director of the ety in Mines Research Stations, professor of fuel hnology in the University of Sheffield and editor *Fuel in Science and Practice*, died at his home in ffield on October 28 at the age of fifty-six years.

graduated in the University of Manchester in 1903, where as an undergraduate he had already joined the band of research workers who laid the foundations of our present knowledge of flame and combustion, the famous Manchester school which will always be associated with the names of H. B. Dixon, W. A. Bone and R. V. Wheeler.

Wheeler became one of the leading authorities on safety in mines both in Great Britain and abroad, being awarded the Gold Medal of the Institution of Mining Engineers in 1937, and also one of the leading fuel technologists, receiving the Melchett Medal of the Institute of Fuel in 1938, but he always remained at heart a research worker. Having little use for the *ad hoc* and empirical type of research, he was fortunate in having the ability to convince those responsible for the organization and financing of the researches over which he had control of the importance and value of long-range and fundamental research. This ability was largely due to the clarity with which he explained complex problems to the non-scientific or non-technical man. As a result he was enabled to build up teams of research workers who have carried out extensive investigations in each of the fields of work in which he was interested.

In dealing with some of the most important problems involved in the winning and utilization of coal, namely, dust explosions, spontaneous combustion, carbonization and industrial burning, Prof. Wheeler regarded a knowledge of the constitution of coal as being of prime importance. This was emphasized in the "Monograph on the Constitution of Coal" written by him and Dr. M. C. Stopes and published by the Department of Scientific and Industrial Research in 1918. In this publication, which greatly stimulated research in this field, they summarized critically the work already done, and surveyed the ground to be covered by future workers. Wheeler took a prominent part in the development of this work with the assistance of many collaborators, and the main results are to be found in a series of twenty-five papers in the *Journal of the Chemical Society* under the general heading of "Studies in the Composition of Coal". The application of these researches to the more technical problems was well brought out in a series of papers published in the technical press. In his work on the prevention of gaseous explosions he emphasized similarly the importance of a fundamental knowledge of the mode of ignition and combustion of gaseous mixtures. The outstanding work in this direction was published in papers in the *Journal of the Chemical Society* dealing with the ignition of gases and with the uniform movement during the propagation of flame. The justification of his long-sighted policy is again shown by the important series of papers in the technical press showing how this knowledge could be applied.

Despite the wide range of the subjects of these researches, Prof. Wheeler always took keen interest in every piece of research under his direction, large or small, and was a continual source of suggestions and advice. He was an extremely hard worker, his enthusiasm for his work was infectious and he earned the esteem and respect of all those fortunate enough to work under him.

No account of Prof. Wheeler would be complete without reference to the respect and affection felt for him by the mining community, men as well as masters, to whom his name was a household word. His staff at the Buxton Research Station of the Safety in Mines Research Board treasure the tributes paid to him by colliers visiting the Sunday 'demonstrations', referring to him, for example, as "the greatest friend of the miner since Sir Humphry Davy".

W. PAYMAN.

Vice-Admiral Sir Percy Douglas, K.C.B., C.M.G.

VICE-ADMIRAL SIR PERCY DOUGLAS, who died on November 4 at the age of sixty-three years, joined the surveying branch of the Royal Navy in 1898 and at once showed marked aptitude for this type of work. He possessed an alert brain and was more than a little interested in 'gadgets'; anything which could relieve the labours of the surveyor in the field was of particular interest to him, and being of an inventive turn of mind, he did a great deal to lighten their work and expedite production.

Whilst in command of H.M.S. *Waterwitch* on the China Station and in collaboration with the late Commander J. Sharpey-Schafer, Douglas introduced the Douglas-Schafer sounding gear, which was a great advance on former methods of sounding in comparatively shallow water; later he was responsible for the Douglas protractor and, jointly with Prof. R. Appleyard, perfected the arcless sextant. During the War of 1914–18, Sir Percy was appointed to serve as hydrographic surveyor on the staff of the Vice-Admiral, Aegean, and at a later stage in the same capacity with the Flag Officer at Dover; between these two appointments he was the first director of the Naval Meteorological Service.

His knowledge of hydrography and geodesy was of the greatest assistance in the Dardanelles campaign, and also in the attacks on the Belgian coast, where indirect fire and bombardment was of such importance and where sound-ranging was developed to meet the need for the accurate bombardment of enemy gun positions.

After the War, Admiral Douglas interested himself in the development of echo sounding apparatus, and it was largely due to his initiative that the Admiralty echo sounding gear was perfected and brought into use. In addition to his official duties as hydrographer of the Navy, Sir Percy was, during his term of office, an *ex officio* member of the National Committee for Geodesy and Geophysics of the Royal Society, and served on the Council of the Royal Geographical Society.

Sir Percy became a member of the "Discovery" Committee in 1925 and his wide experience and knowledge were of immense benefit to this body. Shortly after his retirement he was appointed by the Board of Trade to be acting conservator of the Mersey and somewhat later became chairman of the Dover Harbour Board.

Sir Percy was a fellow of the Royal Astronomical Society and of the Royal Geographical Society a Younger Brother of Trinity House. At the t his death he was serving as Commodore Sup tendent of the Dockyard at Dover.

J. A. EDGE

Dr. T. L. Prankerd

IT is with deep regret that we record the t death in a street accident, on November 11, o T. L. Prankerd, for many years lecturer in bota the University of Reading.

Theodora L. Prankerd was born in 1878 at I gate, the daughter of Dr. O. R. Prankerd. She educated at Brighton High School and the R Holloway College whence she graduated in scien the University of London. Later she was appoi to the staff of Bedford College (University of Lon and then proceeded to carry out her early bota researches at the University of Chicago. In she was appointed lecturer in botany in Unive College, Reading, where she remained until College received its Royal Charter in 1926, and she continued as lecturer in the University up t time of her death. She was admitted fellow o Linnean Society in 1919.

Dr. Prankerd's botanical researches were ch terized by unlimited patience and exactitude. earlier work was morphological. In her first pap the water violet, Hottonia, interest centres in anatomy and possible phylogeny; and this o out more strongly in her next paper on a coal seed of which she gave a very careful descrip Although her interest remained largely morpholog her other published papers are concerned with perception of the stimulus of gravity by organs, reveal a great number of patient experiments. ardently supported the theory of statolith percep and although many consider that this conflicts the hormone theory, she herself was trying to com the two into a comprehensive theory of percep and transmission.

But it will not be as a research worker so muc a teacher and friend that Dr. Prankerd will remembered. Hosts of students have passed thr her hands. Nothing was too much trouble for and many a student will recall with gratitude kindly help which she always offered; and was not confined solely to study. She took a pers interest in her students.

Dr. Prankerd had a keen sense of justice would stop at nothing in her efforts to make jus prevail whether for an ideal or an individual. that reason she was sometimes judged harshly others though never by anyone who was prepare probe beneath that veneer of seeming forcefuln for then they found a kindly and sympathetic wom He or she who finally gained her friendship s realized how intensely loyal she was. She wa woman, too, of great breadth of vision and l ideals. Thus, her life was not devoted solely to plants. She was a great advocate of peace, and efforts for the League of Nations Union were tirel e was also an artist of no mean calibre. She had ny delightful water-colour sketches to her credit. r literary tastes were often reflected in her lectures, ich, though not always easy to follow, were elight to hear.

Hers was such a personality that she will be membered affectionately by many of her former dents when some of their more brilliantly scientific l successful teachers have been forgotten. It is irony of fate that a woman who argued and rked for peace so unflinchingly should have met death on Armistice Day.

Dr. Prankerd leaves her mother to whom she was voted and to whom our deepest sympathies are ended.

WE regret to announce the following deaths:

Prof. F. Angell, emeritus professor of psychology in Stanford University, on November 2, aged eighty-two years.

Prof. Charles Barrois, formerly professor of geology in the University of Lille, on November 8.

Mr. C. J. Bond, C.M.G., a former member of the Industrial Health Research and of the Medical Research Board, on November 23, aged eighty-three years.

Mr. Wilfred Trotter, F.R.S., sergeant surgeon to H.M. the King, and consulting surgeon at University College Hospital, on November 25, aged sixty-seven years.

NEWS AND VIEWS

hecanthropus and Peking Man: Comparative Studies

By a happy and fruitful conjunction in comparative dy of old and new material, Dr. G. H. R. Koenigs-ld, of Bandoeng, Java, and Prof. Franz Weiden-h of the Peking Cenozoic Research Laboratory, able to record in another column of this issue of TURE (see p. 926) some remarkable observations ring on the relationship between those early fossil ninids, or precursors of man, Pithecanthropus of a and Peking man. In the further light now own upon the problem of the descent of man by nt discoveries of both Sinanthropus and Pithecan-opus—of the former, some still undescribed, of the er, some of the more important made only in the rent year in response to intensified search—the hors demonstrate by detailed comparison not only essentially human affinities of Pithecanthropus, ich Dubois, its first discoverer, has come to ques-n, but also the very close affinity of Pithecan-opus to Sinanthropus, of whose right to stand in line of human descent no doubt has ever been sed. Further, among the latest Pithecanthropus terial to be discovered is an upper jaw, which in separation of canines from incisors presents a racter hitherto regarded as distinctively Simian. appearance of this character in Pithecan-opus is notable as it has been adduced as an ument in discussion of the Piltdown jaw. By far most interesting and significant result to emerge however, not so much the affinities of the two ups of fossil remains as their differences, in which only now one now the other exhibits an approach modern man, but these differences also indicate t the variability, which is so marked a feature in individual specimens of Sinanthropus, is almost ally striking when the two groups are compared h as a whole. In other words, there is evidence n at this comparatively early stage of human lution of a variation which may be termed racial. the authors' pregnant allusions to the position of *Homo soloensis*, no more need be said here than to express a confident hope of further light from an equally fruitful collaboration.

Anthropometry and the War

IN a written reply in the House of Commons under date September 28, to a question in reference to offers from ex-officer anthropologists to conduct an anthropometric survey of H.M. Forces, Sir Victor Warrender, financial secretary, War Office, stated that he was advised that "though such a survey might be of scientific interest, it is impossible in present circumstances to carry it out, owing to the time which would be required for the purpose". Captain A. G. Pape, by whom the attention of NATURE has been directed to the passage in *Hansard* reporting question and author (September 28, 1939, p. 1516), writes strongly urging the need and advantages of such a survey, which, he informs us, he himself had suggested to the authorities with the offer of his services. Readers of NATURE will scarcely need to be reminded of the deplorable gap in evidence relating to the constitution of the British population, owing to the lack of systematic records of physical characters and other anthropometric data. The survey contemplated by Captain Pape, however, is apparently of a far more extensive character, and would include observations demanding the services of medical and psychological specialists, and an extension to the rising generation through an organization embracing both university and school. Strong though the argument for an anthropometric record of the population may be—the need will be much more insistent when post-war measures of social amelioration have to be considered—it is probably quite inevitable that in so far as regards H.M. Forces, the time factor is all-decisive. While opportunity might possibly be found to examine troops serving in the field or in training, these subjects would not be representative of an average sample of the population; and the measurement and recording of the minimum observations of any value of men as they are brought up for enrolment in the Forces, who would more nearly approach the standard of the general population, would overburden the medical officer, who already protests against the inadequate time allowed for individual examination owing to pressure of numbers.

The Settlement of Europe

THE admirable broadsheet "European Order and World Order" issued by Political and Economic Planning (P E P), a summary of which appears on p. 948 of this issue, should go far to clarify the confusion which has resulted from the use in current discussions of such terms as 'war aims' and 'peace aims'. The terms on which the belligerent powers will make peace can scarcely be usefully discussed until the outcome of the war is known. On the other hand, neutrals as well as belligerents will have to consider far-reaching measures for reconstruction and for establishing a new international order. This post-war question of reconstruction requires immediate discussion and study if a settlement which is both technically possible and politically acceptable is to be found. No international conference can be expected to do more than put into final form and ratify measures which have already been worked out by experts and approved by the political advisers of all the countries concerned. Moreover, it is neither necessary nor desirable that the reconstruction problem should be tackled simultaneously with that of establishing peace. Indeed the former is visualized usually as a long-term problem for which appropriate machinery must be kept in being over a term of years rather than weeks. The fact that P E P has thought it worth while to issue a broadsheet upon these problems indicates that they are already receiving serious, if unofficial, attention. It is at least encouraging that so many new minds are being brought to bear upon them and so many new ideas are being sifted and taking shape. The scientific and constructive approach outlined by Political and Economic Planning claims the closest attention by scientific workers, and may well help them to see in what direction their own contribution can most effectively be made.

Association of Scientific Workers

THE annual council meeting of the Association of Scientific Workers was held in London on November 25. In the report submitted by the Executive Committee, the activities of the Association during the past year were reviewed. These included general activities before the War, such as the Legal Committee and the Scientific Films Committee, and special activities since war broke out, which included the collection of information on the effect of the War on science and scientific workers. The Executive Committee had drawn up a tentative scheme for the setting up of a State Department for the Co-ordination of Science and had submitted this scheme to a number of scientific bodies for their comment; these bodies had in general replied that they could work in this way to improve the status of scien A net increase in membership of 25 per cent dur the last year was also reported. The president of Association, Prof. F. G. Donnan, in his address the meeting, stressed the necessity of building activities that would have an economic appeal potential members of the Association, and sugges the possibility of establishing an unemploym benefit fund. The Association, in trying to repres men of science of all subjects in one body, ha great task before it, and in view of the existenc many sectional organizations for men of science must offer strong inducements to gain members.

THE general feeling of the membership that Association *should do a great deal more in the d* to-day economic interests of the scientific work particularly those in industry, was expressed in unanimous adoption of a resolution: "That steps taken to ensure that the primary purpose of Association is to effect the organisation of scienti since any satisfactory co-ordination of science depe upon an adequate organisation of scientists". deep concern felt by members of the Association the rapidly increasing disorganization in scien work throughout Great Britain was expressed in discussion of two further resolutions, and whil was carried by a majority vote that the Associa should not press for a Ministry of Science in present circumstances, the Executive Commi was instructed to press for the establishment c national council consisting of representative scien and technical personnel, which would have the ob of achieving adequate organization and full use of scientific resources of the country. The follow officers were elected for the year 1939–40: *Presid* Prof. F. G. Donnan; *New Vice-Presidents*, P P. M. S. Blackett, Prof. D. Keilin; *Hon. Gen Secretary*, Dr. W. A. Wooster; *Hon. Treasurer*, L. Klatzow.

New International Hormone Standards

IT was stated in NATURE of May 13, 1939, that Third International Conference on the Standard tion of Hormones, held at Geneva in 1939, decided that international standards should established for certain hormones of the anterior of the pituitary gland and analogous substances fo in urine and serum, and that international u should be defined in terms of a weight of each s standard. It was further decided that the final paration of these standards, their dispensing i form suitable for the use of the laboratory wor their storage, preservation and subsequent distr tion should be undertaken by the National Insti for Medical Research, Hampstead, London. first of these new standards, as announced earlie the year, namely, that for the gonadotrophic s stance of human urine of pregnancy—chori gonadotrophin—was established in May of this y The preparation of two additional internati standards has been completed, namely, for nadotrophic substance of pregnant mares' serum d for the lactogenic (crop-gland stimulating) sub- nce of the anterior lobe of the pituitary gland. e former standard has been prepared from sub- ntial amounts of material generously provided by e manufacturing firms in four different countries, d the latter from material supplied by seven manu- cturing firms and two research institutes in five ntries. In the case of each standard the individual nples were examined by members of the Conference d a suitable mixture was then made to serve as e respective international standard, and finally pensed in the form of tablets which have been cked in sealed tubes. In the case of each standard, ch tablet contains approximately 100 international its.

THE international standard for the gonadotrophic bstance of pregnant mares' serum is dispensed in e form of 25-mgm. tablets, each sealed tube con- ning ten of the tablets, and the international unit s been defined as the specific gonadotrophic tivity contained in 0·25 mgm. of the standard eparation. The international standard for prolactin dispensed in the form of 10-mgm. tablets, each led tube containing ten of the tablets, and the ternational unit has been defined as the specific tivity contained in 0·1 mgm. of the standard eparation. As in the case of the international ndards for other hormones, drugs and vitamins, e above international standards are held, on behalf the Health Organisation of the League of Nations, the National Institute for Medical Research, mpstead, London, N.W.3, and are distributed erefrom to national control centres established in her countries for local distribution to laboratories, stitutes and research workers, and to workers in her countries in which the establishment of national ntrol centres has not yet been completed. With gard to the supply of these new standards to those quiring them in the United Kingdom, applications ould be made to the Department of Biological andards, National Institute for Medical Research, mpstead, London, N.W.3.

andardizing Genetical Symbolism

AT the International Congress of Genetics held at aca, N.Y., in 1932, it was resolved that the netical societies of all countries be asked to co- erate in preparing recommendations regarding the oblem of standardizing genetical symbolism, in der to discuss them at the next International netical Congress. Prof. Tine Tammes (Groningen), o was appointed to take charge of this work, pro- ced a preliminary report in conjunction with Dr. de Haan and then turned over the task to the ternational Union of Biological Sciences. This dy, together with the International Institute for tellectual Co-operation at Paris, convoked a meet- of delegates from various countries, which was d in the rooms of the Linnean Society of London August 14–15, 1939, with Prof. M. J. Sirks roningen) as chairman. The delegates were Dr. A. Establier and Miss N. Nicolsky (from the I.I.I.C. in Paris), Prof. O. Winge (Denmark), Dr. B. Ephrussi (France), Prof. H. Nachtsheim (Germany), Prof. R. R. Gates, Prof. J. B. S. Haldane and Mr. A. E. Watkins (Great Britain), Prof. K. v. Körösy (Hungary), Dr. K. Ramiah and Dr. S. N. Venkatraman (India), Prof. M. J. Sirks and Dr. S. J. Wellensiek (Holland), Prof. O. L. Mohr (Norway), Prof. M. Skalinska (Poland), Dr. O. Tedin (Sweden), Prof. F. Baltzer, Prof. A. Ernst and Prof. E. Hadorn (Switzerland), and Prof. E. W. Lindstrom (U.S.A.). The delegates from Belgium, Finland, Italy and Japan were unable to attend. A preliminary series of rules for the symbolizing of genes and chromosome aberrations was drawn up at this meeting.

Science and Ethics

IN the *Scientific Monthly* of October, Prof. E. G. Conklin discusses the question: "Does science afford a basis for ethics? The highest level of human development, he urges, is attained when purpose and freedom, joined to social emotions, training and habits, shape behaviour not only for personal but also for social satisfactions. Society, no less than the individual, is seeking satisfactions, and when all these things combine, we have what we call ethics, or the science of right conduct. Science, he considers, affords a sound basis for ethics in spite of the fact that it is regarded as natural rather than supernatural in origin and development. With increasing knowledge of Nature and man, many codes have been shown to be unreasonable and unethical, and science has helped to replace them by more rational and humane ones. Science is knowledge of Nature and of man, and ethics being dependent on such knowledge it is impossible to divorce ethics from science. Science did not create Nature or man or ethics, and cannot be held responsible for their imperfections. It is as absurd to attribute human greed, aggression, hate and war to science as it would be to hold it responsible for hurricanes, earthquakes or pestilences. Because science regards ethics as a natural phenomena, it can hope to determine the causes of unethical behaviour and attempt to improve ethics by controlling these causes.

PROF. CONKLIN thus believes that progress in the control of social disorders should be possible in the same way as in the control of bodily diseases. Science has helped to make war so terrible that sane people everywhere fear and shun it. More indirectly, science can investigate the causes of war and show how they can be removed, for war and social disorders in general can be cured only as bodily diseases are, by controlling their causes. The main hope for human peace and progress lies in the cultivation of habits that make for peace and progress, especially in the leaders of the nations. There can be no final solution of the problems which threaten the very existence of civilization except through the cultivation of a wider and more generous form of ethics. Hope for the future rests in the co-operation of science, education and religion.

Fur-trade in Northern Manchuria

THE predominance in the news of political activities in Manchoukuo tends to obscure the fact that it supports an active Institute of Scientific Research, the latest publication of which describes one of the staple industries of Manchuria, the fur trade (*Rep. Inst. Sci. Res., Manchoukuo*, 3, 227; July 1939). In a lengthy paper W. N. Schernakow describes very fully, from his own journeys in Manchuria and from the contributions of other writers, various aspects of the extensive fur-trade. The majority of the fur-bearing animals are captured by means of snares, traps, pits, as well as by firearms and poison, but sometimes hunting dogs and birds of prey are employed, and one of the illustrations actually shows a hunter in the Barga using bow and arrow. The furs are collected locally, and ultimately most find their way to the fur-market at Harbin. Here in the season 1937–38, 1,217,169 furs were sold, an increase of more than a quarter million over the sales of the previous year. The greater number represents five relatively common species: Tolai hare (*Lepus tolai*) 500,000; rat (*Rattus norvegicus caraco*) 200,000; Sansing squirrel (*Sciurus vulgaris mantchuricus*) and yellow ermine (*Mustela alpina raddei*) 100,000 each; and kolinsky (*Mustela sibirica* of various subspecies) 130,000. The rare skins represented by ten or fewer individuals at the fur-market were wolverine (*Gulo gulo*) and bear (*Ursus mantchuricus*) 10 each; leopard 5 and Manchurian tiger (*Tigris tigris coreensis*) 4. The author regards the preservation of woodland as the surest way of preserving the fur-bearing animals, and he points out that the Chinese destroy not only woodland but even brush-wood wherever they settle.

Recent Archæological Finds in Staffordshire

A NUMBER of discoveries of interest are recorded in the report of the archæological section of the North Staffordshire Field Club for the period 1938–39 (*Trans. and Ann. Rep. N. Staffs. Field Club*, 73, 1939). Among these may be mentioned a disk barrow, hitherto unrecorded, which was discovered by G. J. V. Bemrose, chairman of the section, on a hill slope overlooking the stream at Oakley. Further examination, in the course of which several well-patinated flints were found on the surface, confirmed the view that it was of the central monolith type, the site of the monolith being clearly discernible. The proximity of the Devil's Ring and Finger is considered significant, while it is pointed out that it is probable that Oakley Park drive is the site of a Romano-British road linking Chesterton (Mediolanum) with Rutunium and Uriconium. Further evidence of a Romano-British road comes from Madeley Old Manor Park, where a half-mile stretch of a 'way' has been identified. It forms part of a way, on which on a length known as Longford, between Wellington and Newport, an air photograph has shown a Roman 'castra' near Wall, superimposed on a British hill-fort and other earthworks, hitherto unknown. A Romano-British residence site at Park Springs, of which the excavation was begun by W. L. Hind in 1927, now shows that the corridor and rooms were paved with hard fired tiles, measuring 5 inc square by 1 inch thick. They had been surfaced red slip before firing. The walls were plastered decorated in fast colour-wash, which is still br after sixteen centuries in damp, loamy soil. room was decorated in various shades of green yellow. Evidence points to more than one perio occupation.

Hot Spraying of Shellac

THE high viscosity of whole shellac when liquef and the difficulty of maintaining it fluid for considerable length of time, were responsible for failure of the original experiments to melt and spra under steam pressure. We have received from the L don Shellac Research Bureau, India House, Aldwy London, W.C.2, a pamphlet describing the work d by K. E. Lalkaka in the laboratory of chem engineering of University College, London, on bel of the Indian Lac Cess Committee and under supervision of Prof. H. E. Watson. The later exp ments described were directed towards using pulv ized shellac and causing the powder to fuse by pass through a flame, the fused particles being projec upon a surface to form a well-bonded coat. various means tried for securing a steady supply the pulverized material to the flame are describ and also the development of a simple appara for carrying out the process effectively. A st has been made of the operating conditions.

MATERIALS used in protective and decorative co ings are generally used in solution or emulsion for applied by brush, spray or pad. It is found tha small amount of the solvent is invariably retained the film even after prolonged drying. This resid solvent is responsible for the poor water resista and the comparatively short life of the protect coat. In particular, shellac varnish gives films wh 'blush' when immersed in water, but a flake of shel remains clear and unaffected even after seve months of immersion. The technique of a n method is described and the following surfaces h been satisfactorily treated by the process: wo paper; tin, aluminium and copper sheet; concr glass, asbestos board, plaster castings and por stoneware. The results are published for the inform tion of all interested in this novel field of applicat of shellac.

Electricity on Board Ship

THE Institution of Electrical Engineers has j published the third edition (September 1932) of "Regulations for the Electrical Equipment of Shi (3s. 3d., cloth; and 2s. 2d., paper. E. F. and Spon, or the Institution of Electrical Enginee These regulations enumerate the main requireme and precautions for ensuring safety from fire shock, in connexion with the generation, storage distribution of electrical energy for all purposes sea-going ships of all descriptions with the except of warships. The book will be essential to ma facturers, navigators, and marine architects, and useful to all who travel by sea. It begins by giving finitions indicating the sense in which the various chnical expressions given are used throughout. n 'earth', for example, is a connexion to the general ass of the hull of a steel ship, and detailed definitions e given of words like watertight, weatherproof, etc., that the exact meaning of these words when they pear in marine contracts can be found.

FOR direct current, the standard voltages are 110 d 220, but for small vessels, like tugs, trawlers, all yachts, fishing and similar small vessels, the andard voltages are 12, 24 and 110. The regulans are fairly stringent; for example, every seaing ship in which electric power is used for essential rvices shall, except where other means are available r maintaining these services, be provided with two more generating sets of such combined output that the event of one set being disabled the remaining nerating plant shall be capable of supplying the sential services. Where electric discharge lamps luminous discharge tubes are used, lighting by one more incandescent filament lamps shall be proled as necessary to ensure safety in the event of the tinction of the discharge lamps. It must also be ranged that electric discharge lamps should operate tisfactorily with the ship inclined to the normal at y angle up to 15° transversely and 10° longitu- ally, and with rolling up to 22½° with the vertical. e also learn that lightning conductors need not be ted to steel ships having steel masts. Appendix 3 very important, as the suppression of electrical terference with radio apparatus is clearly discussed. list of devices and apparatus is given in regulation 3, which it is recommended should never be s than ten feet distant from any magnetic mpass.

ining Electrical Engineers

AT the first meeting this season of the South Wales anch of the Association of Mining Electrical gineers, held at Cardiff last month, the new branch sident, Mr. D. J. Thomas, gave his inaugural dress. He referred to the position of the colliery ctrician, who is surrounded with regulations and trictions, with equipment under his care on which ny lives may depend, unless frequently inspected, d yet he has little authority and practically no tus. The equipment also with which he is provided often passed its useful life, while much of the new ipment supplied is unsuitable for the class of work which it is put. The apparatus has to withstand gh usage, and Mr. Thomas believes that there is ufficient appreciation on the manufacturers' part t there are conditions other than purely electrical s that have to be considered. The increasing ount of machine mining performed electrically d the wholesale electrification of surface and derground equipment make the modern colliery olutely dependent upon electricity, and the mining trical engineer holds a position of very great onsibility. It is of vital importance that this uld be recognized.

British Museum (Natural History): Acquisitions

A GIFT has been made to the Department of Mineralogy of a large polished slab of thodonite and pyrolusite, both manganese minerals, from Penorebar, Callington, Cornwall, collected by the donor, Mr. Arthur Russell, president of the Mineralogical Society. A well-crystallized stilbite from Kalumpang, Ulu Selangar, has been presented by the Director of the Geological Survey of the Federated Malay States. This is the first zeolite specimen from that locality to be added to the British Museum collections. Three interesting specimens of Terra Sigillata have been presented by Mr. E. P. Bottley. Similar tablets of clay, formerly included in every pharmacopœia as an antidote for snake bites and poisons, were shaped and stamped from medicinal earth found in various localities, notably the Island of Lemnos, Greece, and Prussian Silesia. These three tablets are probably eighteenth century specimens and bear easily legible insignia and characters. They form a welcome addition to a very fine set belonging to the Sloane collection. Terra Sigillata clays and related materials, such as China clay, have very high absorptive properties which render them of value in the treatment of dysentery and cholera.

Negro Education in the United States

AMERICAN Negroes have seldom played any notable part in education. A well-documented paper book, "Special Problems of Negro Education" (Washington, D.C.: G.P.O. 25 cents), shows that coloured children suffer from an inequality of chances compared with whites. The author, Prof. Wilkerson, has made several studies of the subject, and the results are gathered in this monograph. Negroes are required by law to attend separate schools in eighteen States, from Alabama to West Virginia. Four fifths of them are in the South and supply nearly one fourth of the population. Is their education in separate schools adequate, and, if not, what can be done to improve it? These are the questions the author answers. The figures tabulated are a little puzzling, but suggest on careful examination that during 1933–34 school attendance was considerably less among Negroes than whites. The Negro schools were kept open on the whole for a shorter time, though States offer varying data. A racial difference of one school month becomes over a period of years a real handicap and leads to lower levels of scholastic achievement; pupils retarded in early grades are likely to drop out of school. Eminent authorities all agree that they are quite as good in learning ability as whites. Transportation for education is important for rural districts, and here, too, they are handicapped, while they have fewer and worse-paid teachers. These disparities have been defended, but no sensible authority doubts that they should be eliminated. In Mississippi many of the coloured schools are housed in churches, old stores and shanties and lack decent comfort and educational materials. The story of higher education is similar, but it has to be noted that the Southern States in view are unable to finance public education at a satisfactory level. A much enlarged programme of Federal aid is needed, and a recent decision of the United States Supreme Court recognizes the right of Negroes to "proper provision" of graduate and professional study. So the States must provide separate facilities for them, or admit them to their universities.

Amendments to the Therapeutic Substances Act

THE Joint Committee which administers the Therapeutic Substances Act, 1925, has issued some amending regulations (Statutory Rules and Orders, 1939, No. 1395. H.M. Stationery Office. *2d.* net). A new regulation requires that every holder of a licence to manufacture therapeutic substances, who engages in the culture or manipulation of pathogenic spore-bearing micro-organisms, shall provide separate laboratories, utensils and apparatus required for the culture or manipulation of such micro-organisms. New regulations are also imposed respecting the labelling, testing and standardization of tetanus toxoid and gas gangrene antitoxin.

Earthquake in Turkey

FOR the second time recently Turkey has been stricken by a disastrous earthquake. On September 22, the epicentre was near Smyrna (NATURE, September 30, p. 589). Now, on the morning of November 23, an intense shock destroyed at least six villages in Anatolia. Eighteen people are known to have been killed, but complete news is not yet available since telegraphic and other communications were interrupted by the earthquake.

The Night Sky in December

ON December 22 at 18h. the sun enters the sign Capricornus (the winter solstice). In the latitude of London, the night then lasts for 16¼ hours. The moon is new on December 10 and full on December 26. Lunar conjunctions with the planets occur as follows: on December 9d. 10h. with Mercury; 13d. 1h. with Venus; 18d. 10h. with Mars; 19d. 8h. with Jupiter; and on 21d. 8h. with Saturn. The geocentric distance between moon and Mercury at conjunction on December 9 is only 0·2°. Mars, Jupiter and Saturn south at about 17¼h., 18¼h. and 20h. respectively in mid-December and are therefore well placed for observation in the evening sky. Venus is also coming into visibility as an evening star and may be seen low in the south-west after sunset. Mercury is at greatest elongation (21° W.) on December 17, and it may then be seen low down in the south-east before sunrise. In the late evenings of this month, there is a fine array of stars between the eastern horizon and the meridian. The variable star, Algol (β Persei), souths at about 21¼h. in mid-December. Its change of light is most easily noticeable about 1¼ hours before and after the following epochs: December 4d. 4·8h.; 7d. 1·7h.; 9d. 22·5h.; 12d. 19·3h.; 15d. 16·1h.; 27d. 3·4h. and 30d. 0·2h. To the east of Algol, spread over an area of about 2° in diameter, is a cluster of about five hundred remote stellar systems. A member of another cluster in Gemini, for which a spectrogram was secured at the Mt. Wilson Observatory, shows a redward sl of the spectral lines equivalent to a speed of recess from the solar system of more than 14,000 miles second and indicating a distance of 135 million li years. The Geminid meteors, with their great frequency about December 10–12, have a radi point a few degrees preceding Castor. At midnight December 31, the brightest star, Sirius (mag. −1 is 4¼ min. before the southern meridian.

Announcements

IN view of the delay likely to be caused by pos difficulties in the present circumstances, writers "Letters" submitted for publication in the cor spondence columns are advised that, in gene proofs of communications will not be sent to auth outside Great Britain.

DR. GERHARD DOMAGK, who was recently awar the Nobel Prize for Physiology and Medicine for 19 has been elected an honorary member of the Pharr ceutical Association of the Hindu University Benares.

DR. JUAN JACOBO SPANGENBERG has been nc inated president of the National Department Health of the Argentine Republic in succession Dr. Miguel Sussieri, who has retired.

THE King has been pleased to grant Dr. Herb Chatley his authority to wear the insignia of Order of the Brilliant Jade conferred upon him the President of the National Government of Republic of China, in recognition of valuable servi rendered by him as engineer-in-chief of the Whang Conservancy Board.

PROF. DOUGLAS MCCANDLISH, of the Departm of Leather Industries of the University of Leeds, been appointed honorary director, and Mr. W. Atkin honorary research assistant, of the Proc International Research Laboratory.

THE Bradshaw Lecture of the Royal College Surgeons of England will be delivered at the Coll in Lincoln's Inn Fields by Sir James Walton, December 14 at 3.30 p.m. The subject of the lect will be "The Surgery of the Common Bile Duct"

A LEAGUE against syphilis and other vener diseases has been founded in Cuba under the auspi of the Cuban National Institute of Social Welfare

THE Central International Seismological Bur has removed from Strasbourg to 9, boulevard de Pyramide, Clermont-Ferrand, France, from wh address it will continue to function as hitherto.

AN Elgar scholarship in naval architecture of value of £130 per annum for three or four year now being offered. Entries close on January 15, 19 Full particulars may be obtained from the Secret of the Institution of Naval Architects, 10 Up Belgrave Street, London, S.W.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 945. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

n Experiment on the Effects of γ-Radiation on the Grain Weevil

THE use of X- and γ-radiation as a means of ntrol of insects attacking stored products has never en fully investigated. We have recently made me experiments on the action of γ-rays on the evil *Calandra granaria*, which, although of only a eliminary nature, are of interest inasmuch as ey show that the control of these pests by radiation possible, under laboratory conditions at least.

Weevils were exposed to the mixed β- and γ-rays m 10 gm. of radium. The radium was contained 50 monel metal tubes 13 mm. long × 5 mm. in ameter and having a wall thickness of 0·5 mm., sely packed side-by-side to form a cylindrical slab mm. in diameter and 13 mm. deep.

One hundred adult weevils of mixed ages were put to a shallow celluloid box 40 mm. in diameter and mm. deep, provided with air holes in the lid and thin celluloid sheet 0·25 mm. thick on the under-le.

The box was placed directly over the radiation urce so that the thin celluloid underside rested on e tops of the radium tubes. On account of the low tration (0·5 mm. monel + 0·25 mm. celluloid) a nsiderable amount of β-radiation was transmitted the weevils, in addition to γ-radiation.

A similar celluloid box also containing 100 weevils s kept near by, shielded from radiation, to serve a control.

At the beginning of the exposure the weevils were wling slowly around the bottom of the box in eir usual fashion. Under the action of the radiation ey began to move faster, and towards the end the exposure, which lasted one hour, they owed a very lively motion. This increased activity s not due to local heating, for a thermometer ced over the radium tubes showed no significant e of temperature

After exposure, all the insects were alive and had umed their normal rate of movement. They were nsferred to a jar of grain and incubated at a nstant temperature of 27° C. The controls were ated similarly.

At first, it seemed as if the radiation had produced effect, for living insects were observed from time time in the jar containing the exposed culture. ter an interval of two months, however, both jars re carefully examined. It was found that the posed culture contained no living insects, whereas e control culture was flourishing. Thus it appeared t exposure to radiation had sterilized the weevils d prevented them breeding.

Unfortunately it was not possible to get a measure the radiation dose, as the radium had to be put derground soon after the outbreak of war, as a precaution against air attack. The γ-ray dose at the centre of the celluloid box may, however, be roughly estimated at 35,000 röntgens per hour. To this must be added the contribution of the β-radiation; this cannot be reckoned with any degree of accuracy owing to the complexity and uncertainty of the screening corrections. Nevertheless, it seems likely that the total dose delivered in one hour by β- and γ-rays together was of the order of 10^5 röntgens.

To deliver a dose of this magnitude to a fast-moving stream of grain entering a silo bin would not seem a practical procedure at the moment, but the development of X-ray plants of large radiation output may some day make this feasible. It should be remembered also that sterilization of insects may be possible with smaller doses of radiation than were given in this particular experiment.

However this may be, we feel that the principle involved is of sufficient interest to warrant a fuller investigation, which we hope to carry out when circumstances permit.

We gratefully acknowledge the loan of 8 gm. of radium by the Union Minière du Haut Katanga.

L. G. GRIMMETT.
Radium Beam Therapy Research,
London.

G. V. B. HERFORD.
Biological Field Station,
Imperial College of Science
and Technology,
Slough.
Nov. 6.

Local Growths in Animals Produced by Injection of Intercellular Wound Hormones

THE following preliminary experiments show that intercellular wound hormones[1], produced by living cells as a physiological response to injury[2], induce local overgrowths when injected repeatedly into rats and mice.

The wound hormones were prepared by mincing whole rat or mouse embryos, or adult rat spleens, washing the minced tissues and suspending them in isotonic salt solution, irradiating the cell suspensions with lethal ultra-violet, and obtaining the intercellular fluids (containing the wound hormones) free from cells by centrifugation and Berkefeld filtration. Control fluids were obtained from tissues treated similarly except that irradiation was omitted. All manipulations were carried out aseptically and (prior to centrifugation) at body temperature. The details of the technique have been reported elsewhere[3].

The fluids were injected subcutaneously over the abdomen in 0·5 c.c. quantities. In the first two series of experiments (using white mice) injections were made thrice weekly; in the third series (using white rats) they were made twice weekly. Six to eight weeks after starting injections, all animals in the test groups of all series developed hard, tumour-like masses near the site of injection, or, in some instances, on the tails or feet. These continued to persist, and usually to grow in size, until the animals were killed at the end of ten to twelve weeks. A typical tumour removed at autopsy weighed 1·15 gm. Histological examination of the overgrowths showed them to be composed largely of connective tissue and striated muscle.

Control fluids led in some cases to the development of similar but much smaller and less persistent growths. In this connexion, it must be remembered that some wound-hormone production would be expected in the control preparations because of unavoidable mechanical injury to the tissues, since it has been demonstrated that mechanical injury leads to the production of such factors[4].

The work is being extended with more highly purified preparations, and will be described in detail when the current investigations are completed.

JOHN R. LOOFBOUROW.
ANDRE A. CUETO.
DANIEL WHALEN.
SISTER MARY MICHAELLA LANE, S.C.
Institutum Divi Thomæ,
Cincinnati, Ohio.
Nov. 2.

---

[1] Sperti, G. S., Loofbourow, J. R., and Lane, Sister M. M., *Science*, 86, 611 (1937); Loofbourow, J. R. and Morgan, Sister M. N., *Studies Inst. Divi Thomæ*, 2, 113 (1938). Sperti, G. S., Loofbourow, J. R., and Dwyer, Sister C. M., *Studies Inst. Divi Thomæ*, 1, 163 (1937). Loofbourow, J. R., Cook, E. S., and Stimson, Sister M. M., NATURE, 142, 573 (1938).

[2] Loofbourow, J. R., Dwyer, Sister, C. M., and Morgan, Sister M. N., *Studies Inst. Divi Thomæ*, 2, 137 (1938). Loofbourow, J. R., and Dwyer, Sister C. M., NATURE, 143, 725 (1939).

[3] Loofbourow, J. R., Cueto, A. A., and Lane, Sister M. M., *Archiv. exp. Zellforsch.*, 23, 607 (1939).

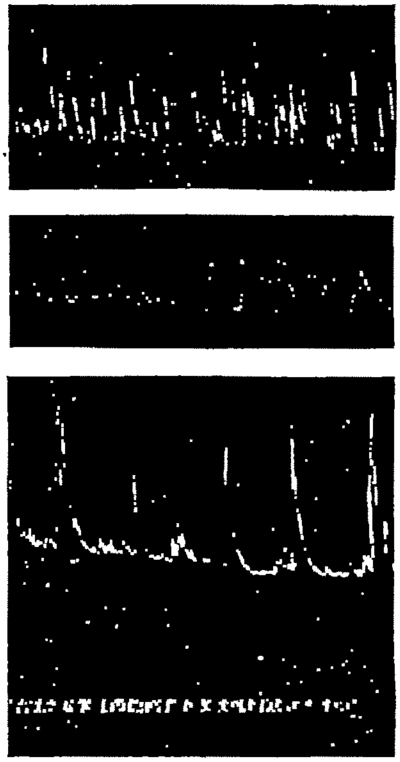
[4] Fischer, A., *Virchows Archiv.*, 279, 94 (1930). Fardon, J. C., and Sullivan, W. A., *Studies Inst. Divi Thomæ*, 2, 39 (1938). Loofbourow, J. R., Cook, E. S., Dwyer, Sister C. M., and Hart, Sister M. J., NATURE, 144, 553 (1939).

Intermittent Activity in Polychaete Worms

THE undulatory movements by means of which Nereis renews the water in its burrow are well known. Lindroth[1], in a recent study of respiration in *N. virens*, finds that the movements are intermittent in this species. "Ventilationsperioden von etwa 5 Minuten Länge werden von Ruheperioden von 20 bis 30 Minuten abgelöst". He quotes instances of other polychaetes, in which ventilation periods alternate with rest periods.

Lindroth explains this intermittent activity as follows. When the worm is quiet, the contents of the burrow can be regarded as a closed system. Owing to the metabolism of the worm, oxygen gradually disappears and other substances accumulate. Finally, an unspecified chemical factor acts as a stimulus and evokes the respiratory waves. The resulting renewal of the water in the burrow soon removes the stimulus, so the movements cease again.

It would, however, be unwise to adopt this simple and attractive hypothesis unless the actual chemical stimulus can be experimentally identified and demonstrated. Intermittent rhythmic activity is very commonly shown by isolated nerve-muscle preparations of polychaete worms and it often seems to be the normal activity pattern. I found[2] that *Arenicola marina* shows rhythmic outbursts of gulping or feeding movements alternating with periods of quiescence, and was able, by studying a series of dissected pr parations, to localize the pace-maker for this inte mittent activity in the walls of the œsophagu Wu found[3] that longitudinal ventral strips of tl body wall of the same species (including the ner cord) "often showed outbursts of rhythmic activi alternating with more quiet periods". I observe similar activity outbursts (although in this case on exceptionally) in dissected preparations of Glycer Miss I. C. Ledingham and I have just complet a study of the action of low salinities on isolat rhythmic preparations from polychaete worms. Th involved taking kymograph records of great numbe of longitudinal ventral body wall strips (includi the nerve cord) and of 'isolated extroverts' (that the proboscis and part of the œsophagus, with t stomatogastric nervous system but without t circum-oral nerve ring or brain) from *Nereis diver color* and *Perinereis cultrifera*. We find that regular intermittent activity very commonly appea especially in preparations from the latter speci in which it seems to be the normal pattern.



The accompanying records, taken by Miss Ledin ham and me, show two body wall strips (abo and an extrovert (below) from *Perinereis cultrifera* all from different individuals. The preparations we suspended in a large volume of sea water, well aerat at 16°–19° C., and the movements were recorded l light isotonic levers. The time signal marks minut The occurrence of periodic 'activity outbursts', both parts of the nervous system, is obvious. Son times the body wall strips give records like that the extrovert in the figure, that is, short, vigoro outbursts at long intervals.

Except in the case of the *Arenicola marina* extr vert, where the intermittent rhythm is very stea and regular and its normality can scarcely be doubt contractions of these isolated preparations have to be interpreted in terms of movements of the ole animal. The frequent occurrence of inter- tent activity in body wall strips suggests, how- r, that the periodic ventilation of Nereis may ult from the inherent nature of its nervous chanism, and not from the alternating accumula- and removal (by the ventilation movements mselves) of metabolites.

G. P. WELLS.

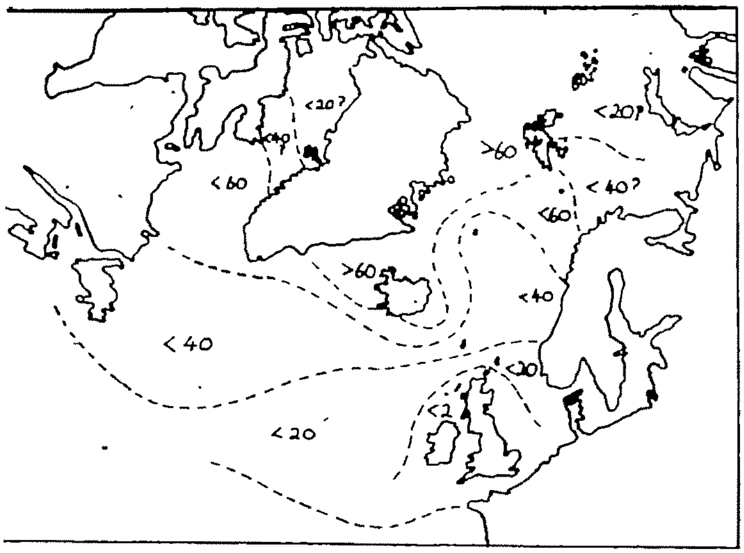
University College,
London.
Temporarily at:
epartment of Zoology,
University College,
Bangor.
Oct. 24.

droth, A., *Zool. Bidr. Uppsala*, 17, 367 (1938).
lls, G. P., *J. Exp. Biol.*, 14, 117 (1937).
, K. S, *J. Exp. Biol.*, 16, 251 (1939).
lls, G. P., *J. Exp. Biol.*, 14, 290 (1937).

---

tribution of the Colour Phases of the Fulmar (*Fulmarus glacialis*)

HARACTER gradients[1] in animals are receiving so ch attention that additional raw material, par- ularly of a quantitative kind, is urgently required.



ERCENTAGES OF 'DARK' FULMARS IN THE NORTH ATLANTIC (SUMMER BREEDING AND OCEANIC DISTRIBUTION).

ornithologists, who by reason of their numbers e already made a good start with the distribution he 'bridled' form of the guillemot (*Uria aalge*)[2,3], ht now well extend their observations to the mar (*Fulmarus g. glacialis*). Unlike the guillemot, fulmar does not exhibit a simple 'dimorph-ratio e', but shows a polymorphic one (first discussed Eagle Clarke[4]), which seems, from the limited lence available, to be of a rather complicated ure. The accompanying distribution map, com- d from twenty-six literature sources, gives a eral indication of the situation.

very stage between almost white and dark 'blue' nage is found in the fulmar. The darkest specimen mined (from Bear Is.)[5] seems to be Ridgway's[6] *tura drab* (pl. xlvi) on the back, and on the breast between *mouse-grey* and *deep mouse-grey* (pl. li), a plumage very similar to that of the dark form of the North Pacific subspecies, *F. g. rodgersii* (a race in which a similar polymorphism appears to exist).

To prepare the map, birds have been held to be 'dark' or 'light' according to which side they fall of the arbitrary mean suggested by Roberts[7]. I have attempted to interpret the literature in terms of this mean.

The maximal preponderance of dark forms seems to extend from Iceland seas (excluding, apparently, the Iceland breeding stock) via east Greenland to west Spitsbergen. Towards Bear Island, there is a slight diminution in the proportion, and the Jan Mayen birds appear to be predominantly of the lighter forms, as are those of the Faeroes, which were only colonized between 1816 and 1839. In Britain dark forms are extremely rare (only, it seems, about 2 per cent); with the exception of the large colony on St. Kilda (*circa* 20,000 pairs), the rest of the British population (*circa* 40,000 pairs) has established itself since 1878.

The situation east of Spitsbergen is obscure, but it is probable that the gradient falls somewhat sharply in that direction. The birds' distribution extends eastwards as far as Lonely Island (Einsamkeit).

From the West Atlantic information is also scanty, but the numbers of the dark forms seem to reach a peak of 40-60 per cent in the south of Davis Strait and may fall off northwards towards Baffin Bay, and southwards towards the Newfoundland Banks.

Examination of skins, and observation in the field, indicate that the polymorphic forms, though exhibiting every gradation, can be arbitrarily grouped in four main classes:

DD (double dark). Underparts uniform very dark or dark blue-grey, head and neck dark.

D (dark). Underparts uniform medium or light blue-grey, head and neck dark.

L (light). Underparts white, near-white, or white flecked or shaded with grey; on crown, nape and hind-neck grey colour continuous with that of mantle.

LL (double light). Underparts white, or near-white, head and neck white.

Roberts's arbitrary mean lies between *D* and *L*.

I shall be very glad to receive any counts of the relative numbers of these forms, either at colonies or on sea-transects. In the latter case it will be useful to give at least the noon positions of any voyaging ship from which a series of observations is taken.

JAMES FISHER.

Zoological Society of London,
Regent's Park,
London, N.W.8. Oct. 31.

[1] Huxley, J. S., NATURE, 142, 219 (1938).
[2] Southern, H. N., NATURE, 142, 951 (1938).
[3] Southern, H. N., *Proc. Zool. Soc. Lond.*, Ser. A, 109, 31-41 (1939).
[4] Clarke, W. E., *Scot. Nat.*, 221-25 (1914).
[5] Bertram, G. C. L., Lack, D., and Roberts, B. B., *Ibis*, Ser. 13, 4, 816-31 (1934).
[6] Ridgway, R., "Color Standards and Color Nomenclature" (Washington, 1912).
[7] Roberts, B., *Ibis*, Ser. 13, 4, 259-64 (1934).

Rules of Zoological Nomenclature

SUCH cases of the abuse of the rules of zoological nomenclature as are indicated by Prof. W. Garstang in NATURE of September 9 indicate a failure in the functioning of the present rules which is an ever present danger and hindrance to the work for which systematic researches exist. The existing rule that no names shall be changed if the result will be greater confusion than uniformity needs enforcement. At present, this can only be done by a long and cumbrous procedure which has resulted in comparatively few, a few hundred, *nomina conservanda*, and those generally only of common genera, and very few species. It is also unfortunate that this remedy comes after the damage has been done. The position needs something much more rapid and thorough which, under the present scheme, would mean the appointment of whole-time searchers in each group, who would present lists of a thousand or so names annually to a committee of superhuman patience. Such a scheme is utterly impossible.

Are there any alternatives? I suggest that the old rules, having served well in the old days, should now be altered radically. Consider how different is our position now. We have a vast body of systematic literature, upon much of which the most careful labour of the most skilled observers has been freely and generously expended. This vast labour has not been, for the most part, an end in itself; its essential value is to be the foundation of such subjects as ecology and genetics. It must therefore be regarded as an essential tool, to be altered and adjusted only when we are compelled by dire necessity. What would become of a factory in which the machinery might be adjusted without reference to the work of the factory as a whole? This is exactly the danger the framers of the rules of nomenclature had in mind and tried to avoid, but which insistence on the letter of the law, and neglect of its spirit, has made rampant.

I venture, therefore, to recall a suggestion I made more than thirty years ago, which was approved by the late Sir Arthur Shipley and published in NATURE, namely, that a small committee of experts in each group should select the most useful books in each, the names in which should be unalterable for any literary or priority reasons. Conversation with my friends shows that I must enlarge a little; it seems to be taken that I mean the establishment of a kind of Holy Writ—an idea abhorrent to science. The committee on group *Z*, say, decides that the most useful books in that group are *A* . . . *H*, dated, say, 1850 to 1920 (for obvious reasons no book of very recent date could be included). It is then found that the author of book *E* published excellent descriptions of a number of species, but took little trouble over synonymy, and some of his species are the same, or, in the opinion of subsequent authors, should be reckoned as varieties of species described by the authors of *A*, *B* or *C*. The names used by the latter authors therefore have priority, and are to be used; research into literature, once important and useful, but now only of historic value, of older date than that of the book *A*, will not be allowed to upset *E*'s names. Criticism founded on new knowledge, or even individual views of the relationship of species and genera, would be as free as they are now. In this way thousands of names, species as well as generic, could be saved by one year's work.

Something might also be done by ignoring the so-called work of those who change names on trivial grounds, as sinners against the workers for wh
convenience they, in fact, exist. The first neces
is that a worker who is not a specialist in systema
shall be able to get the description, variation
distribution of the species with which he is dea
with the least possible difficulty and the grea
possible certainty. Again I repeat, this is the
for which systematists work, and those who wo
put difficulties and delays in the way should rec
every possible discouragement from all scien
workers.

CYRIL CROSSLAN

Universitets Zoologiske Museum,
København.

Birds of Britain

IN the review of the "Handbook of British Bir
vol. 3, in NATURE of October 21, p. 691, there
some criticisms which require an answer. Some
merely matters of personal experience. 'S. G.'
never seen bracken used for nesting by the gol
eagle, but others have. Nests in trees have alw
been a small minority, except in one restri
district. As to the share of the sexes in provi
food for the young, H. B. Macpherson, who watc
a nest for long periods in 1909, records in his di
no fewer than twenty occasions on which the fem
brought food to the nest. A. Brook in his diary st
that the hen brought a grouse and a young har
the nest on June 14. While I agree, and h
stated in the "Handbook", that the male takes
chief part in this work, it is impossible to ig
Macpherson's evidence, and 'S. G.', to whom I m
tioned this fact, could give no explanation of
discrepancy.

May I quote one sentence from 'S. G.'s' own not
"I believe that the cock [*sic*] must have come tw
to the eyrie unperceived by me, for when I left
hide there were two more grouse in the nest."
eyrie in question was ten yards from where 'S.
kept watch.

F. C. R. JOURDAI

Whitekirk,
Southbourne,
Bournemouth.
Oct. 25.

DURING the past thirty-five years I have vis
more than a hundred golden eagles' eyries in
Highlands of Scotland, yet I have never seen brac
used as a nesting material. This shows, I th
conclusively, that bracken must be very rarely u

Eyries in trees are certainly not in a "s
minority". I used to know of at least seven pair
golden eagles (some of them have now been dri
away by the attentions of egg collectors) wh
almost invariably nested in trees. I should
indeed, that tree-nesting golden eagles are in
majority in the Central Highlands although i
minority in the Western Highlands; yet even in
west I know of several eagles' eyries in trees.

During the years 1924–36, my wife and I watc
for more than three hundred hours, throughout
day and night, at both rock and tree eyries of gol
eagles, yet we never saw the female golden e
carry in food. It was she who almost always *fed*
young, but the food was *always* brought by the m
This seems to show that at Mr. H. B. Macphers
eyrie (he watched, I believe, only at one eyrie)
bringing of food by the female was exceptional.

S. (

Synthesis of Coenzymes I and II

URING the past year, two biological methods for determination of coenzymes I and II in blood e been reported[1,2]. Kohn and Klein, using the hod described by Kohn, have reported recently *in vitro* synthesis of the pyridine coenzymes I . II by human erythrocytes[3]. In their study, sh defibrinated blood was incubated in tightly pered flasks, or tubes, for 18–24 hours at 29°–35°'' ; arently a mixture of red cells, white cells and serum used. In the presence of added nicotinic acid de or nicotinic acid, the *in vitro* synthesis of these zymes by defibrinated blood had also been erved in this laboratory, but from our experi-its it seemed that the red cells stored and carried enzymes instead of performing the synthesis. ordingly, we took duplicate samples of venous od from five normal persons, two patients with elogenous leukæmia, and one patient with phatic leukæmia, and by repeated washing arated the red blood cells, the white blood cells the serum. In each case, 1 c.c. of venous blood, its hæmatocrit equivalent of washed cells, was ubated 18 hours with an equal volume of saline ch contained 0·25 mgm. of nicotinic acid amide cubic centimetre. The control tubes contained nicotinic acid amide and were incubated the same gth of time with an equal volume of saline.

epeated tests show that : (1) the concentration oenzymes I and II in normal human blood and æmic blood is doubled after incubation with otinic acid amide ; (2) carefully washed erythro-es, however, from normal blood and leukæmic od, resuspended in saline or serum, show no ease in the concentration of coenzymes I and II r incubation under similar conditions ; (3) the centration of coenzymes I and II is greatly eased in a suspension of white cells of the lymphoid . myeloid series after incubation with nicotinic l amide.

he above findings are inconsistent with the state-nt of Kohn and Klein that the normal erythrocytes omplish the synthesis of coenzymes I and II after ubation with nicotinic acid, and suggest the tenta- hypothesis that nucleated cells are essential for synthesis of these complex enzymes.

S. P. VILTER.
R. W. VILTER.
T. D. SPIES.

Department of Internal Medicine,
versity of Cincinnati College of Medicine,
Cincinnati, Ohio.

Oct. 13.

---

hn, H. L., "The Concentration of Coenzyme-like Substances in Blood Following the Administration of Nicotinic Acid to Normal Individuals and Pellagrins", *Biochem. J.*, **32**, 2075 (1938).

ter, R. W., Vilter, S. P., and Spies, T. D., "Relationship Between Nicotinic Acid and a Codehydrogenase (Cozymase) in Blood of Pellagrins and Normal Persons", *J. Amer. Med. Assoc.*, **112**, 420 (Feb. 4, 1939).

hn, H. L., and Klein, J. R., "The Synthesis of Cozymase and of Factor V from Nicotinic Acid by the Human Erythrocyte *in vitro* and *in vivo*", *J. Biol. Chem.*, **130**, 1 (1939).

Benzedrine and Brain Metabolism

HE unquestioned value of benzedrine (phenyl-ropylamine) in the treatment of narcolepsy has le it of interest to discover in what ways this g might influence metabolic events in the nervous em.

It has been known for some time[1] that the presence of amines such as tyramine or isoamylamine brings about a marked diminution in the respiration of brain examined *in vitro*. In spite of the fall, however, of the oxygen uptake of brain tissue respiring at 37° in a glucose phosphate medium, oxidation of the amine[2] may take place with the formation of ammonia and the corresponding aldehyde[3]. The enzyme responsible for the oxidation of the amine has been termed amine oxidase, and it has been proved[3] that certain amines which are but feebly or not attacked by the oxidase nevertheless combine with the enzyme and compete with amines which are vigorously oxidized. Among such amines[4] is benzedrine which, whilst suffering little or no oxidation by the amine oxidase of brain, greatly inhibits the oxidation of tyramine or isoamylamine in the central nervous system.

It has now been found that the fall in brain respiration brought about by the presence of tyramine or isoamylamine can be partially or wholly relieved by the addition to the system of small quantities of benzedrine. This phenomenon is shown by the results given in the following table. The effect of adding benzedrine to brain tissue consuming oxygen in the presence of glucose and of tyramine is greatly to stimulate the oxygen uptake.

OXYGEN UPTAKE AT 37° OF GUINEA PIG BRAIN TISSUE IN PRESENCE OF GLUCOSE-PHOSPHATE AFTER 2 HOURS EXPOSURE TO BENZEDRINE, TYRAMINE AND A MIXTURE OF BENZEDRINE AND TYRAMINE.

Amine present	μl O_2 uptake in 1 hour	
	Expt. A.	Expt. B.
Benzedrine sulphate (0 03%)	193·6	177 7
Tyramine (0·03%)	71·1	90 1
Tyramine (0·03%) + Benzedrine sulphate (0·03%)	198 5	170·8

The facts show that the diminution of brain respiration brought about by the amine $R.CH_2NH_2$ when present at low concentrations is not due, or wholly due, to the presence of the free amine but to the accumulation of the aldehyde R.CHO formed as a result of oxidation of the amine by the amine oxidase. Benzedrine owes its stimulating effect on brain tissue respiration in the presence of $R.CH_2NH_2$ to its inhibitive action on the formation of R.CHO. Owing to the competition between benzedrine and $R.CH_2NH_2$ for amine oxidase, the greater the quantity of the inhibitory amine present the greater is the quantity of benzedrine required to neutralize the inhibition of brain respiration.

The molecule R.CHO, for example, isovaleric aldehyde, has been found to be highly toxic to respiratory processes in brain, and this toxicity is not influenced by the presence of benzedrine.

Benzedrine at low concentrations, for example, 0·001 per cent, has little influence on the oxygen uptake of brain when this respires in a glucose medium in the absence of an inhibitive amine ; its stimulating effect is only observable if an amine such as tyramine is also present. At relatively high concentrations benzedrine itself exerts large inhibitive effects on brain respiration. Such effects are due to causes other than aldehyde formation.

Benzedrine does not neutralize the inhibitive action on brain respiration of narcotics such as the barbiturates, or of a drug such as bulbocapnine. Its effect appears to be confined to the amines capable of aldehyde formation in the central nervous system.

It is permissible to suggest, in view of these facts, that the clinical effects of benzedrine administration may be related to respiratory changes in the brain. It would be of interest to discover whether there accumulates in conditions of narcolepsy toxic bodies (? aldehydes) the formation of which is retarded by the administration of benzedrine

Details of the experimental results recorded above will be published shortly.

P. J. G. MANN.
J. H. QUASTEL.

Biochemical Laboratory,
Cardiff City Mental Hospital.
Oct. 26.

---

[1] Quastel and Wheatley, *Biochem. J*, 27, 1609 (1933)

[2] Pugh and Quastel, *Biochem. J.*, 31, 286 (1937).

[3] Pugh and Quastel, *Biochem. J*, 31, 2306 (1937). Blaschko, Richter and Schlossmann, *Biochem J*, 31, 2187 (1937).

[4] Pugh and Quastel (unpublished).

Factors Determining Physical Size and Proportions

THE mathematical methods[1] devised to deal with the analysis and distribution of human ability and temperament[2] can be fruitfully applied to problems of isometric and allometric growth[3] and to those of physical anthropology[4].

A factorial analysis was undertaken of fourteen anthropometric measurements obtained from two separate adult male samples, one consisting of 64 mental patients heterogeneous for age and disease, and the other of 50 university students homogeneous for age and social status. The two independent analyses gave strikingly similar results.

Without identifying statistical entities with biological principles, it was shown that physique, in general, could be most usefully regarded as the resultant of two relatively independent factors or sets of processes, one determining the growth (or size) of the body as a whole in its various dimensions, and the other determining disproportionate development in length or circumference of the body. The establishment of racial or constitutional (growth) types would have to be based on a study of these two factors separately. These factors may ultimately be explicable in metabolic and genetic terms. The conventional indexes of somatometry would, if this view be correct, give little hope of revealing true racial or growth type differences, since 'type', as defined by excessive linear or circumferential development, is masked by the general processes governing size, and this latter factor would have to be statistically controlled if 'type' is to become evident.

As regards the problem of physique and nutrition, the implication seems to be that two norms would be required: a norm for general or uniform development of the body, and another for typological variations.

Three measurements of the head, four of body length (arm, leg, trunk, stature), three of body breadth (shoulder, chest, pelvis), three of body circumference (chest, waist, pelvis) and one sagittal (chest depth) were used. Coefficients of variation for the measurements descended in this order of magnitude: circumferential, sagittal, breadth, length, head. Of all the fourteen measurements, breadth and circumference of the pelvis and waist circumference were found most informative (that is, most discriminative) of general size or growth, and leg length together with circumference of waist and pelvis m informative of typological characteristics when size influences are statistically controlled.

J. I. COHEN

Psychological Laboratory,
University College,
London, W.C.1.

---

[1] Thomson, G. H., "The Factorial Analysis of Human Ability" (U of London Press, 1939).

[2] Burt, C., *Brit. J. Med. Psychol.*, 17, 158 (1938).

[3] Huxley, J. S., and Teissier, G., *C.R. Soc. Biol.*, 121 (1936).

[4] Clark, W. E. Le Gros, NATURE, 144, 804 (1939).

Surface Features of Mars at the Recent Oppositio

ADVANTAGE has been taken of the recent v favourable opposition of Mars to make a cl examination of the surface features. The 9 in. Co photo-visual refractor has been employed, usu with a magnification of 250. A fortnight of reasona clear weather at the end of July assisted considera and nearly one hundred drawings of the disk h been made. The following is a summary of the c points of interest revealed by these:

(1) Vast changes appear to have occurred on north-east edge of Mare Cimmerium, where apparently new dark marking has appeared. T seems to occupy the region of Cyclops and Cerbe II, Pambotis Lacus having apparently beco merged in it. It is separated from the main M Cimmerium by a narrow isthmus, broader at north end and very prominent under certain illumi tions. At the end of July it was very plain a obvious, being one of the darkest markings on planet. The reduction of the numerous drawings it has yet to be made, so that exact positions are available at present.

(2) Until July 22, Hellas was bright and obvi with a sharply defined margin, particularly on west, but on July 23 it has become dark and h with a much less definite outline. It remained so every subsequent observation. At all times, e before July 23, it was darker than the remainder

(3) Edom Promontorium became very pl towards the end of August and was one of the m prominent features. Earlier, a white region Ausonia showed up very plainly.

(4) Iuventæ Fons showed as a dark point July 10 but was not seen again, despite a cl search for it.

(5) The North Polar region was a very interesti feature. Apparently it was covered by a v eccentrically situated cap of fog or ice. At tin this was invisible but on other occasions it extenc well on to the disk. Probably this can be accoun for by the rotation of the planet, although t point has not yet been investigated. Generally was duller than the South Polar Cap, but on July it was equal to it in brightness, while on August 4 quite outshone everything on the disk, the Sou Polar Cap appearing very dull in comparison.

Various other features of interest have been not particularly in the Solis Lacus region, but, until final reduction of the observations is complete, it impossible to discuss them fully. It is hoped publish the entire results in due course.

M. GEDDES.
I. L. THOMSEN.

Carter Observatory,
Wellington, W.1,
New Zealand.
Sept. 19.

Measurements of the Velocity of Light

M. E. J. GHEURY DE BRAY suggests[1] that measure-ents of the velocity of light show that it is changing cording to a formula:

$$c = 299{,}900 - 3{\cdot}855\,T, \tag{1}$$

being measured in years from 1900.

Assuming that Planck's constant and the energy E ven out by an excited atom remain unchanged, the lation

$$E\lambda = ch \tag{2}$$

ows that a change in c must be accompanied by a oportional change in λ. But the wave-length of e red calcium line has remained constant to within e part in five million for thirty years, only 0·5 per nt of the change required by (1).

It is probable that there are unsuspected systemic errors in the determinations of c.

KITCHENER.

Trinity College,
Cambridge.

---

[1] ATURE, 144, 285 (1939).

THE decrease of velocity of light deduced from the d-shifts is of the order of 1 km./sec. in 6,000 years, 1 in 600,000,000 for thirty years, which is quite nsistent with the apparent constancy of the wave-ngth mentioned by Lord Kitchener. Our observa-ons, being affected by unsuspected systematic rors, and covering only a third of a century, give what is probably a greatly exaggerated rate of slowing down. The remarkable fact is that *all* the determinations are unanimous in indicating the existence of such a variation, and the red-shifts, if interpreted so as to escape from fantastic results, confirm it.

The Table 1 of the communication referred to cannot be dismissed on the ground of "unsuspected systematic errors". It is admitted that the method of the revolving mirror may suffer from physical bias, but no such reproach can be levelled against the toothed wheel method, which is only open to objections of a physiological nature. These can be readily overcome by substituting for the observer's eye a photo-electric sensitive device. While France and the United States share between them practically the whole initiative in the measurement of c, Great Britain has only to her credit a conspicuous failure. Is there in this country no one who can redeem it from this position and settle this question, which lies at the basis of physical science, considered in its broadest aspect?

Two observations, of Newcomb (1882·7: 299860) and of Michelson (1882·8: 299853) agree so closely that, if we consider that they were made by different observers, working independently with different instruments and different techniques, in different places, they must be extremely accurate, despite their large probable errors. It is significant that the second in date gives a lesser value of c.

M. E. J. GHEURY DE BRAY.

49, Great Thrift,
Petts Wood.
Nov. 2.

Points from Foregoing Letters

L. G. Grimmett and G. V. B. Herford describe an periment to test the possibility of controlling insect sts by means of radiation, in which it appeared at grain weevils (*Calandra granaria*) were sterilized a radiation dose of β- and γ-rays estimated at ^{5} rontgens.

Injection into rats and mice of intercellular wound rmones, produced by injuring tissue cells with thal ultra-violet, was found to produce local over-owths, in investigations of J. R. Loofbourow, A. A. ieto, D. Whalen and Sister M. M. Lane. The tumours re composed mainly of connective tissue and iated muscle.

G. P. Wells discusses the frequent occurrence of termittent rhythmic activity in isolated prepara-ons from polychaete worms.

J. Fisher describes the distribution of the colour-ases of ***Fulmarus glacialis***, and shows the existence a polymorph-ratio cline. The dark types are most merous in the neighbourhood of south and east eenland and west Spitsbergen, and fall off in oportion northwards towards Baffin Bay, and uthwards towards the Newfoundland Banks and e British Isles; in the latter they constitute less an 2 per cent of the population.

C. Crossland expresses dissatisfaction with the rking of the rules for zoological nomenclature, on e grounds that the present methods of making ***mina conservanda*** are too cumbrous, and he pro-ses an alternative method. He points out that the rk of the systematist is not an end in itself, but exists that workers in such subjects as ecology and genetics may, with rapidity and certainty, find out what is known of the species' structure, relationships, distribution and ecology; any interference with the literature which hinders this end should be discouraged.

P. J. G. Mann and J. H. Quastel show that benzedrine stimulates the oxygen uptake of brain *in vitro*, when this respires in the presence of certain amines. This is accomplished by an inhibition of the formation in brain of toxic aldehydes.

An investigation is reported by J. I. Cohen in which factorial methods of analysis, as used in psychometry, are applied to anthropometric measurements. The results suggest that physique may be regarded as determined by two sets of processes, one governing growth (or size) in all body dimensions and the other, relatively independent of the first, governing specifically linear or circumferential development.

Lord Kitchener shows that, with certain assumptions, a large secular change in c is inconsistent with the observed constancy of spectral wave-lengths. M. E. J. Gheury de Bray points out in reply that the decrease of velocity of light deduced from the red-shifts is 1 in 600,000,000 for thirty years, which is not inconsistent with the apparent constancy of the red calcium line. It is suggested that the toothed-wheel method in combination with a photo-electric sensitive device should be used to re-determine the velocity of light.

RESEARCH ITEMS

Prehistoric Rock Pictures in Dutch New Guinea

ROCK PAINTINGS collected in the islands off the coast of the Onia Peninsula, Dutch New Guinea, by members of the Frobenius Expedition in 1932 have been described and figured by J. Röder (*Man*, Nov. 1939). The paintings—there are no engravings—have been executed in grooves and hollows of the cliffs, washed out by sea-spray, which form a series of galleries, following the coast-line at a height of two to four metres above high-water mark. Apart from quite recent drawings, three layers can be distinguished. For the most ancient, red paint is used. In this layer four styles can be recognized, though there is a far-reaching uniformity of subject. In the earliest style, however, the most characteristic subject is the silhouette of the hand, with silhouettes of feet and arms. The hands occur in dozens on the same wall—right hands, left hands, hands of children, but only rarely with mutilated fingers. In aboriginal tradition these mark the wanderings of the ancestral immigrants, who were blind. In later styles of the red paint layer, the hands are absent, but other subjects are much the same—fish, trepang, crocodile, lizards, and man, at times scarcely to be distinguished from an animal. Often, apart from the big find spots, the human figures are surmounted by a large head-dress like a pointed nightcap, the hands being raised as in adoration. These are now said to be representations of ancestors. The sex is prominently characterized; and sometimes the figure is so abbreviated that only the sign of sex remains. Here is evidently a fertility cult, which survives to-day in the use of wooden figures. Subjects in black paint point to a different culture in which the boat is prominent—previously unrepresented, but now taking a part in cult. There is in this layer a progressive degeneration in style and execution. Paintings in white are mostly superimposed on the red, as if a comment were intended. Caves with pictures of both the red and black periods are found. A cave deposit on excavation revealed three cultural layers, of which two contained pottery, but the lowest flint implements only. A figure on a stalactite pillar with arms upraised was evidently an ancestral figure or deity to which, presumably, offerings had been made on a stone showing traces of red from the second cultural layer. Burials in the semi-caves were made up to represent boats.

Basque Origins

THE results of recent research on the origins and affinities of the Basques, which had been interrupted by the Civil War, are reviewed by Mr. Rodney Gallop in the course of an account of the people appearing in *Discovery* of October. The most recent researches tend to confirm the 'positivist' view of Julien Vinson that "from the earliest times the Basques have never been more than a small tribe dwelling in a few valleys of the Western Pyrenees". The basis of the confirmation is archæological and anthropological rather than linguistic, and rests on the existence of a uniform culture in north-west Spain and south-west France from palæolithic times onward, belonging to a people whose skulls, found on both palæolithic and neolithic sites, correspond closely with a type which predominates among the Basques of to-day, but is found but rarely amo the adjacent French and Spanish populations. Th type lies between the brachycephalic and dolich cephalic, and is distinguished by prominent templ high cheek-bones, a narrow loose jaw, a long point nose, and a projecting chin. The affinities betwe the Basque and Iberian languages, demonstrated place-names and fragmentary inscriptions fou almost all over Spain, are possibly to be explained due to adoption or free borrowing by the primiti Pyrenean ancestors of the Basques on first conta with the relatively advanced Iberians. Antiquity stamped on Basque syntax and vocabulary, the latt pointing to a derivation from an age of stone and time reckoning of a three-day week. Caution necessary in cultural analysis; and although it true that the Basque cultural heritage is distin from that of their neighbours, a careful comparati study of Basque traditional peasant art reve numerous analogies with the common stock European tradition.

Nitrogenous Excretion from Root Nodules

FOLLOWING the experiments of A. Virtanen Helsinki, G. Bond and J. Boyes have investigat the possible excretion of nitrogenous substances fro the root nodules of the leguminous plants, soya bea garden pea and broad bean (*Ann. Bot.*, N.S., 3, N 12, 901; 1939). Three different grades of sand we used, and in some cases, soil. In spite of Virtane claim that extensive excretion was frequent obtained, these authors obtained consistently neg tive results from their experiments similarly carri out with sand cultures. The soil cultures we inconclusive. The discrepancy may be explained the presence of considerably more direct sunlight Helsinki than at Glasgow; but this has yet to established.

Polyploid Cells in *Cucumis Melo*

C. D. ERVIN (*Proc. Nat. Acad. Sci.*, 25, 335–33 1939) shows that the production of tetraploid cells the periblem of roots is a common and freque occurrence. Rarely is the plerome affected, a octoploid cells are infrequent. The number of tetr ploid cells increases towards the older portions of t root. Secondary pairing of chromosomes is oft evident in tetraploid cells.

Coasts of Cardigan Bay

IN a study of the present-day coastal forms Cardigan Bay ("Sand and Shingle Formation Cardigan Bay", *Geog. J.*, Sept. 1939), Mr. J. A. Stee dealing particularly with the shore between Pwllh and Fairbourne, shows that there is a steady moveme of beach material towards Tremadoc Bay. Along t Lleyn coast this material moves eastward, and alo the Merioneth coast in the main northward. Bo movements are the result of prevailing south-wester winds which cause the waves to strike at an obliq angle and so move the material. Material broug down by the rivers Glaslyn and Dwyryd has help to shallow Tremadoc Bay. The north-eastern entrant shows great sand-flats produced by t beach drift. This accumulation has caused the wav break on a constantly shallowing bottom, pro- essively farther and farther from the mainland. nsequently Morfa-Harlech and Morfa-bychan have wn seaward with their outer beaches at right gles to the main direction of wave approach. tween them the rivers have maintained an open nnel. These processes are still continuing.

mage by Spray Fluid

IT is most important that a spray fluid applied for control of insect or fungal attack shall not pro- ce any injury of the host plant. This is unfor- nately the case with many Cucurbitaceous crops America, which cannot be sprayed with Bordeaux xture without considerable stunting and loss of ld. James G. Horsfall, G. E. R. Hervey d R. F. Suit have investigated this damage (*J. ric. Res.*, 12, 911–928, June 1939) and find t it is at a minimum when the spray fluid is tral. Changes in the hydrogen ion concentration her towards alkalinity or towards acidity bring out dwarfing and leaf deformation, for both the per factor and the lime in the mixture play their rt in producing damage. Reduced photosynthesis, hardening of young cells by the calcium ion, and ysiological drought of the tissues when Bordeaux xture is present, appear to be the main causes of ury. The obvious remedy, namely the use of tral spray fluid, is not regarded as practicable der agricultural conditions, but further research uld ultimately indicate the appropriate practice.

in the Netherlands

IN *Mededeelingen en Verhandelingen*, 42 (Kon. d. Met. Inst.), Dr. C. Braak discusses the occurrence fog in the Netherlands, as revealed by observations de at eighty-two observing stations well distributed r that country. On the basis of Hann's classifica- n, according to which a place with less than 25 days per annum is not a foggy place but one with re than 50 fog days can be regarded as foggy, the therlands occupies an intermediate place only, ich fact will perhaps come as a surprise to many, low-lying country with so many dykes and such indented coast-line, and one containing extensive nufacturing districts, might have been expected be conspicuously foggy. Dr. Braak offers no ex- nation, and one can only suppose that the gener- open character of the country allows the wind circulate very freely—the presence of so many dmills is suggestive of this being the case—and t this generally prevents the air from becoming gnant enough for fog to form. The annual number fog hours deduced by Köppen's method is 442 at sterdam (Filiaal) but only 157 at Amsterdam rtus). In general, the figure lies between 200 and , at lightships as well as on land. Of particular erest are four charts, Figs. 3–6, showing the per- tage of the year's fog days that occurs in each son. It might have been expected that these uld show broadly a tendency for fog to be most quent in winter at places farthest from the sea, ich would most often be under the influence of tinental anticyclones, while the coastal towns and tships would have most of their fogs in the early t of the summer. This is definitely not the case. would be more accurate to say that in general ter (December–February) is the time for fog, even the lightships, and that in the north-west more n half the year's fogs occur in the winter quarter. There is a general falling off in fog frequency in the spring (March–May) quarter, and over a large proportion of the country the months June to August yield less than 5 per cent of the year's total, 10 per cent being exceeded only at lightships. It is only in autumn that distance from the sea and fog frequency show a marked tendency to be associated. It must be remembered, however, that on the Continent the available water vapour is reduced by frost in winter more often than in the British Isles, and this reduces the number of fogs in the coldest part of the winter and tends to make the annual maximum frequency fall earlier than in the latter.

Reaction of Fluorine with Carbon

MOISSON in 1890 obtained carbon tetrafluoride, CF_4, by the action of fluorine on carbon, and Ruff and Keim (1930) showed that hexafluoroethane, C_2F_6, and possibly higher compounds were also formed. J. H. Simons and L. P. Block (*J. Amer. Chem. Soc.*, 61, 2962; 1939) have further investigated the reaction, which is complicated by explosions unless the reaction tube is heated just below dull red, and the carbon is mixed with amalgamated copper gauze or with a small quantity of mercurous or mercuric chloride. The liquid product was fractionated, and the following compounds isolated: CF_4, C_2F_6, C_3F_8, C_4F_{10} (two isomers), C_5F_{12}, C_6F_{12} and C_7F_{14}. The first five are gases, the rest liquids. The probable synthesis of a large number of similar compounds is inferred. Their physical properties approach very closely those of the inert gases.

Nature of Radio Fade-out

A PAPER (*Phys. Rev.*, March 15) by L. V. Berkner discusses the nature of radio fade-outs in the earth's sunlit hemisphere which are coincident with bright solar chromospheric eruptions and with certain geomagnetic effects of a specific character described by Fleming and McNish. They are examined by means of the vertical incidence recording of ionospheric echoes with a wide range multi-frequency technique. It is concluded by examining a series of observations that a fade-out is best described as an upward projection of the lower (absorption) limit of echo return, and that it is caused by intense absorption of ionizing radiation which emanates from bright chromospheric eruptions either at the base, or below, the *E* region, that is, below the 110 km. level. It is shown that no appreciable absorption of chromospheric-eruption radiation takes place at a height greater than that of the *E* region. Hence a process of selective absorption must operate. The localization of the region of intense absorption to space below the 110-km. layer, is interesting. An analysis of geomagnetic effect during a number of fade-outs observed by McNish shows it to be an augmentation of the diurnal variation of terrestrial magnetism. This is proved by the fact that not only is the magnetic vector of the associated geomagnetic effect always in the same direction as the diurnal variation, but also these vectors agree in direction at locations where the diurnal variation vector appears anomalous. It is not only similar in character to the diurnal variation but must also arise in the same atmospheric regions, and, therefore, must in fact be a part of it. It appears from the state of the theories that only the Stewart-Schuster 'atmospheric dynamo' theory of diurnal variation is possible, taking into account the restrictions imposed by these observations.

EUROPEAN ORDER AND WORLD ORDER

POLITICAL and Economic Planning (P.E.P.) has issued a readable but comprehensive pamphlet entitled "European Order and World Order". The principles on which the maintenance of Western civilization depends are summarized under four headings: freedom of thought, speech and movement; establishment of the rule of law both nationally and internationally; the progressive use of the State as an instrument of public welfare, not merely for policing or the protection of private interests; and the organization of production and distribution to raise the standards of living and of life of all peoples. Compromise on, or surrender of, any of these essential values endangers the stability of our whole civilization. The central problem for Europeans is to make clear those principles, to see that our institutions and policies conform to them and to place behind them an overwhelming and enduring assembly of forces.

The success of the totalitarian challenge has been due largely to lack of clear thinking and moral courage in the democracies. It has scarcely been recognized that peaceful change, in both domestic and international affairs, depends upon extensive research and planning, so that problems are seen and dealt with before they become chronic or acute, and before their reactions on other problems multiply. Technical and economic advances have made all countries so closely interdependent that the corresponding political advances can no longer be delayed.

While a crushing military defeat of Germany may not be necessary, it is vital that the basic principles of civilization represented by Great Britain and France should emerge triumphant. It has been necessary to reassert those principles in war because of recent failures to vindicate them in peace—failures which arose inevitably from the widespread attitude which insists on a complete divorce between economics and social needs, and at the same time has refused to face continuing after school age that blend of training and public propaganda known as education.

The fundamental task in reconstruction is to fill in these gaps in the use of economic power and of leisure, the existence of which has been exploited by extremist movements. Unless that is done, no political superstructure and no expression of ideals can save Western civilization from disintegration.

Much progress has recently been made towards the establishment of world economic security, particularly in respect of the basic raw materials and foodstuffs. Wheat, beef, sugar, tea, whale-oil, rubber, tin, steel, aluminium and other commodities are already controlled on a world-wide or a European basis, although most of the schemes are still very young. These schemes require extension and improving by securing their joint control by consumer and producer interests, and providing buffer pools under disinterested management, and by making them accountable to an international supervisory authority, such as a Permanent Cartel Commission of the League of Nations. Other steps in the same direction would be the establishment of international public utility corporations, comparable with the Tennessee Val Authority, for backward territories, and the provis of international machinery for rendering raw mater available on special terms for particular backw areas, victims of aggression, or in times of natio disaster, etc. The creation of international mechani for rural loans, grants-in-aid and price insura schemes are other measures suggested to relieve want and insecurity of primary producers..

The idea of a division of the world into indust countries and a much larger group of colonial prim producing countries is mischievous, and indust development of all countries within their econo limits should be encouraged. Finance should subordinated to trade and economic developme Again, the systematic development of social servi accompanied by competent economic and finan policies, would be a powerful aid to world order could greatly increase the productivity of peop burdened with ill-health. In education, as in organization of the creative use of leisure or development of colonies, there are large opportuni for international effort.

The logic of events in the economic and so fields is compelling an international approach thereby inducing a reconsideration of the relat between nationalism and wider groupings. On question of the federalization of Europe, the bro sheet touches but scantily, pointing out that our must be to create political forms out of which a f developed federal system could easily emerge wh the necessary degree of economic and political hom geneity in Europe has been attained. The probl of European order can and should be isolated wit the problem of world order. Settlement of the f would simplify settlement of the second, particula as large areas in other continents are Europ dependencies.

The term European order in itself raises question, what is Europe, whether it should incl or not Great Britain or the U.S.S.R., for examp No treaty or political mechanism can provide s stitutes for courage, foresight, intelligence integrity, but it is important that the settlement a the war should both express and further the u of European civilization by a suitable mechanism, economic stimuli, by education and leadership.

The broadsheet accordingly proposes that settlement should include not only provision common institutions and common funds, but also formulation in broad terms of the essential conditi of European civilization, backed by organ publicity, as strong and as effectively watched as police arm. The establishment of a standing Europ- Council in appropriate relation with the League mi lead to a start in financial and economic affairs. would involve, however, a common policing age for Europe or part of it, and also a specific age for economic and social reconstruction, adequa financed. Many functions such as the improvem of communications, credit facilities, health servi education and research could be promoted m effectively by a European agency than by a hos national agencies.

THE COLONIES AND FOREST ADMINISTRATION

BY PROF. E. P. STEBBING

his Annual Forest Administration Report for 1938* the Conservator of Forests, Trinidad and bago, summarizes the forest policy in force. The uses merit repeating here, for though they have n current in forest management in the British pire for several decades, they have often proved be pious platitudes rather than a carefully ught-out planning to which the Government cerned intended to adhere rigidly. The clauses :

'(1) The permanent reservation by the Crown of tably situated areas of forest of a total acreage ficient to supply the benefits necessary for the lfare of the community—indirect benefits in the m of the maintenance of climatic conditions for icultural crops, preservation of water supply, pre- tion of erosion and flooding, and so on, and direct efits in the form of the supply of forest produce.

The management of these forests in such a way to encourage the fullest possible utilization of ir products on the basis of a sustained yield.

Such improvement of the existing growing stock will enable the Colony in the future to become least self-supporting in lumber."

here is nothing new in this. It may be found in form or another in the forest reports and memo- da of every Colony. In the past, how much of se praiseworthy aims has been effected ? It may admitted that the Forestry Department in Trinidad the past decade or so has received support from Government which has enabled progress to be de in a correct forest administration. But even e the forestry question appears to be regarded as a whole but as applying to parts of the country y. It is said that the general position with regard forest reservation is eminently satisfactory except the western portion of the Northern Range. In district apparently the greater part of the land a has for many years been under private owner- p, and until recently was mainly covered by cacao, est or second growth. The Conservator, on the ject of this area, continues as follows :

'In the present depressed state of cocoa, land ners are renting out increasing areas of steep hill- es to agricultural peasants, who grow field crops, h as maize, tomatoes, etc., thereon, under a tem of shifting cultivation. These peasants prefer highest, steepest, and most inaccessible portions the hillsides, as the danger of loss of crops by edial larceny is thereby lessened. The abnormally h rainfall of 1938, coupled with the increase of arings, was productive of erosion, flooding and dslides to an unusual degree, and revealed clearly dangers of the existing situation. The problem is ler investigation by the Lands Advisory Com- ttee."

his description might equally apply, taking local ditions into consideration, to parts of West or t Africa, the Malay States, the Dominion of South ica, and elsewhere.

It is admitted that the utilization of local forest produce in Trinidad has not reached by a long way the maximum production permissible, either in the more or less pure mora (*Mora excelsa*) forests or in the natural mixed forests of the Colony. In the latter the complaint is made that the high cost of exploitation, owing to their small volume-production per acre of marketable species, is a factor contributing to the Colony's dependence upon imported soft woods. From a perusal of the report it would at first sight appear that this latter was a new problem. But it is one which has been in the past, and is at the present day, facing the forester in charge of tropical broad-leaved forests the world over. It is the business and duty of the trained forest staffs to devise methods of successfully dealing with this problem. But they require their Government to have a fixed forest policy, to maintain an adequate forest staff not subject to repeated fluctuations, and to make available adequate grants of money for development.

During the War of 1914–18, the Colonies and their forest services were offered a great opportunity. Imports of foreign timbers, chiefly softwoods, were cut off. They had to depend upon their own resources. Most of them realized their own weakness and incapacity owing to the paucity of their forestry staffs. These have been considerably strengthened since then, though in many cases they fall far short of what is required.

The Colonies are now offered a second chance. It may be suggested that the work which should be required from the forestry staffs in all the Colonies during the continuance of the war should proceed on two main lines : (*a*) Map and report all areas in the Colony subject to any and all forms of erosion, whether forest or agricultural (that is, in the form of shifting cultivation) ; (*b*) carry out an enumeration survey or stock mapping in all forests accessible, and likely to be accessible by means of a grant to open out communications, on a 5 per cent enumeration basis, of such species and only such species as from their locally known qualities are likely to prove saleable, over and above the timber species already of marketable value.

This work of primary importance to the Colony concerned has not been carried out in a detailed and concentrated manner, as is well known. The finance departments of the Colonies have not been able to see beyond the annual revenue produced from the forests ; the staff have frittered time away over this revenue-hunting business ; or in experiments with small areas of plantations, fuel and otherwise, necessary as this work may have been ; and so forth. Since the War of 1914–18, a quarter of a century has passed and but small progress in the correct conservancy of its forest estates has been made by the Colonial administration as a whole. They are now given a second chance, with all the advantages of having clearly before them the opportunity lost twenty-five years and more ago. Will they profit by the lesson of the past and take it ?

---

* Council Paper No. 48 of 1939. (Trinidad : Government Printer, 9.)

ORIGIN OF DEFECTS IN COPPER CONDUCTORS

MR. J. E. DEERING contributes a useful article on the origin of defects in copper conductors to the *Electrical Review* of October 3. When hard drawing became a common practice, copper wire became a practical substitute for galvanized iron wire for overhead telegraph and telephone lines. The effect of the process was to raise the tensile strength of copper from 6·5 tons to 20 tons per square inch, which is almost equal to that of wrought iron, whilst its resistance is only about one-sixth. The effect of the cold drawing of copper is to make its resistivity only about 3 per cent higher than that of standard annealed copper.

Most contracts for the supply of copper wire quote the British Standards Institution specification, which states that the wire shall be approximately circular in section, smooth, uniform in quality, pliable, free from scale, inequalities, 'spills', 'splits' and other defects. Mr. Deering states that representatives of purchasing firms engaged upon the inspection of copper wire may be able to detect physical defects and yet are often unable to detect their origin. The following consideration of the different stages of manufacture will greatly facilitate the tracing of the causes of shortcomings.

During its passage through a succession of rolls after it has been ejected at white heat from the furnace, a copper billet, initially measuring 6 ft. by 4 in. by 3¼ in. and weighing 250 lb., increases in length as its cross-section diminishes. It emerges from the rolls at a greater linear speed than that at which it entered, for it not only takes up the speed of the rolls, but is also squeezed forward by an amount corresponding to the reduction in cross-sectional area. Rapid operation is necessary, as it prevents too great a difference in temperature of the metal from one end to the other, causing sometimes 1¼ per cent variation in the tensile strength of the wire.

To ensure a reasonable temperature throughout the rod before being drawn into wire, it is 'roughly annealed' by heating at 1200° F. and quenching with water. It is then pickled in dilute sulphuric acid to remove mill scale. During the rolling, the shape the cross-section is varied from pass to pass, fo the section were circular throughout fins would produced ; these would be bent over in the next p to form 'cold shuts', which might be below the surf for a distance, and possibly remain throughout complete process. A combination of shapes—squa ovals and rounds—is therefore used, and this kne the copper, rendering it homogeneous and ductile

The next stage is the breaking down of the rod pulling it through a dieplate with 12–18 holes. dies are usually of steel, but for copper cast iron sometimes used. For drawing long lengths of wire, diamond dies are occasionally employed. E hole has two zones—a short tapered one and a b mouth leading up to the approach. The walls of latter must be quite clear of the entering wire, wh might otherwise cause the metal of the die to drawn forward and piled up in the throat.

A departure in circularity in section may oc during wire-drawing, if the wire has slipped on drum of the coiling block, resulting in a 'flat' on surface through rubbing. Lack of smoothness sometimes due to the same cause. Non-unifo quality is traceable to impurities in the ore its Absorption of gases giving rise to blowholes wl the ore is being smelted into billets may also occ If during rolling a rod crowds a pass and iss with fins, these may become laid into the rod s show up as 'spills' on the surface. These are elimina by 'scalping'.

The origin of 'splits' occurs in the smelting sta If a fresh supply of metal is poured into a la which already contains a small amount of mol metal, the two will not mix or weld together. T seam or seal so formed will remain throughout rod or wire being rolled and covered in later stag so that it may appear on the surface at odd interv Two interesting photomicrographs are shown a high-conductivity copper rod and of a sect of the same rod after it has been made into ha drawn wire.

BELGIAN EARTHQUAKE OF JUNE 11, 1938

THIS earthquake has been studied by O. Somville, chief of the Belgian Seismological Service (*Annales de l'Observatoire Royal de Belgique*, Série 3, 2; 1939). On June 11, 1938, at midday by the public clocks near the epicentre, an earthquake was felt in Belgium, North France, Holland, North-West Germany, Luxembourg and South-East England.

The shock reached intensity VII on Sieberg's modification of the Mercalli-Cancani Scale in central Belgium where it was strongest, and displaced tiles as far away as Herne Bay in England. The earthquake was the most intense of approximately 140 experienced in Belgium since the year 1086. the Belgian Observatory at Uccle the Wiech mechanical instruments were thrown complet out of gear, though the long-period Galit instruments with galvanometric registration gave distance as between 50 and 60 kilometres fr Uccle and suggested that the epicentre was to north-west. This latter proved incorrect, as epicentre by later calculations turned out to between Audenarde and Renaix, almost west Uccle. On a basis of 3,570 communications, isos were drawn using Sieberg's modification of Mercalli-Cancani Scale, and two maps showing disposition of these are figured in the text, together with a map showing the point intensities in Holland.

It appears that altogether 17,550 chimneys were damaged, 3,000 in Courtrai alone, which represents 10 per cent of the possible number. There was no loss of life though ten people were slightly injured. Most people heard a sound as of the passage of a heavily laden cart, and several experienced two hocks, of which the second was the stronger. By the method of hyperboles the epicentre was found to be at geographic co-ordinates 50° 47′ N., 3° 35′ E., with an uncertainty of 4 or 5 km. A diagram of the determination is given in the text. The depth of focus, using the Mohorovicic tables of $\overline{P}$–P_n and Gutenberg's corrections, was of the order of 45 km., and this was confirmed by the formula for near stations.

$$\text{Time of propagation of } \overline{P} = \frac{\sqrt{h^2 + \Delta^2}}{V},$$

where h is depth of focus, Δ is epicentral distance both in kilometres, and V is speed of wave taken as 5·7 km./sec.

The initial time was calculated to be 10h. 57m. 42s. G.M.T., and it was found that north-east and south-west of the epicentre compression was registered first, whilst in the other two quadrants dilatation was initially experienced. Readings for P_n P^* $\overline{P}$ α S_n and S pulses for twenty-four stations in Europe are given together with a graph, and seven of the seismograms are reproduced. Six notable aftershocks have been noted.

SACRED FEASTS OF THE FOX INDIANS

IN "Ethnography of the Fox Indians" by William Jones, edited by Margaret Welpley Fisher (*Bureau Amer. Ethnol., Bull.* 125; 1939), certain passages are entatively identified with the contents of a sealed packet recording "ancient mysteries" of the Fox ndians, reported to have been among papers in the ustody of the author's father (see NATURE of November 25, p. 914). These passages deal with "The Sacred Feast".

One kind of sacred feast is held in autumn, winter or spring. A man kills a deer and decides to pray. He informs a number of members of his own gens, say, the Eagle gens, of his intention, and each brings ood, maple sugar, pumpkin, corn, etc. The prayer s held during the day, beginning in the morning. Waiters come to the lodge of the man getting up he feast and prepare the food; and invitations are then sent to others outside the gens. When the uests appear they find the Eagles waiting for them, seated at one end of the lodge, with the medicine bags spread out in front of them. They drum the air slowly with gourd rattles and chant songs. Before the first singing and while the food is cooking, the Eagles say to themselves to which spirit the food s sacrificed. The sprinkling of tobacco accompanies the mention of each spirit's name. A period of silence follows, then when the food is cooked the second singing and the eating begin. All food must be eaten before the fourth singing begins, and at the close of the fourth singing all the people disperse.

At the summer feasts in the summer bark lodges there is added dancing. As soon as the corn ripens, thanksgiving feasts are held to which each gens nvites members of the different gentes. These ervices are religious, preparatory to the thanksgiving ances. Each gens holds two services at which newly athered corn is eaten as well as the flesh of a dog illed for the purpose. The inviting gens does not eat, but does the praying to the manitou for his goodness in giving them corn. These services are purely religious and no one comes unless nvited.

In the same manner in the dances, such as the Wolf or Eagle Feast dances, dog, the principal thing aten, is an offering made to Manetowa to invoke his pleasure and presence at the dance, and no one comes to the dance unless he comes with the thought of coming into the presence of Manetowa. There is an atmosphere of sacredness; all enter silently and slowly, and there is no hilarity. During the dancing the men not taking part smoke or chew tobacco, while the women chew but do not smoke. The use of tobacco forms part of the rites to invoke Manetowa.

A feast is often held for the spirit of sickness so that he may not bring sickness. He has the power of granting long life. He is a manitou. Once a Winnebago—among the Winnebago, disease-giver was the most sacred of all their spirits—is said to have had the power of driving away the spirit of sickness. When the people were all dying of smallpox, he rode a white horse painted green and decked out gaily. He would run towards a house, yell at the spirit within, and strike against the lodge. This he did to drive out the spirit, and thereby gained many gifts.

Before a run is made on the buffalo, every camp makes a sacred feast to the buffalo, in which the food must be pumpkin or corn or maple-sugar; always sugar together with the other two if possible. Dog or any other kind of meat is not used. The feast is made as soon as the hunters know they are in the vicinity of the buffalo.

In the buffalo dance the men and women imitate the run and movement of the buffalo when in flight. The leader in the dance has his head covered by a buffalo mane. Dog, corn and pumpkin are eaten.

The Mowitihagi, "Dirty Little Ant", otherwise known as "Those who worship the spotted calf", is a society in which many of the members belong to the Thunder gens. It is a most important society, ranking with the gentes in some of the buffalo ceremonies. At its dance a small image of a buffalo made of stone is brought out from the bag in which it is usually kept and placed on the floor halfway between two fires. It is about 8–10 inches long and 6–7 inches high, of red stone, and in every respect a representation of a buffalo bull. It is said to be alive and a manitou. In the dance, tobacco is offered to it. It is brought out twice a year only in the sacred feast of the Mowitihagi.

SCIENCE NEWS A CENTURY AGO

The Observatory of the Rajah of Travancore

"We have seen with not a little pleasure," said the *Athenæum* of December 7, 1839, "an Astronomical Ephemeris, printed at the press of the Rajah of Travancore, and calculated for the meridian of the observatory recently established at Trivandrum, the capital of that State. Those who feel an interest in the intellectual progress of the people of India must be gratified to learn that the computations for this work were all made by native youths of Travancore, who received their education at the free school maintained by the Rajah. His Highness . . . came to a determination, in 1837, to establish at his capital an observatory of a superior kind; with the double view of affording his aid to the advancement of astronomical science, and of introducing, by its means, correct ideas of the principles of this science among the rising generation under his government. For the situation of Astronomer he chose Mr. John Caldecott, who, aided by Colonel Fraser, the British Resident at Travancore, decided on the plan of the building which is now erected, and which stands in latitude 8° 30′ 35″ N., longitude 76° 59′ 45″ E. Hitherto the observations have been carried on with small but excellent instruments belonging to Mr. Caldecott; but his Highness the Rajah intends to furnish it with the finest instruments to be procured in Europe, having, for this purpose, secured the services of T. Jones, T. Simms, and Dollond. . . ."

John Caldecott, who was born in 1800 and died in 1849, was the commercial agent to the Government of Travancore, but after the erection of the observatory devoted himself entirely to science. He was elected a fellow of the Royal Society in 1840.

Vegetable Monstrosities

THE issue of the *Medical Times* of December 7, 1839, contains the following note: "At the Linnean Society on December 3 the secretary read a communication from the Rev. Mr. Hicks describing some vegetable monstrosities recently met by him in the neighbourhood of York. They consisted in a union of two or more flowers into one, without any lines of junction whatsoever being visible, and in a multiplication of the stigmata, the pistils and petals of the plant—what De Candolle has denominated, with great propriety, an unnatural excess of fructification. In one or two species of iris and in a specimen of scrophularia nodosa, or sulphur wort—all which were exhibited to the meeting—the malformation of structure was strikingly apparent."

Iron Smelting in India

AT a meeting of the Asiatic Society on December 7, 1839, extracts from a journal by Captain Jacob, of the Bombay Army, were read. One of these referred to the process of iron smelting in the Mahabaleshwar Hills. The smelting was carried on in the most primitive way imaginable. The ore was dug from pits 20 or 30 feet deep, and in appearance was like rough gravel. The furnace was a hole in the earth lined with charcoal, and fitted with a clay oven. The bellows were two goat skins, worked alternately by the hand, and terminated in a clay pipe, which formed the nozzle. About three hours were required to smelt 12 seers of ore, producing about 5¼ seers of a rough, drossy, impure iron, which lost about 2 seers more in being worked into its destined form. Thi quantity sold in the bazaars for a quarter of a rupe (less than a penny a pound). Better English iron wa finding its way into the hills, at the same price o even cheaper.

Mortality in Malta

THE issue of the *Medical Times* of December 7 1839, contains the following information: "From th absence of all malarious agencies the character o this island has been supposed exceedingly salubrious The returns adduced, however, show that compare with Britain, the mortality is as 25 to 22 per 1,00 of all ages: among the troops during the 20 year antecedent to 1837 it averaged 18$\frac{1}{10}$ths and th admissions to hospitals 1·142 per 1,000 of the forc annually. Passing over the ordinary forms of disease such as fever, ulcer, syphilis and others whose fatalit in the tropics is proverbial, the prevalence of disease of the lungs, in a climate hitherto supposed particularly favourable to persons predisposed to them is marked as a singular circumstance. Consumptio in particular carries off a larger population, both civ and military, than it does in the whole United Kingdom, for it appears by the bills of mortality that tw thirds of the deaths are from this disease."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on c before the dates mentioned:

TEACHER OF ENGINEERING SUBJECTS—The Principal, Technic Institute, Ladywell, Dover.

UNIVERSITY GRADUATE to direct Institute of English Studie Sofia—British Council, 3 Hanover Street, W.1 (December 14, quotin 'Sofia').

TEMPORARY FORECASTERS, Grade II (Male) in the Meteorologic Office—The Under-Secretary of State, S.2 b. (Met.), Department Q.A Air Ministry, Adastral House, Kingsway, W.C.2.

TEMPORARY METEOROLOGICAL ASSISTANTS (Male) in the Meteor logical Office—The Under-Secretary of State, S.2.B. (Met.), Department Q.J., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Standards Institution. No. 853: British Standard Spec fication for Calorifiers. Pp. 60. (London: British Standards Inst tution.) 3s. 6d. net. [201

Memoirs of the Cotton Research Station, Trinidad. Series A Genetics, No. 15: (a) The Genetics of Leaf Shape in Diploid Cottor and the Theory of Gene Interaction; (b) The Genetics and Taxonom Distribution of some Specific Lint Quantity Genes in Asiatic Cotton By R. A. Silow. Pp. 259–298. 2s. 6d. Series B: Physiology, No. 11 Experiments on the Extraction of Sap from the Vacuole of the Le of the Cotton Plant and their Bearing on the Osmotic Theory Water Absorption by the Cell, by T. G. Mason and E. Phillis; Stud on the Partition of the Mineral Elements in the Cotton Plant, 1: Pr liminary Observations on Nitrogen and Phosphorus, by E. Phillis ar T. G. Mason. Pp. 531–586. 2s. 6d. (London: Empire Cotton Grow Corporation.) [201

Other Countries

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Mémoi No. 86: L'Ordovicien de Sart-Bernard. Par Hug. Maillieux. P 60+3 plates. Mémoire No. 87: La biologie du domaine souterrain la faune cavernicole de la Belgique. Par Robert Leruth. Pp. 50 Mémoire No. 88: Die subterrane Molluskenfauna Belgiens. Vo Caesar R. Boettger. Pp. 68+1 plate. Mémoires Hors Série. Résulta scientifiques du voyage aux Indes orientales Néerlandaises de L AA. RR. le Prince et la Princesse Léopold de Belgique. Publiés p V. Van Straelen. Vol. 2, Fascicule 20. Gastropoda-pulmonat Scaphopoda et Bivalvia. Par W. Adam et E. Leloup. P 126+7 plates. (Bruxelles: Musée Royal d'Histoire Naturelle Belgique.) [201

An Indian Medical Review. By Major-General H. W. C. Bradfiel Pp. v+658. (Delhi: Manager of Publications.) 2.8 rupees, 4s. [20

ditorial & Publishing Offices
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, DECEMBER 9, 1939 No. 3658

SCIENCE AND THE WAR

T. ANDREW'S DAY, November 30, saw the customary anniversary meeting of the Royal ociety, held this year, not at the Society's rooms Burlington House, London, but at Trinity llege, Cambridge, where the offices of the Society ere removed on the outbreak of war.

In the general part of his anniversary adess, Sir William Bragg spoke on the position the Royal Society, and, by implication, of men science generally, in relation to the war. He inted out that a very large number of fellows the Society are serving the nation in different pacities, but he is clearly not satisfied that full e is being made of the scientific resources of eat Britain. Sir William thinks—and his ews will meet with general agreement—that spite of the widespread acknowledgment of the fectiveness of science, the ways of using science d scientific men are being discovered too slowly. here can be little doubt that our administrators, a body, lack that knowledge of the fundaentals of science which would enable them to ake better and speedier use of its fruits. Sir illiam put this basic knowledge in the form of ur "propositions":

"1. Science, that is to say, the knowledge of ature, is of fundamental importance to the ccessful prosecution of any enterprise."

"2. Science is of general application. There is t one science of chemistry, another of electricity, other of medicine and so on: there are not even istinct sciences of peace and war There is only e natural world, and there is only one knowledge f it."

"3. Fruitful inventions are always due to a mbination of knowledge and of experience on e spot."

"4. There are difficulties peculiar to the application of science to war purposes", in that it is not easy to maintain during times of peace the necessary connexion between this special application and the general body of science.

These generalizations are well worth putting on record, for their significance extends far beyond the present times of stress which have provoked them.

Sir William then turned to consideration of the way in which more use might be made of science. He believes that, for the present, "the most successful ways of using knowledge are personal and elastic", rather than through a formal Ministry of Science, and he threw out the suggestion that the Royal Society, possibly through a selected small group of fellows, might be used as a regular consulting body, giving advice as required and also being kept so informed of the progress of events that "it might foresee occasions and needs".

The suggestion should be given very earnest consideration. The task of selecting a suitable group of fellows of the Royal Society for this purpose would not be easy, but there is no gainsaying that the Society has a unique range of consultant experience on which it can call. In addition to the direct use of such a body, it may be suggested that close collaboration with the Central Register of specialists maintained by the Ministry of Labour in association with the Royal Society and professional institutions would have valuable consequences. In this way the Register might serve, not only as a source of scientific and other trained personnel, but also, as an index to the state of research in Great Britain, to suggest lines of investigation which may enable us, in Sir William's words, to "foresee occasions and needs".

DISCOVERY AND INVENTION IN WAR-TIME

APART altogether from limitations of resources and materials imposed by national needs and the diversion of scientific workers from creative or fundamental work to emergency problems of defence and the like, the impact of war is rarely favourable to scientific advance. War necessities may, and often do, stimulate invention, but they rarely favour, and indeed commonly retard, scientific discovery and the advance of knowledge. Even in such special branches as aviation, the War of 1914–18 actually retarded technical progress, and as has been pointed out in these columns from time to time, warped the development of civil aviation.

Under conditions of war, the conservation of resources, and above all of creative and fundamental thought and work, becomes a matter of prime importance, and we may well return with increased interest to the symposium on invention presented some years ago before the Institution of Mechanical Engineers, as well as to the highly suggestive study of C. Nicolle, "Biologie de l'Invention" (Paris: Librairie Felix Alcan), published in 1932. Although the symposium on invention was concerned primarily with the evolution of invention and the development and exploitation of invention relative to patent law and economic recovery, the broader questions of the place of invention in industry and its relation to scientific discovery received passing notice.

Even in regard to invention, we may not assume too readily that all is, and will be, well under war-time conditions. The needs of a time of emergency are apt to stimulate invention to solve day-to-day or urgent problems rather than the long-range problems, and particularly those involved in the reconstruction and re-integration of social and economic life after the war. If the latter needs and problems are entirely neglected, there are likely to be many gaps in our knowledge and many unsolved problems which will hinder us reaping the full benefit of our war-time effort. Nor should it be forgotten that it is not only from *ad hoc* research or investigation that the solution or clues to the solution of even the most urgent problems have always come. Fundamental research has a stimulating and fertilizing value which should make us chary of starving it even in the direst necessity.

M. Nicolle's little book, however, made a m serious attempt to probe the theory or mechani of scientific discovery, to which some attention w given in the symposium. In spite of frequ discussions, we are little nearer to the und standing of this question than in the time Bacon. Fundamental creative ability may inde defy analysis, but a knowledge of the conditi which encourage or stimulate it is worth whi all the more when the need to conserve resour is most imperative.

It is recognized that discovery precedes inv tion possibly by long spans of time, and inventi itself presupposes knowledge based on experim and observation. Broadly speaking, as Mr. H. Dickenson pointed out in the symposium question, a discovery is the apprehensi of the order of Nature, while invention the guidance of the known forces of Nat into new channels for the benefit of man. Wh we are primarily concerned with here, however, the ability to evolve new schemes or contrivanc commonly called inventiveness, and the fact which are favourable or unfavourable to t exercise or development of this faculty.

Many factors have similar influences on bo invention and the more creative act known discovery. The initial effort required either creative thought or inventiveness can be repress or prolonged by excessive knowledge. The deade ing effect of the abundance of technical a scientific literature to-day has frequently be the subject of comment, whether from the poi of view of encouraging excessive specializati and pre-occupation with the details of a narr field or from the mental indigestion it may cau

This position, however, arises in part from t chaotic condition of scientific and technic literature, and the failure of scientific workers organize a really adequate and effective abstracti service, with the advantages which the exp handling of such literature and the eliminati of duplicated effort would afford. The stringen of war-time conditions in regard to paper a printing may yet supply an added stimulus whe the rational motive has been insufficient to ov come inertia or prejudice.

Even when allowance is made for such retardi influences, it has to be admitted that fundament ative ability defies analysis. Although, at present time, a wide experience is more essary than ever, conscious thinking out science is a process rarely if ever leading to el results. As Sir J. J. Thomson observes in ecollections and Reflections": "New ideas come re freely if the mind does not dwell too long one subject without interruption. It is, I think, general experience that new ideas about a ject come when one is not thinking about it the time though one must have thought about good deal before. It is remarkable that when as come in this way they carry conviction with m and depose without a struggle ideas which viously had seemed not unsatisfactory".

he creative mind concentrates more or less ensely for a less or greater space of time upon roblem for which no solution is known. A new l correct solution comes to it in exactly the ne way as a forgotten name or fact often comes us after we have cudgelled our brains in vain it. Just how or what determines the incidence the new idea remains an unexplained mystery. can only note the predisposing factors which mulate it or appear to accompany it.

ne of these has already been noted— break in conscious thinking about the ject. Dr. H. S. Hatfield pointed out in the ne symposium that in early youth the power ssimilation may afford a criterion. The creative d frequently has much less power of assimila- n, but along some particular line it actually s ahead of the matter presented to it, re-invent- what is known. Initiative is another charac- stic, even if we dissent from the proposition t genius is merely a capacity for taking infinite ns. It is rare, however, to find genius without t capacity, at any rate in directions which ve its ends.

gain, creative work is rarely accomplished by steady round of daily hours most favour- e to routine work. It has mostly been omplished in violent bursts of overwork at h pressure, alternating with periods of com- ative idleness in which the unconscious mind able to order its content. Problems are not ved more slowly by easier going : rather they not solved at all unless the attack reaches certain intensity. The creative act, as M. olle points out, is essentially irrational. We not impart merely by training the sense of ues and the capacity to discriminate instan- eously between essential and non-essential. We can only hope to supply the conditions or opportunities in which they flourish and develop and in which they can be most readily stimulated.

Creative genius, again, is something more than intelligence. It is not simply the acquisition of new facts and their systematization. Such powers may be possessed to a high degree by minds incapable of creative originality. It is indeed true that if genius is to accomplish anything effective, it must be accompanied by good sense, and that, even so, collaborators may play an indispensable part by keeping the creative spirit in touch with realities and supplying just that capacity to work out the consequences or practical applications of the discovery with which genius is apt to be too impatient to trouble. Anything that endangers its spontaneity or limits its freedom, however, threatens the creative spirit. True though it may be that genius may triumph over any misfortune or obstacle, it is only those who succeed of whom we hear.

In science, no less than in art, creative work flourishes in an atmosphere of sympathy and enthusiasm, where the mind is quickened and encouraged to expand. We lay constraint or even discipline on the truly original at our peril. Such minds are rare, but it is difficult to distinguish between latent genius and the normal intelligence. It is one of the dilemmas of wartime that we must seek to preserve for the creative few the full freedom of thought and work essential, while the many accept the discipline and constraints demanded in the national interests. More, rather than less, in war than in peace, the price of liberty is eternal vigilance, and no severer task lies upon the shoulders of scientific workers than that of seeing that all the vigour which they bring to national service in its myriad needs, and the readiness with which they accept sacrifice and discipline with their fellow citizens, shall not be allowed to impair for one moment the disinterested search for truth They who claim to be defending the cause of freedom and truth must see to it that, within their ranks at least, the quest for truth is unimpeded, and that no political considerations are allowed to fetter discovery or exposition of its results when these are prompted by the disinterested desire to enlarge the bounds of knowledge. Ultimately it is in the truths won in many fields of knowledge—physical, economic, social—by creative minds that alone we can build the new social order which will make the present sacrifices worth while.

THE COMPLETE CORRESPONDENCE OF LEEUWENHOE

Alle de brieven van Antoni van Leeuwenhoek (The Collected Letters of Antoni van Leeuwenhoek). Uitgegeven, geïllustreerd en van aanteekeningen voorzien door een Commissie van Nederlandsche geleerden (edited, illustrated and annotated by a Committee of Dutch scientists). Deel (part) 1. Pp. 454 + 40 plates. (Amsterdam: N. V. Swets and Zeitlinger, 1939.)

IN 1931 when the Royal Dutch Academy of Science and the leading medical authorities in Holland were considering how best to celebrate the tercentenary of the birth of Leeuwenhoek in 1632, it was resolved to prepare and publish a complete annotated edition of his scientific writings, accompanied by English translations. English-speaking people will be grateful for the translations, and will appreciate cordially the compliment implied in this decision. The Royal Society of London from the very outset gave valuable encouragement to its humble Dutch correspondent, and in doing so displayed the soundest judgment, since Leeuwenhoek's earliest letters by no means foreshadowed the important results he was later to achieve; and this is all the more surprising when it is remembered that his first letter was written at the age of forty.

The present instalment of this difficult and important enterprise, the first of twenty, is an imposing quarto volume which includes a general introduction and preface by Prof. G. van Rijnberk, the president of the committee, the first twenty-one letters written between April 1673 and February 1676, in Dutch and English versions, a discussion by Dr. A. Schierbeek of Leeuwenhoek's micrometric methods as related to modern standards, brief notes on the persons mentioned by Leeuwenhoek and the annotators, bibliography, indexes in Dutch and English, and thirty-nine plates based on photographs of the original drawings which have survived, and also some modern figures which the committee considered essential to elucidate the text. The work is well printed, but the paper used in the plates is so friable that in the reviewer's copy one sheet had broken at the hinge and worked loose before the book was used. Also we suggest that it is a mistake to reproduce line engravings as half-tone blocks—the line block gives a better result, is less costly, and can be printed on durable paper. It must be allowed that the illustrations of the work generally admit of some improvement. In particular the figures of Leeuwenhoek's microscopes are unworthy of an edition which aspi to present to us the *complete* Leeuwenhoek. 1921, Roemer published photographic reproducti of the Utrecht microscope which were admirabl

Of the twenty-one letters now listed one never been available and its contents are the fore unknown, and two others are merely coveri letters of only a few lines each. Hence this volu deals with but eighteen of the relevant letters. has, nevertheless, taken several years to prepa so that unless the rate of publication can materially accelerated the entire correspondence some two hundred and eighty letters can scarc appear in the lifetime of the present generati A similar Dutch undertaking—the works of C Huygens—was commenced in 1888 and is proceeding. All the eighteen letters above m tioned were published in Holland *in extenso* 1931 with English translations, except those whi had been more or less completely translated in *Philosophical Transactions*. The present volu therefore, contains nothing new apart from th passages which were rejected by the *Philosophi Transactions* translator. These omissions pr to be of little importance, except perhaps section on digestion which forms the conclusi of letter 18 (12).

The first concern of the English reader will with the accuracy of the translation. Most Du biologists speak and write English so well that would seem unnecessary, and even ungracious, offer them any assistance. Nevertheless, th are criticisms to be met, and we would stron urge the Dutch committee to anticipate them submitting the English version of all fut volumes to the censorship of one of their Engl friends. The translation, or rather the interpre tion, of Leeuwenhoek, due largely to his cha and inexact manner of expressing himself, can quite speculative and laborious. We had hop that these difficulties, magnified in Great Brit by lack of familiarity with the language a customs of seventeenth century Holland, could a would be resolved by a Dutch-speaking committ When the *Philosophical Transactions* transla found himself in deep waters, as he frequently d he took refuge in a literal translation of Leeuw hoek's words. *That*, however, is the way of e and perplexity. In Dobell's book the proble were faced with uncompromising determinati and precise knowledge, and most of them yield to this treatment. Our Dutch friends, on the ot hand, have made the mistake, as we think, pting the orthography and faulty text of the *ilosophical Transactions exactly as printed*, not m excluding typographical errors. Obvious wnright mistakes are of course corrected, and se parts which were omitted in the *Philosophical nsactions* are translated into *modern* English. e result, leaving us as it does practically where were, is somewhat disappointing.

We admit that to edit the whole of the Leeuwen- ek correspondence with the meticulous scholar- p of a Dobell would be a stupendous task, and ld not be entrusted to one man, but this is a e where the counsel of perfection is not an ernative but the only course to follow. In sequence of the method adopted by the Dutch mmittee, the *Philosophical Transactions* letters presented to us in a hybrid dialect which n an Englishman cannot fully comprehend thout recourse at times to the Oxford ctionary, nor is any attempt made to parallel distinctive style of the original. Moreover same word may have a different connotation seventeenth and twentieth century English. cannot but feel that, if only for the sake of formity, the *Philosophical Transactions* versions uld have been corrected *and* modernized, so to reduce the whole text to the same idiom. A few examples as reprinted by the Dutch mmittee from the *Philosophical Transactions* ll illustrate the point: p. 33, "Whence I am ne to collect" [inclined to the opinion]; p. 107, some few places [in the liver] the blood lay n-wise . . . dispersed through the Liver out the veins" [? veined like marble]; p. 109, hese Globuls I judged to be blood, and that, cking our body with a pin without hitting a in, the bloody Globuls did issue from between se [muscle] filaments"; p. 123, "the red obuls agitated pesle-mesle, and as if each obul had yet a second motion, and that about axe" [pell-mell and axis]; p. 197, "the holes the Nerve were not round nor so regularly ited by one another" [punched]; p. 303, ppeared to me in *my* Microscope, of the thick- s of a great Bread-knives back"; p. 305, "it sed but very slowly through blew Paper"; p. 7, "then will each degree of hardness . . . se more or less sharpness of taste upon our ngue, and consequently produce a su[i]table eration" [specific reaction]. In this passage the itors have modernized the spelling of "sutable", d in another place they have substituted "I pared" for "I did myself prepare", but why y should have done so in these and a few other es whilst ignoring all other archaisms is not plained.

Here are some examples of their modern English which objection could be taken: p. 173, "the yolk-cells give these eggs a troubled [turbid] appearance"; p. 209, "examination of the optic nerve by picking [teasing] it"; p. 217, "post-mortal changes in the optic nerve"; p. 221, "inhomogenous nature of tobacco-smoke"; p. 223, "containing in its inner hollow a grain of gun-powder"; p. 227, "the sting of a scorpion is not letal" [use of German instead of English equivalent]; p. 349, "egg-pod" [shell membrane]; p. 355, "That is why it may make [give] the impression of a cavity"; p. 357, "the medulla often contains air, and then appears to be black, owing to a total reflexion [!] of the light". To translate "Heer liefhebber" as "gentleman amateur" is to carry literality too far. "Philosopher" or even "virtuoso" (as on p. 303) would be more suitable.

Apart from a number of minor misprints the following points should be included in the list of errata and addenda: pp. 41 and 73, Letter 5 (3) as published in the *Philosophical Transactions* includes a part (par. 6) of Letter 2; p. 45, the plate of the bee in the Lancisian library in Rome is dated 1625 and bears the name of Stelluti; p. 75, "And exhibiting my Blood to myself in very small parcels, the globuls yielded very colour"—the *Philosophical Transactions* version which is followed has it correctly "very little colour"; p. 151, the belief that nerve fibres were tubes which transmitted fluid contents survived until the middle of last century; p. 155, the whole paragraph refers to the vagus and none of it to the optic nerve—in the latter part of the paragraph Leeuwenhoek was perhaps describing the pulmonary plexus of the vagus; p. 175, the suggestion that Leeuwenhoek discovered the eggs of the liver-fluke in the gall bladder *of the rabbit*, but not the oocysts of Eimeria as suggested by Dobell, is so highly improbable as to be unacceptable without further evidence; p. 213, dark ground illumination was undoubtedly described by Hooke in 1678, which lends colour to the conjecture that Leeuwenhoek may have hit upon it in 1675; p. 219, sections as aids to anatomical study were used before Leeuwenhoek by Boyle (1663), Hooke (1665), and Grew and Malpighi (1672); p. 331, the attribution of the discovery of Daphnia to Goedart by Swammerdam is difficult to explain but nevertheless an error, and the reference to the "Historia Generalis" 1665, Tab. VI, should be 1669, Tab. I; p. 383, in discussing Leeuwenhoek's estimate of a hairsbreadth the annotator has misunderstood a statement by Dobell, who did *not* assume that Leeuwenhoek's wig was made of human hair—in fact the contrary is expressly implied.

If some of the shortcomings of this work have been dwelt upon, it must not be concluded that its merits are not considerable and impressive. The defects we have mentioned are remediable for the past and preventable in the future. The discoveries of Leeuwenhoek are of such importance as to exact the highest standard of performance on the part of those who seek to do him honour. In the efflorescence of the arts and sciences which occurred in Holland in the seventeenth centu Leeuwenhoek occupies a commanding place, a therefore any commemorative edition of writings should reflect the universal reverence which the genius of this remarkable man is he

F. J. COLE

MINERAL NAMES

Descriptive List of the New Minerals, 1892–1938

Containing all New Mineral Names not mentioned in Dana's "System of Mineralogy", sixth edition, 1892. Compiled by George Letchworth English. Pp. vii + 258. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 18s.

MR. GEORGE L. ENGLISH, well known to mineralogists all over the world from his long connexion with the firm of Ward's Natural Science Establishment at Rochester in New York State, has compiled from various sources an alphabetical list, with definitions, of all new mineral names not included in the sixth edition of Dana's "System of Mineralogy" published in 1892.

Beginning in 1897, the Mineralogical Society of Great Britain has published fourteen lists of new mineral names, compiled by Dr. L. J. Spencer and printed at the end of each volume of the *Mineralogical Magazine*. In each list the names were arranged alphabetically, but as the fourteen lists contain more than 2,100 names, it will be a great convenience now to have all the names available in one volume.

For several years the Mineralogical Society of America has had a Committee on Nomenclature at work. The final report of this Committee has recently been adopted by the Society, and Mr. English has been able to incorporate in his list the changes in names proposed. These changes fall under two headings: (1) those merely involving a different spelling from that adopted by E. S. Dana in the sixth edition of the "System of Mineralogy"; and (2) those calling for a definite choice between two alternatives both in common use among American and British mineralogists. It is satisfactory to note that a certain measure of agreement was reached between the American Committee and a committee appointed by the Mineralogical Society of Great Britain at a joint discussion which took place in Washington in 1933, and the only names of common minerals for which the spellings preferred by the United States mineralogists are not likely to be taken into general use here are: 'sulfur' for 'sulphur', 'hematite' for 'hæmatite', and perhaps 'feldspar' 'felspar'.

The spellings 'feldspar' and 'felspar' have bo been in general use in American and Brit mineralogical and geological books for nearly century and a half. The spelling 'felspar' w introduced in 1794 by R. Kirwan in the seco edition of his "Elements of Mineralogy". In first edition he had spelt it "feltspar" and "f spar", and he explained his change of spelling i footnote: "This name seems to me derived fr *fels* a rock; it being commonly found in granit and not from *feld*, a field; and hence I write thus, felspar." In this assumption Kirwan w wrong. The name was not German, but Swedi It was first introduced by D. Tilas in 1740 in t first volume of the *Transactions of the Swed Academy of Sciences*. It seems that Tilas wr "feldtspat" in his manuscript, but in the print paper the name appears with no fewer than fo different spellings on a single page: "feldt spa "feltspat", "fältspat" and "feldtspat". Linna used "fältspat" in 1748 and so did Cronstedt 1758. Contemporary German works gave bo "Feldspat" and "Feldspath", and in English find "field-spar" (1772), "feltspar" (Kirwan 178 "feldspar" (Hutton 1785), "fieldspath" (Bedd 1791) and "feldspat" (Wedgwood 1792).

Tilas had published no explanation of t derivation of his name, but it is believed to re to the abundance of the mineral in the tilled fie in the rapakivi granite district of south-weste Finland, and its derivation from the Swed "feldt" or "fält" (= field) is undoubted. J. Dana in his famous "System of Mineralog adopted the spelling "feldspar" from the st (1837) and this spelling has remained in gene use in the United States, while Kirwan's spelli "felspar" was adhered to in Great Britain. In t last few years, since the discussions with t American Nomenclature Committee, many miner ogists in Great Britain have adopted the spelli "feldspar", but this has not been accepted by t leading mineralogical and geological periodic Fortunately, whichever spelling is used, no co fusion in meaning will arise.

THE RARE EARTHS

melins Handbuch der anorganischen Chemie
ıhte völlig neu bearbeitete Auflage. Herausge-
ben von der deutschen chemischen Gesellschaft.
stem-Nummer 39: Seltene Erden. Lief. 1:
nleitender Überblick, Geschichtliches, Vor-
mmen. Pp. 122+iv. (Berlin: Verlag Chemie,
m.b.H., 1938.) 14.25 gold marks.

HIS part of Gmelin's "Handbuch" contains a historical account of the discovery and currence of the so-called 'rare earths', a descrip- n of their minerals and an account of their ographical distribution. The discovery of large posits of monazite sand in Brazil, in North and uth Carolina and in India has perhaps rendered e designation rare earths misleading, but it is in mmon use, although in this work the term cludes the elements scandium and yttrium as ll as the fascinating cluster of elements which idges the gap between barium and hafnium.

In spite of much previous work dating back to e year 1794, the mystery of this cluster remained solved until the work of Moseley on atomic mbers and of Bohr on atomic structure provided e solution. The number of elements was fixed fifteen, of which all but one are definitely known. e existing data about No. 61, which is called inium or florentium, are derived from X-ray ectral lines in the *L*- and *K*-series. The unusual similarity of chemical properties of the others is associated with peculiarities of atomic structure, the outer shells of electrons being alike in all cases.

The most characteristic property of the group is their paramagnetism, which begins at cerium and increases progressively to lutecium. This property is associated with the occurrence of valency electrons in the fourth quantum group. Moreover, whereas the basicity of the tervalent elements increases from aluminium to lanthanum, it decreases very slightly but steadily from lanthanum to lutecium. A similar increase and decrease is noticed in the dimensions of their ionic radii (the lanthanide contraction). No mention is made of the recent work of Klemm and Bommer, which reveals a periodicity of atomic volume with high peaks at europium and ytterbium.

Modern views on crystal structure have had an important bearing on the development of geochemistry. The rare earth minerals occur chiefly in granites and pegmatites, and their occurrence is determined more by lattice dimensions than by valency; the small ionic radius of aluminium seems to render it incapable of replacing rare-earth metals to form isomorphs.

A comprehensive table gives the proportions of the various elements in many minerals as deduced from spectral intensities.

MECHANICS OF SPORE DISCHARGE IN TERRESTRIAL PLANTS

ore Discharge in Land Plants
y Dr. C. T. Ingold. Pp. vii+178. (Oxford:
arendon Press; London: Oxford University
ess, 1939.) 7*s*. 6*d*. net.

R. INGOLD has for some time paid special attention to the discharge of spores, par- ularly in the group of fungi, stimulated as he atefully acknowledges by the important contribu- ns Prof. A. H. R. Buller has made to this subject his six volumes of "Researches on Fungi". Dr. gold's own publications have so far dealt only th fungi, but following up this interesting subject has examined critically the spore discharge of yptogamic land plants as a whole, and the esent volume deals with the Bryophyta and eridophyta as well as the Fungi. It is perhaps tural considering the inception of his investiga- ns that his latter group of plants receives preferential treatment, but we must remember also that the methods of spore liberation among fungi are more varied.

Reviewing these seriatim, the author deals with the water-squirting mechanism of the Ascomycetes and other fungi, with the discharge due to rounding-off of turgid cells, with the catapult mechanism of Sphærobolus and with the drop-excretion process of basidiospore discharge. The mechanism of this latter process is not as yet fully explained. Prof. Buller has stated that "it may be that the force of surface tension is used in some way to effect discharge". Dr. Ingold gives a very careful consideration to this suggestion and from his calculations concludes that there appears to be sufficient surface energy to discharge the spore: but that it is not easy to see how this energy could be mobilized to bring about the discharge. A final solution of the problem, he thinks, must be sought in a more intensive study of some cases of abnormal discharge which have been reported by Buller.

In connexion with the basidiospore discharge Dr. Ingold describes his observations, accompanied by excellent drawings, on the liberation of the basidiospores of Puccinia and also of the so-called "shadow yeast" *Bullera alba*, which from the nature of its spore formation must be included among the Basidiomycetes. In the Bryophyta he describes in detail the scattering of the spores from the open capsule of *Cephalozia bicuspidata* by the spring mechanism of the elaters released by water-rupture. This latter process is also dealt with in considering the spore discharge of the ferns and of Selaginella.

In concluding a final chapter given up to general consideration of spore discharge in Crypt gams, the author makes a plea for the expe mental study of this process in the ordina botany courses at the universities. The realizati of this very reasonable hope will be great facilitated by the publication of the book und review, which not only describes clearly the ma fascinating methods of spore discharge and disper found in cryptogamic land plants, but also co tains a large number of excellent illustrations, mo of which have been specially drawn to explain t various mechanisms of dispersal. The historical i troduction and the bibliography will be of gre value to students of this very interesting subje

DETERMINANTAL LOCI

The Geometry of Determinantal Loci
By Prof. T. G. Room. Pp. xxviii + 483. (Cambridge: At the University Press, 1938.) 42*s*. net.

PROF. T. G. ROOM uses the symbol $(|p, q|_r, [n])$ to denote the locus, in projection space $[n]$ of n dimensions, whose equations are given by the vanishing of the determinants of order $r + 1$ of a matrix (x_{ij}), of p rows and q columns, whose elements are linear functions of the (general homogeneous) co-ordinates in $[n]$. This he calls a determinantal locus; particular determinantal loci are the conic in [2] and the quadric surface, cubic curve and cubic surface in [3], with respective symbols $(|2,2|_1, [2])$, $(|2,2|_1, [3])$, $(|2,3|_1, [3])$ and $(|3,3|_2, [3])$. $(|p,q|_r, [n])$ may be *projectively generated* as the locus of the meets of the $\infty^{r(p-r)}$ sets of corresponding $[n-p+r]$'s of q projectively related $[n-p]$-stars, and, since $(|p,q|_r, [n])$ is the same as $(|q,p|_r, [n])$, there is a conjugate projective generation obtained by interchanging p and q. Thus the cubic curve in [3] may be regarded either as the locus of the meets of corresponding planes of three related pencils or as the locus of the meets of corresponding lines of two related point-stars. If p and q are equal, the two conjugate generations are of the same kind.

Prof. Room's book, in which he uses both synthetic and algebraic methods, is divided into three main sections. Part 1 deals with the general $(|p,q|_r, [n])$ and Part 2 with the loci obtained by specializing the matrix (x_{ij}), with particular consideration of the cases in which this matrix is symmetric or skew-symmetric. Part 3 is an exhaustive and fascinating account of the different types of determinantal quartic primal and associated loci in [4].

The general theorems proved in the first two parts are of a formidable nature, but they a freely illustrated by examples in which the alg braic quantities are given particular numeric values. The author recognizes that it is general the special cases which are of the greatest intere and, while sympathizing with his evident desire keep the book to reasonable proportions, we shou have liked to see him develop some of them furthe

In the generation of the cubic surface in [3] b three related point-stars, there are six sets of thr corresponding planes which meet in a line inste of a point. These six lines and six others, whic arise from the conjugate generation and are paire with these, form a *double-six* of lines, with t property that no two lines of the same set of s intersect and each line of one set meets all b one of the lines of the other. The remainir fifteen lines of the cubic surface arise naturall though not so simply as this, from the projecti generation. In chapters iv and xiii, Prof. Roo describes many new such configurations of line spaces with remarkable intersection properties.

The class of determinantal loci is very extensiv It includes, for example, all plane algebraic curve and, in fact, as the author claims, almost all lo of whose projective properties anything is know are either determinantal loci or closely connecte with them. The great diversity of the problem solved and the naturalness with which they fa into the author's scheme fully justify that clai The book consists very largely of origin researches, and among these the chapters on th representation of spaces by points and the chapt and appendix on the freedom of loci are pa ticularly interesting.

The index and table of contents are admirabl complete and the author suggests a useful cour of selective reading. D. W. B.

X-RAY ANALYSIS AND THE STRUCTURE OF MATTER*

BY SIR WILLIAM BRAGG, O.M., K.B.E., PRES.R.S.

WHEN the new methods of X-ray analysis were first introduced a quarter of a century o, there was naturally no clear realization of the tent and character of the fields of research in iich they would eventually be employed. Certain plications were found for them at once, but the ars have brought wide and unexpected develop-ents. Some of these are gathering themselves gether, and, in conjunction with other methods physics and chemistry, begin to form what ight well be called a new branch of science.

In the early phase of the X-ray crystal studies, e object of interest was the perfect crystal; in e later phase, attention is directed towards the partures from perfection, which turn out to be the greatest interest and importance.

EARLY WORK ON CRYSTAL STRUCTURE

It will be remembered that the method of alysis of the structure of matter by means of -rays was based upon a suggestion made by Dr. . von Laue. If the atoms in a crystal were in gular array, the passage of ether waves through e crystal should be accompanied by diffraction ects, provided that the lengths of the waves were the same order of magnitude as the spacings of e atoms. In the case of the ether waves emitted an X-ray bulb—if indeed the X-rays were her waves, of which there was some doubt at the ne—there were reasons to suppose that the ave-lengths were of the magnitude required. ie experiment was made, and was successful.

The diffraction effects provided means whereby e crystalline arrangements could be calculated. ie researches of the first few years of X-ray alysis were therefore concerned with the aracter of the crystalline arrangement in a umber of the simpler cases. As confidence grew d skill increased, more difficult structures were tacked, and indeed it has been very surprising find what complicated structures can be unvelled. One helpful circumstance has been the istence of families of substances, since the pro-essive differences in the members of a family ve rise to corresponding changes in the diffrac-n patterns. Thus, for example, the large family silicates was examined and the connexions tween composition and diffraction effects, and again between the latter and structure, were observed and compared. Certain simplicities and uniformities then appeared, and it became possible to put in order a mass of details which had not previously appeared to have any relation with each other.

It was not long before the results in this field of research became so numerous that books of no small size were required to contain them. In thousands of cases, the dimensions of the unit cell of the crystal were determined, and at least the space group or character of the arrangement of the atoms within the cell. In a number of these cases the exact relative positions of the atoms could be found, though this additional task has often been formidable. Work of this kind continues, and rightly so, to be the occupation of many investigators. All such work belongs to the first phase to which I have referred.

IMPERFECTIONS OF CRYSTALS

The application of the X-ray methods has for some time been entering on a second phase. It now deals with a natural phenomenon differing entirely from that which was the first to be examined. The earlier work was concerned with the arrangement of the atoms in a perfect crystal, that is to say, a body in which the mutual forces are balanced, and the arrangement is complete. Thermal movements may still be there, but the average dispositions of the atoms are settled, and are uniform throughout the body of the crystal.

It is doubtful whether there is such a thing as a perfect crystal large enough to be handled; perhaps the crystals of diamond and graphite are nearest to perfection. In almost all cases there are deviations from complete uniformity. A crystal that has every appearance of being perfect may consist of an assemblage of minute crystallites, more nearly perfect individually but lacking uniformity of orientation to a greater or less degree. Other bodies that do not appear to be crystalline at all may consist of crystallites oriented so irregularly that the bodies seem to be isotropic. The crystallites may vary in size as well as in relative orientation. Two or more crystal forms may be present in the same body, so mixed together that only the X-ray methods can make any attempt to disentangle them. Sometimes one greater lattice overrides in a more or less regular fashion a smaller lattice, as a pattern of ploughed fields may override a pattern of furrows. Also a lattice may be distorted by strain. In a substance in the liquid state there may be associations and partial arrangements sufficient to show X-ray diffraction.

---

* From the presidential address to the Royal Society, delivered on vember 30.

Moreover, arrangements and dimensions may vary with time, both in solids and liquids; some forms or extents of arrangement may even disappear, new forms may appear at the expense of the old. Perfection of crystalline arrangement is a goal which is never achieved. In fact the processes of the world are based upon such deviations from perfection, and their continuous modification. If all arrangements of atoms were complete, there would be nothing left but stagnation and the peace of death.

It will be seen, therefore, that a new field of research of extraordinary interest is being opened up. It is in this field that the physicist and chemist, and indeed scientists of every persuasion, must look for explanation of many of the properties of their materials, such as their relations to magnetism and electricity, thermal conductivity, tensile strength, various surface effects and so on; and also the time changes in these properties, such as the creep to which the engineer has to give so much attention. Properties such as these have been called by Orowan and others the 'sensitive' properties, since they depend on the particular state of a body, which state in turn depends largely on the conditions of the new field of which I am speaking. The biologist finds interest in it, because the life processes seem to involve the relations between large aggregates, molecules or assemblages of molecules, with one another or with media in which they are imbedded. Somewhere in this field life and matter are first found in association.

It may seem unreasonable to expect help in the resolution of such complications from the X-ray diffraction effects. It is to be remembered, however, that the X-ray photographs are very rich in information. The gratings are three-dimensional and may be examined from a variety of aspects; each photograph or spectrometer record is a two-dimensional diagram of positions and intensities of diffracted spots. A light spectrum of the ordinary kind is uni-dimensional only. The photographs vary in definition, being less easy to read as they deal with more complicated cases; but the technique is rapidly improving.

MOSAIC EFFECT

The earliest of these phenomena of the larger field was the so-called mosaic effect. A crystal of rocksalt, for example, is a mass of small cryste each of which approaches to regularity far m completely than the whole. The separate cryst lites are not in perfect alignment with each oth Hence arose one of the perplexities of the ea days. It was extraordinary to find that the l perfect crystal reflected the X-rays in grea intensity than the more perfect, and that t reflections from the face of a crystal—quartz, example—might be increased if the surface w roughened. The puzzle is solved if we remem that, as Darwin and others pointed out, o crystallite may screen another. If the orientati of the two are exactly the same, and they are at the proper angle for reflecting the incide X-rays, the first crystallite will partly absorb t rays in producing its own reflection and the low will not have its full opportunity. But if, as usual, the crystal is moved through small ang about the above setting so as to give every cryst lite its chance—provided that the X-rays c penetrate the crystal so far as to reach it—and the second is in the right orientation for refle tion when the first is not, then the incident ra get through the first and are reflected by t second; the integration of all effects theref gives a larger total when the crystallites are r parallel.

This mosaic character is very common, even crystals of the purest material. There are indi tions, as remarked by Goetz and others, that some cases at least it is the state of grea equilibrium. Thus W. A. Wood shows th crystals of copper and other metals of extre purity are reduced by cold working to crystalli in more or less complete disarray. The substan do not then return to their former state, thou they can be taken some way towards it by moder heating. To restore them to their original state would be necessary to begin over again from t melt. A similar effect was shown by Ewald occur in the case of rocksalt. It may also significant that of the two forms of diamo examined by Robertson and Fox, that which the more transparent to infra-red and ultra-viol and may therefore be taken to be in grea internal equilibrium, is also the one in whi there is some mosaic character.

If this form of disintegration of a larger crys into crystallites is really due to the release energy, it might be expected to proceed until t process was complete and the substance beca amorphous. Wood shows that it does not proce indefinitely and that the copper crystallites ha an average linear dimension of about 700 A.; silver the figure is 800, for nickel 1200, and so c The disintegration ceases at a certain point. T metals were of extreme purity. Unless it appe at the mere trace of impurity governs the effect, must be supposed that the disposition to form ggregates of definite magnitude is present in the pper atoms themselves.

The presence of crystallites of a definite pattern, eir dimensions, their preference for any particular ientation in relation to the body which contains em and their proportional amounts are all etermined by the X-ray photographs. It is to e remembered that the diffraction spectra of a mpound of different crystallites do not modify disturb each other's evidence. The data on hich calculations are based are the forms and tensities of the spots and lines in the X-ray otographs. The calculations are often difficult d lengthy because so many factors have to be ken into consideration ; in fact there is plenty evidence, and the most troublesome part of the siness is its interpretation.

APPLICATIONS TO METALS AND TO LARGE MOLECULES

It will be readily understood that such measure- ents as these can be of great assistance in the udy of metals. It is possible to examine in a new d most effective way the phase diagrams of the etallurgist, and the various effects of composition, mperature and time, and this not only for binary loys but also for ternary and still more compli- ted mixtures. With these powers in hand, and ith the remarkable accuracy of the modern -ray spectrometer, which can show minute anges of form due to temperature or an admix- re of foreign atoms, and can show also any varia- ons in the extent of order and disorder in the omic arrangements, it is not surprising that eoretical metallurgy has acquired a new life d that practical metallurgy begins to gain ereby.

Since the X-ray methods can do so much to scover the composition of molecules, even very rge molecules such as the phthalocyanines obertson) or the sterols (Bernal, Crowfoot and hers), and also to determine the arrangement of e molecules in crystalline aggregates, and yet rther to find any preferred orientations that ere may be, the methods can be fitly used for e examination of fibrous materials. In cotton, lk, rubber and many other substances there are ng-chain molecules which are linked together into ystallites having preferred orientations along the ngth of the fibre. So also nerve, muscle, horn d such-like contain proteins and keratins in rous forms. It is even possible, as Bernal has own, to find some details of the composition, ructure and arrangement of immense molecules ch as those of a virus. Very interesting papers on these subjects have been communicated to the Royal Society, some of them during the present year.

It is to be observed that the extension of the X-ray methods to these larger scale problems is greatly facilitated by extrapolation from simpler observations. In the case of organic substances, the modes of assemblage into characteristic combinations of atoms, such as the association of carbon atoms in the benzene ring, are governed by rules which are so closely followed in the simpler cases that they can be assumed to hold in the more complicated. These rules relate to the distance from atom to atom in various cases, and the mutual orientations of atoms. In this way very important suggestions have been made in respect to the construction of the more difficult assemblages.

It is to be remembered, of course, that there are other physical methods of observation which contribute to the understanding of the complex substances of Nature, which are all the more efficient now that the X-ray methods are able to make their characteristic contribution. First of all comes chemical science, the power of which is so obvious and well known that I need not do more than refer to it. Optical properties have been found to be extremely useful. So also the magnetic properties are found to be closely related to structure. Thus, for example, the disposition of a molecule containing benzene rings can often be predicted from diamagnetic measurements.

The sum total of these powers, some new, some old, all reinforcing each other in a common advance, is so great that, as I have already said, a new field of inquiry of first-rate importance has been well entered. That which the eye can see is one thing : that which the microscope reveals is another. Far beyond any vision is the individual atom and the atomic nucleus, of which so much has been discovered in recent years. But a vast range of magnitudes lying approximately between 10 and 10,000 A. has never been accessible to the direct attack which the ranges on either side of it have experienced. Within this range lie all the processes which are concerned in the building of living substances, animal and plant, and in the changes of growth and decay. In this range lie also elements that are the origin of the properties of our materials, alloys, glasses, fibrous substances of all kinds, and here take place transformations which change these properties, some of them especially rapidly when urged by heat, some so slowly that centuries must pass before they become visible or effective. The recent advance into this new field is only the preliminary to what is sure to follow. We have before us an inquiry of supreme interest.

CAMBRIDGE UNIVERSITY EXPEDITION TO JAMAICA

BY DR. V. J. CHAPMAN,
UNIVERSITY OF CAMBRIDGE

THE Expedition left England in two parts, on June 15 and 22, and was scheduled to return on September 19. Owing to the outbreak of war, the main party left Kingston a few days earlier than was anticipated, but in spite of this change of plan the principal items in the programme were carried to a successful conclusion. The personnel consisted of Dr. V. J. Chapman, the leader, Dr. H. Hamshaw Thomas, who took charge of the forest party, Mr. J. A. Steers, who took charge of the schooner party on her voyage around the island, Mr. J. S. Colman in charge of the zoology, Mr. W. R. Philipson, Mr. J. Lofthouse the surveyor, Mr. K. R. Sporne, and Mr. D. J. Crisp. We were fortunate in being able to co-opt three persons in Jamaica, and it is a pleasure to record how much their inclusion helped the expedition. The local members were Mr. C. E. Hamshere who assisted the geographers, and Miss O. Baxter and Miss L. Scudamore who aided the forest party. The Expedition was largely financed by the Royal Society, and our thanks are due to that body and other institutions which provided money, and also to the Government departments of Jamaica and private residents in the island whose ready co-operation greatly facilitated our work.

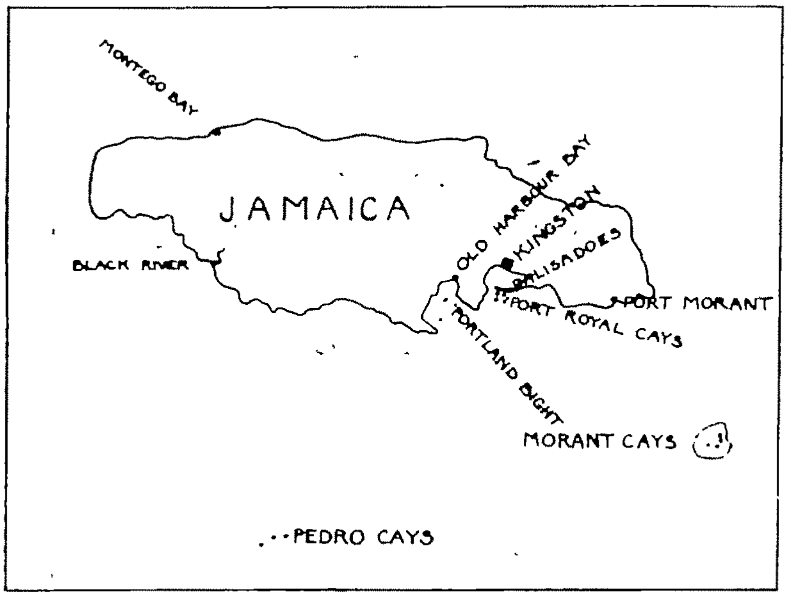


Fig. 1.

The primary object of the expedition was study the development of the cays and of t shore line, especially in the neighbourhood Kingston, and also the role of the plants a animals concerned in the process. A visit w first paid to the Morant cays which lie on a sho about 60 miles south-east of Kingston (see acco panying map, Fig. 1). Whe later on, the cays near Kingst were examined, it became appa ent that the Morant cays for an independent group the stru ture of which is quite unlike th of the Kingston cays. The Mo ant cays, four in number, a simple sand cays composed *Halimeda* and shell sand togeth with coral fragments (Fig. These cays were unique amo those investigated in that th beach rock forms promenad comparable to those of the lo wooded islands of the Gre Barrier Reef. These structur always occur on the windwa sides of the cays and are heavi eroded. In some of the depre sions crystalline salt and alg appeared to be combining to pr duce a hard crust similar to th formed on the surface of the promenade, and it hoped that an analysis of the crust and the alg salt mixture may throw some light on its form tion. Whilst the height of the promenades on th Queensland islands suggested that a slight fall sea-level had occurred, we came to the conclusi that this was not the solution on the Morant cay but that storm waves and spray would probab account for their height.

Of the cays in Portland Bight, all but two a built up largely of *Halimeda* sand, whilst those Port Royal (outside Kingston Harbour) form graded series extending from the outer cays, wi coarse coral on the exposed south-east and sou sides, to the inner sandy cays, with only a fe boulders on their weather sides. The similari of the environment of these two groups of ca makes it very difficult to explain why one set so different from the other. Many of the ca

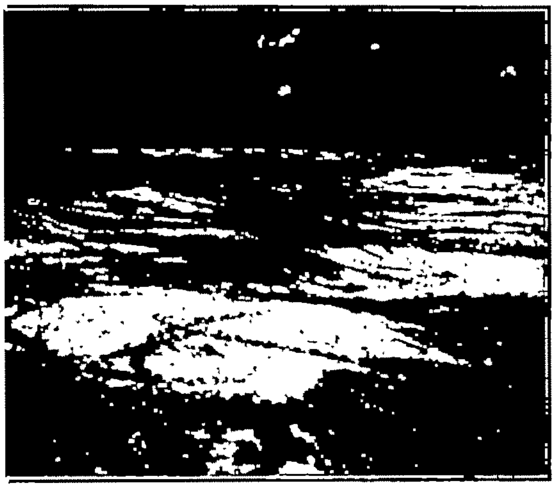


Fig. 2.
Ipomœa and low sand-dunes, South East Cay, Morant Cays.

sees one or more lines of beach rock lying at rying distances off-shore, and it would seem at these represent former outlines of the cays d they might therefore be used to indicate anges of shape. A study of the physiography the Palisadoes, together with what is known of past history, suggests very strongly that this d and shingle spit rests on a rocky ledge, and at it has united several former shoals or cays ich are now represented by the stable salients amb Point, Little Plumb Point, and Rocky int. There are three factors which have con- lled the development of this spit in the past and ich will determine any future change.

(1) Hurricanes. These are capable of opening breaches in the spit and re-isolating the lividual cays.

(2) Earthquakes. These may have the same ect.

(3) Sand and shingle movement from east to st due mainly to wave action. Normally the lutionary work of this last factor predominates, t it has been upset time and again in the past the single or combined effect of the first two.

In other parts of the world where coral reefs are be found, the calcareous red algæ play no incon- erable part in their formation, and hence it was prising to note how insignificant this group of e are in Jamaican waters. It may be said t the cays and reefs of Jamaica are conspicuous the comparative paucity of living coral and careous red algæ, although conditions would pear to be favourable for both. *Halimeda*, in ing rise to a sand, is the only alga which plays real part in shore-line development, but even s genus is not as abundant as might be expected l it seems that its maximum abundance must e been reached in the past. The observation that many of the cays do not appear to occupy greater areas than they have in the past, as revealed by lines of former beach rock, strongly supports the thesis that fresh supplies of *Halimeda* sand are not being produced at a great rate.

The mangroves, of which there are three principal species, *Rhizophora mangle*, *Avicennia nitida* and *Laguncularia racemosa*, form the principal vegetation which is concerned with shore line development in this part of the world. They are completely absent from the Morant cays, and this can probably be explained by the fact that the dominant winds blow from the south-east and so any seeds would have to travel over a considerable distance in order to reach the cays. With a persistent wind in this quarter, colonization from Jamaica is out of the question even though it is so near. By way of contrast, the cays in Portland Bight and off Port Royal bear all three species. The mangrove vegetation can be divided into three groups: (*a*) reef mangroves with roots in the holes and crevices of the boulders; (*b*) mud mangroves occurring at the mouths of estuaries; and (*c*) sand mangroves growing on the sand cays and sand spits. Those in group (*a*) play no part in the

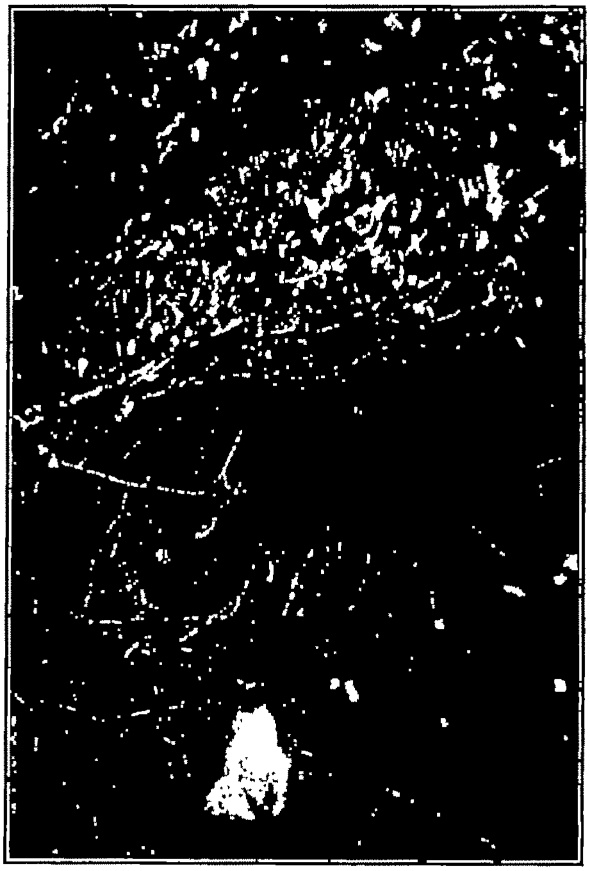


Fig. 3.
Pneumatophores of *Avicennia nitida*.

formation of new land, but those in group (*c*) may spread and unite several small sand cays or ridges and so produce one large swamp. This has undoubtedly occurred along the inner edge of the Palisadoes and is taking place to-day in the Bogue islands near Montego Bay.

As the tidal range in Jamaica is very small, any zonation of the different mangroves is not easy to distinguish. In protected bays, on the leeward side of cays, and along rivers, *Rhizophora* forms a narrow outer fringe with *Avicennia* behind, whilst *Laguncularia* tends to mix in with the *Avicennia* when the ground becomes slightly higher and drier. In exposed sand-spit areas, however, *Laguncularia* forms the outer fringe with *Avicennia* behind, whilst *Rhizophora* is confined to the damper pools and depressions. Ultimately the mangrove vegetation yields to dune, salina, or freshwater swamp, depending on the local conditions. The most active production of new land by mangroves is taking place at the mouths of rivers, but even in some of these localities exposure to wave action has occasionally brought about an onset of erosion. In such places old mangroves lie uprooted in front of the protecting ridge, whilst seedlings never have an opportunity to establish themselves. In other places where there is very little mud or sand deposition the mangroves produce a marine peat, but it is evident that the formation of new land by this method must take an extremely long time; in the end it results in a much more solid substrate than is normally associated with mangroves.

Particular attention was paid to the ecology of *Avicennia nitida* and the functions of its pneumatophores (Fig. 3). The tides around Jamaica permit of one major (nine inches to one foot) and one minor (three to five inches) tide a day, and observations showed that only the major tide covered the soil in much of the swamps. In addition to this diurnal fluctuation there were the spring tidal cycles, and it was evident that in some of the swamps quite a number of days could elapse between two floodings. It was also established that *Avicennia* grew on three distinct types of soil: (*a*) sandy soil; (*b*) muddy soil; (*c*) peat. The oxygen content of the soil water was very low, ranging from 0 to 0·26 per cent, and although bubbles of gas could be obtained from most positions within a swamp, upon analysis such gas always yielded a low oxygen value, the average being about 7 to 8 per cent. This is very different from the concentration in the atmosphere, and it is probably insufficient for the respiratory metabolism of the lateral roots. Analyses of the gas contained in the pneumatophores and lateral roots showed that it was not very different from that of the atmosphere so far as the oxygen
carbon dioxide content were concerned. T
means that the pneumatophores must form
channel for gaseous interchange. Whenever pa
of the pneumatophores were below the soil s
face they bore slender horizontal rootlets at
depth of about 1 cm. If, however, the whole
the pneumatophore was exposed, as, for examp
when the lateral roots crept among the bould
or were exposed upon the beach, the horizon
rootlets would be absent or else growing
directly from the lateral roots. These are eviden
the absorbing organs, and normally they deve
from the pneumatophores. Some evidence
also obtained to show that, whilst not prima
organs of respiration, nevertheless the pneuma
phores do exhibit some respiratory activity.

The zoologists, Mr. Colman and Mr. Crisp, sp
most of their time collecting for the British Museu
one of the more interesting finds being *Littor*
minima, of which only three specimens h
previously been known. Three level-traver
were made across well-vegetated beach-rock a
from one of these, which exhibited excellent al
zonation, samples of the flora were also taken.
tide gauge was established at Port Royal and fr
the records obtained it is hoped to secure so
data about the relative positions of the differ
animals and plants in relation to tide-lev
T. A. Stephenson and his school have shown th
on the South African coast, where the tidal ra
is comparable to that at Plymouth, systematica
related animals tend to occupy the same e
logical positions as at Plymouth. It theref
seemed worth while to compare with these t
places the corresponding distribution in the Car
bean where the range of tide is very small.
soon became evident that there is, on the wh
a remarkable paucity of living coral around
cays, especially the Morant cays, and this
striking because in similar places off the Quee
land coast masses of coral would be encounter
At present there seems to be no adequate ex
nation of this feature, but it is clear that the c
and reefs are not coral in any full sense of
term. The general conclusion is that the Jamai
marine fauna, though varied, is, neverthele
somewhat scanty.

Very little can be recorded about the activit
of the forest party because the collections, wh
have been left in Jamaica for safety, have yet
be examined. Dr. Thomas collected much mate
of the monotypic genus *Rhipidopteris peltata* a
also of the genus *Elaphoglossum*, both of wh
are imperfectly known. Messrs. Philipson a
Sporne, apart from collecting for their own p
poses, secured a collection of wood specimens
the Imperial Bureau of Forestry at Oxford.

TREE RINGS AND CULTURES IN THE SOUTH-WESTERN UNITED STATES

ENDROLOGICAL evidence, in other words the tree-ring method of dating as applied the archæological investigation of early cultural mains in the south-western United States, not ly confirms, and is itself confirmed by, strati- phical evidence, but also serves to afford a clue at least one among the causes which may have ntributed to bringing about fundamental changes mode of life of south-western peoples, and even e decay of a flourishing civilization. It has, for ample, long been an open question among nerican archæologists why a people living in all scattered villages should develop a tendency concentrate in urban communities, which er become the great communal houses of the eblo period; and further, why this Pueblo ilization, on attaining a remarkable peak-point development, should suffer a serious decline, d many settlements be abandoned. At neither int does there appear to be any significant ctuation in numbers of the population, nor y serious increase in raiding activity of hostile bes.

It is pointed out by Dr. F. H. H. Roberts, jun.[1], a survey of current archæological knowledge of e south-west, that both these crises coincide th periods of drought indicated by the tree-ring quence, while the period of greatest expansion Pueblo civilization is also a twenty-year period favourable conditions.

In introducing this report on his archæological vestigations in eastern Arizona, Dr. Roberts vances arguments for a new classification and menclature in south-western archæology, to persede that adopted at a conference held at cos in 1927. It was then decided to accept a crimination in the Basket Maker culture, at that ne the earliest differentiated in the south-west, to three stages, and of the Pueblo cultures into e, of which the latest stages were post-Columbian d extended to modern times. Yet, as Dr. oberts points out, Basket Maker I, the primary age of a simple nomadic hunting people, leading to the semi-hunting, semi-agricultural phase the later Basket Maker culture, is entirely pothetical, and no relics which can be assigned it have been discovered. Hence he suggests its imination, and the substitution of 'Basket Maker' nply for the second stage, the earliest known present, and 'Developed Basket Maker' for age III. Pueblo I and II become 'Developmental eblo', while Pueblo III–V are covered by Great Pueblo, the period of greatest expansion, 'Regressive Pueblo', the period of decline, 'Renaissance Pueblo' and 'Historic Pueblo', as more truly in consonance with the history of the development of the culture.

Further, in considering the character of the earliest period, Dr. Roberts distinguishes three types of culture—two major provinces, to which he now adds a third. Of these the first centres in the plateau country of the area comprised in the States of New Mexico, Arizona, south-west Colorado, Utah, eastern Nevada, western Texas, and northern Mexico. For this the name 'Anasazi' is proposed. The second is the culture of the desert precincts and lowlands, to which the name 'Hohokam' is applied, while a third province, hitherto considered a variant of Anasazi, is the 'Mogollon', which centres in San Francisco and the Mimbres River valley in south-west New Mexico.

The main differences between the Anasazi and Hohokam cultures summarily stated are as follows: While the Hohokam practised cremation, the Anasazi buried their dead. The Hohokam built rectangular, single-unit houses of pole, brush, and plaster construction, while the Anasazi progressed from circular, or rectangular, single-unit dwellings of poles, brush, and plaster to multi-storied communal houses of stone. The Hohokam progressed from flood-water irrigation to an extensive canal system for watering their crops; but the Anasazi depended mainly on flood-water, though in some sections they employed small ditches. Both used coiled pottery, but their finishing processes differed, as did the decoration, the Anasazi developing from black to polychrome, while the Hohokam used red on buff.

The Mogollon cultural pattern is that of a sedentary agricultural-hunting complex, in which the hunting aspect is more pronounced than in either Anasazi or Hohokam. As a rule, the dead were buried, but there was some cremation. Houses were rounded and semi-subterranean, followed by rectangular semi-subterranean, and then by the Pueblo type.

While dendrological evidence is available for dating the Anasazi culture, the varieties of timber used in house construction in the Hohokam culture is not adaptable to tree-ring studies; and the determination of period in Hohokam must depend upon pottery types and reference to trade objects of the Anasazi penetration until A.D. 1000, when

Anasazi settlement took place in the Hohokam province. Timbers from the Mogollon houses have been dated, making correlation with Anasazi possible. It is suggested that basic Mogollon, not yet clearly defined, was contemporary with Modified Basket Maker, and its later stages of development with Developmental Pueblo, Great Pueblo, and Renaissance.

Investigation of the relations of the Mogollon culture to various phases of Anasazi, both Bas Maker and Pueblo, have been in progress throu out the summer of 1939: at Glenwood, New Mex (Field Museum of Natural History, Chicag a second expedition working also near Glenwc (Logan Museum); and on a village site occup A.D. 700–800, south of Showlow, Arizona (Ariz State Museum).

---

[1] *Smithsonian Inst.: Bur. Amer. Ethnol. Bull*, 121 (1939).

OBITUARIES

Prof. H. H. Meyer

THE death of Hans Horst Meyer on October 6 severs perhaps the last direct link with the beginnings of experimental pharmacology as a separate science.

Meyer was born on March 17, 1853, in Insterburg in East Prussia, and studied medicine at Konigsberg, Leipzig and Berlin. A story goes that he passed his qualifying examination in all subjects except pharmacology and that it was to rectify this defect that he undertook an investigation under Jaffe, which gave him an introduction to the technique and literature of experimental physiology. Later he went to Strassburg to work under Schmiedeberg, as did nearly all the prospective pharmacologists of the time, and had just been appointed assistant to Schmiedeberg when he was called to Dorpat in 1881. Here he succeeded Boehm, the immediate successor of Buchheim, who had established in Dorpat the first laboratory for experimental pharmacology. In 1884 he became professor at Marburg where he worked for twenty years, after which, in 1904, he became director of the Pharmacological Institute in Vienna. He held this appointment for another twenty years, retiring in 1924. Still active, he was put in charge of a department for standardization of drugs, an appointment to which there was no age-limit and accommodation for which was given in his old laboratory. Up to a year or two ago, he still held every month in his own house a discussion on some pharmacological problem, which all the workers in the Pharmacological Institute, including his successor Pick, attended, and I am informed by one of the staff that up to the end Meyer took a leading part in these discussions, with little impairment of his enthusiasm or of the constructive and critical acuity of his mind.

Like most of the pharmacologists of his time, Meyer was no narrow specialist. His investigations ranged over a wide field, and behind it all was the desire to link up pharmacology with general biology and pathology on one hand and the treatment of disease on the other, towards the establishment of a more rational therapy. His influence is to be measured not only by his achievement but also by the vision which prompted it and by his guiding example of the lines upon which pharmacological investigation could be profitably pursued. Among the phar acological problems he investigated were the acti of the alkaloids of jaborandi and corydalis, ac poisoning with phosphorus and with metals, especia iron and bismuth, and the action of purgatives a astringents. He also did some pioneer work on t reaction of the blood, on heat-regulation and on t action of diuretics and, resulting perhaps from early work on jaborandi, he was especially interest in the development of the knowledge of the autonom nervous system.

Meyer's claim to a permanent place in the histo of pharmacology will, however, probably rest up his contributions to two problems which lay outsi the range of routine descriptive pharmacology. T first of these was his theory of the action of narcotic he sought to explain their action by their relative greater solubility in lipoids than in water, which l to their accumulation in the cells of the central nervo system with a consequent suspension of nervo activity.

This theory, which was independently and alm simultaneously suggested by Overton, has requir subsequent modification, but its importance lies its being a pioneer attempt, based upon experiment evidence, to solve one of the fundamental proble of pharmacology—the chemical or physical basis f the site and quality of pharmacological action. T other problem to which he introduced new co ceptions was the action of bacterial toxins. Especial will be remembered his suggestion that tetanus tox travels to the central nervous system by way of th motor nerves rather than by the blood stream. I also showed that antitoxins were the more effecti the earlier they were given, and were relative inefficaceous once the toxin had combined with t tissues.

Apart from his own work, Meyer profound influenced, by his wide knowledge and imaginati power, those who went to work with him fro different parts of the world. His scientific eminen was recognized by many universities and learne societies outside his own country. He was the seni surviving honorary fellow of the British Physiologic Society and, with J. J. Abel, was the first honora member of the British Pharmacological Society.

J. A. GUNN.

Dr. E. P. Poulton

EDWARD PALMER POULTON, who died on October , was the eldest son of Sir Edward Poulton. He s born at Oxford in 1883, and educated at the agon School, Oxford, and at Rugby; in 1902 he tained the Brackenbury Scholarship in natural ence at Balliol College, Oxford. After taking the st M.B. he read Chemistry Finals.

Poulton went to Guy's Hospital for his clinical rk in 1907 and qualified B.M. (Oxon.) in 1910. ter appointment as house physician, he won the dcliffe Travelling Fellowship and worked in rmany. His early scientific work (1912–14) was stly on the metabolism of uric acid and of creatin d creatinin.

In 1914 Poulton was appointed assistant physician Guy's Hospital, and he became interested in the mical side of diabetes, working on the value of eolar air determinations as a measure of the dosis and also writing on the value of starvation the treatment of diabetes. The introduction of ulin in 1922 intensified his interest in diabetes, and main clinical work continued to be with diabetic tients.

In 1920 he was elected to a Beit Memorial Research lowship. At an early stage he had worked with ldane on the effects of want of oxygen on respiran, and this influenced the direction of much of his er work. From 1918 until 1925, with a series of pils, Debenham, Joffe, Campbell, Parsons, and er Spurrell and Warner, he was working conually on the problem of dyspnœa in connexion h the oxygen and carbon dioxide carriers in the od, and with its hydrogen ion concentration and h the oxyhæmoglobin curve. For a time at Guy's spital an oxygen chamber was installed where ients could live in an atmosphere of, say, 40 per t oxygen, and the influence of this on their ease and on their physiological processes could be served. He was satisfied that many patients with onic bronchitis and heart disease obtained benefit m this treatment, and this was the foundation of belief in oxygen therapy which became the main erest of his later years.

nother early interest to which Poulton returned ain was the problems of pain in gastric ulcer l of pain and of normal sensation in the œsophagus. carried out investigations on himself and others introducing into the œsophagus a balloon which ld be distended while the subject was under ray examination. In 1928 he gave the Oliver-arpey Lectures, dealing with the experimental dy of certain visceral sensations, and the next r published a paper in the *Guy's Hospital Reports* the physiological considerations underlying abninal pain.

The mechanical side of any investigation always de a great appeal to Poulton, and much of his er work was concerned with the development of aratus, for example, positive pressure machines l oxygen tents. Although often rather complicated appearance, his oxygen tent in its final form was neat and beautiful piece of apparatus. His enthusiasm for oxygen therapy has no doubt been one of the factors leading to the increased use of this treatment; latterly his enthusiasm led him to start experimental observations on patients with such diverse conditions as rheumatic carditis and cerebral hæmorrhage.

Apart from the many published papers on the subjects mentioned, Poulton published two books, "Oxygen and Carbon Dioxide Therapy" with Argyll Campbell, and "Diets and Recipes and Treatment of Diabetes and Obesity". He also acted as editor of the 12th to 14th editions of "Taylor's Practice of Medicine", the first of these in 1922. This was perhaps his greatest contribution to medical teaching; he devoted much time and trouble to the preparation of each edition, so that this old text-book was made a good practical guide and kept remarkably up to date.

Poulton was chairman of the International Society of Medical Hydrology, and in 1937 was president of Section I (Physiology) of the British Association—an unusual distinction for a practising physician. He was also greatly interested in the work of the League of Nations Union and spent much time on this.

There were many qualities, including his whole-hearted enthusiasm and his charm and kindliness, which endeared him to his many friends. Although he knew his heart was affected, his regular hospital duties and teaching, his research work and writing, and his many societies and meetings, show how little he let this stand in the way, and in their multifarious activities he never spared himself.

In 1911 Poulton had married Elfrida, youngest daughter of Mr. Charles Maclean of Glenearn, Perthshire, and had three sons and two daughters. His eldest son has recently qualified and is now a medical officer at Pembury, the second is in the Army, and the third a medical student. M. CAMPBELL.

Major A. E. Levin

WE regret to announce the death of Major Arthur Everard Levin, which took place on November 8 after a short illness. Levin was born on February 17, 1872, and was educated privately. He took up electrical engineering as a profession and enlisted in the Royal Engineers on the outbreak of the South African War. For some time after the conclusion of that war he held a Government appointment and later was associated with the firm of Mordey and Dawbarn, consulting electrical engineers, retiring from his profession in 1928. He remained with the old 'Volunteers' when they became 'Territorials' and was called up for service on August 5, 1914. Later he was placed in command of the first Electrical and Mechanical Company to be sent to France, and was mentioned in dispatches in April 1918. He saw service in Italy in the same year.

After demobilization, Levin's interests turned to astronomy. In 1919 he was elected a member of the British Astronomical Association and in 1921 a fellow of the Royal Astronomical Society. His work in astronomy was mainly connected with computations.

He was the second director of the Computing Section of the British Astronomical Association, formed in the 1920–21 session, a position which he held with only one or two minor interruptions until 1938. The annual production of the "Handbook" required much time and patience, especially with computers who had to be initiated into the subtleties of the calculations essential for the work. Levin displayed a wonderful amount of tact and judgment in teaching new computers, and his unfailing courtesy and kindness will never be forgotten by those who could always turn to him for advice and guidance.

The "Handbook" is used at many of the great observatories for the information that it supplies on various branches, not least that dealing with the ephemerides of comets, for which the perturbations by the major planets have been computed. In this connexion reference may be made to the last great computational work that Levin undertook, in collaboration with Mr. J. G. Porter, his successor as director of the Computing Section. This was the computation of the perturbations of the planets on Comet Pons-Winnecke for two revolutions, Cowell's method being used for the greater portion of the work. The comet was found almost exactly in its predicted position by van Biesbroeck, an indication of the accuracy of the calculations. Levin made a speciality of the mutual eclipses and occultations of Jupiter's satellites, and a full description of his method of prediction appeared in the *Memoirs of the British Astronomical Association*, 30, 3, December 1934. He was elected president of the Association for the sessions 1930–32 and proved himself a very popular and efficient officer.

It is characteristic of Levin's love for astronomy that he presented his 4-inch refractor to the Association this year, and he has also left all his astronomical books and his 6-inch telescope and observatory, now at Selsey, to the Association. He leaves a widow and one son, the latter serving in the Navy.

Dr. G. D. Lander

GEORGE DRUCE LANDER, who died on October 25, aged sixty-five, was a man with a strong personality and a chemist whose work was characterized by breadth of outlook and soundness of judgment.

Lander studied chemistry at the Royal College of Science and Birkbeck Institution, London. After working with Japp in Aberdeen on the synthesis of pentacarbon rings, he proceeded to St. Andrews, where he assisted Purdie in his researches in stereochemistry. Purdie and Lander observed that the product obtained by the action of ethyl iodide on the silver salt of optically active lactic acid possessed a higher rotation than ethyl lactate prepared by the usual esterification process, and they suspected that the higher value was due to the presence of a small amount of the ethoxy derivative. This and similar observations led Purdie and his associates to devise the silver oxide – alkyl iodide method of alkylation, a reaction which afterwards proved to be the most serviceable tool in the hands of organic chemists
the St. Andrews and Birmingham Schools for t
controlled degradation of carbohydrates. At Univ
sity College, Nottingham, Lander made a study
the chemistry of imino-ethers, and in 1903 he v
appointed to the chair of chemistry and toxicolc
at the Royal Veterinary College, London.

In order to deal satisfactorily with the increasi
number of cases of suspected poisoning amo
animals on which he was consulted, Lander found
necessary to make a comprehensive experimen
survey of the methods for the detection of mine
and other poisons. Some results of this work w
published in communications to the *Analyst*. C
cumstances also arose which led him to investig
the separation and identification of very mini
amounts of alkaloidal drugs, and a short pa
entitled "Microanalysis of Alkaloids" was aft
wards published in the *Analyst*. His skill in manipu
tion contributed to his success in this field, in wh
he was actively interested for the remainder of
life.

Lander retired from the Royal Veterinary Coll
in 1920. The well-known "Systematic Inorga
Chemistry" by Caven and Lander was published
1906, and Lander's "Veterinary Toxicology" in 19
Lander was a member of the Court of Governors
Birkbeck College for some years, and an exami
in chemistry and toxicology for the Royal College
Veterinary Surgeons from 1923 until 1939. After
retirement from teaching he resided at Tenterd
Kent, and devoted much time to the municipal aff
of that ancient borough. He leaves a widow, w
gave him much assistance in his analytical work

G. W. CLOUGH

WE regret to announce the following deaths:

Dr. William H. Brown, lecturer in botany in
Johns Hopkins University, formerly director of
Bureau of Science at Manila, on November 9, a
fifty-five years.

Dr. Livingston Farrand, emeritus president
Cornell University, formerly professor of anthropol
in Columbia University, on November 8, a
seventy-two years.

Prof. E. A. Gardner, emeritus professor of classi
archæology in the University of London, on Novem
27, aged seventy-seven years.

Prof. Waldemar Lindgren, formerly professor
geology in the Massachusetts Institute of Technolo
on November 3, aged seventy-nine years.

Prof. F. K. Richtmyer, professor of physics
Cornell University, on November 7, aged fifty-ei
years.

Mr. A. A. Simpson, C.M.G., C.B.E., president
the Royal Geographical Society of Australasia,
known for his explorations in Australia, on Novem
27, aged sixty-four years.

Prof. Charles Vaillant, formerly director of
X-Ray Departments in the Baudeloque Clinic
the Lariboisière Hospital, one of the most emin
X-ray pioneers, on December 4, aged seventy-se
years.

NEWS AND VIEWS

ience and Censorship

THE so-called magnetic mine and the device ently used by Germany for laying mines at sea means of aircraft are reminders—if such reminders e necessary—of the increasing use which is being ade in warfare of recent research and invention. is must not be placed either to the credit or debit le of the balance sheet of science. Very few indeed the scientific developments now being widely used the present war are the outcome of research rected towards their present purposes; rather they e adaptations of results obtained by men of science their inquiries into natural phenomena, and many them have a history of much useful service to ankind before their powers for destruction were ilized. Scientific curiosity, the urge to know how d why things work, must never be stifled; and time of war, this is especially true. It is all the ore regrettable, therefore, that the powers that be glect to release information which would satisfy e curiosity of scientific workers. Speculative ticles in the lay press carry little conviction; it ould not be unduly difficult to keep men of science formed of the general principles of so-called new eapons without giving information to the enemy; is would do much towards allaying the doubts oused by official silence. As was pointed out in e leading article in NATURE of October 14: "In e fighting services themselves the methods of fence and offence are largely scientific. Some of ese methods are highly secret; others are well own to the enemy. There could be no conceivable rm, and there might be great good, in informing e public freely of the latter. . . . The present nger is that everything scientific may be censored, en laws of Nature." Publication of scientific facts ready well known to the enemy—for example, the ructure of various of his own instruments captured action or otherwise recovered—would prove not erely of interest to men of science but also probably the utmost value in forming the topic of scientific scussion.

ıvasion of Finland

EARLY this year, Czechoslovakia was lost to mocracy by the action of Germany; last September, Poland was invaded and very shortly afterards divided between Germany and the U.S.S.R. ow Finland has been attacked by the U.S.S.R. he methods adopted by the aggressors, German and ussian, have been similar in each case. These two ictatorships are making a determined onslaught on naller and independent States, and all who value eedom of thought and other democratic institutions ill regard their actions with abhorrence. Finland, as separate State, is young in years, but her people ave already established for themselves a reputation r enterprise and industry. A considerable export ade in timber, wood-pulp and butter has been built up, and the country also possesses valuable nickel deposits which were being developed. Helsinki, the capital, has an ancient university and a technical institution. Readers of NATURE will recall several communications in these columns from Prof. A. I. Virtanen and colleagues, of the Biochemical Institute, Helsinki, describing work on chemical aspects of the biological fixation of nitrogen, while Dr. P. Suomalainen has recorded work on changes in the blood which occur in hibernating animals. It is also of interest to note that M. Pekkala, finance minister in the new Government formed immediately after the invasion of Finland, is director of the State Forest Institute.

Science and Political Theory under the Soviets

A LITTLE while ago archæologists and students of the prehistory of the Eurasiatic continental tract received with profound regret and no little dismay the news that no further numbers of *Eurasia Septentrionalis Antiqua* would be published. This much-valued archæological periodical has been issued under the auspices of the Finnish Archæological Society and edited by A. M. Tallgren, professor of archæology in the University of Helsinki. Founded by Prof. Tallgren himself, it has contained in the twelve volumes of its issue many notable contributions to archæological science in its special field, the prehistory of European and Asiatic Russia and adjacent regions, by archæologists of world-wide reputation; but its mainstay has been the work of its editor, Prof. Tallgren himself, who has devoted more than thirty years to this subject. It was his constant aim, however, to advance knowledge in this field by synthetic study of the broader problems, rather than by specialized research; and for this purpose it has been necessary for him to seek international co-operation both by way of comparative study and for constant reference to, and verification from, original material in museums and collections. This assistance has been given freely. Prof. Tallgren modestly attributes the success of *Eurasia* to the collaboration of more than a hundred archæologists in Europe and the United States. He personally, for his own special studies, has relied to no little degree upon the help of his Russian colleagues; but for some time past he has received no periodicals from Russia, and his letters and inquiries addressed to Russian archæologists have remained unanswered. The failure of this essential source of information and the absence of collaboration from this field of investigation leave so many gaps and uncertainties in Prof. Tallgren's studies that with profound reluctance he has come to the conclusion that his work, and with it the publication of *Eurasia*, must come to an end.

IN making this announcement, Prof. Tallgren does no more than glance at underlying causes when he refers to the possibility of harming an individual in his own country even by commendation. Under the Soviets, the imposition of Marxist doctrine on archæological theory has constrained research workers, members of the staffs of archæological museums, and teachers in universities and higher schools to subscribe to a particular theory of cultural development, in which emphasis is laid on economics to the exclusion of all other influences bearing on the development of peoples. The enforcement of this political doctrine on scientific teaching and research has fixed a gulf between the Russian archæologist and his Western colleagues, and the Soviet political dictatorship is evidently determined that it shall be completely effective against Western archæological thought, which in taking a broader view is accused of interest only in the study of the exploiters of the proletariat. Hence the Russian archæologist must be guarded against the views of those who, for example, attach weight to the influence of migration. Those who do not conform implicitly to this frustration and perversion of the spirit of science and the aim of research, or such variation of it as may occur to Soviet rulers from time to time, have been removed from the performance of their duties, while some have vanished, leaving no trace.

Prof. D. H. Campbell

ON December 16, Prof. Douglas H. Campbell, emeritus professor of botany in Stanford University, California, will attain his eightieth birthday. His repeated presence as a foreign guest at meetings of the British Association has passed him almost as one of ourselves. His many friends among British botanists will wish to congratulate him on carrying as a light burden his tale of years. The nature and extent of his researches brought him early into prominence. Having learned Continental methods of research in the laboratory of Kny, his own fine memoir on the Ostrich fern (1887) opened that long series of researches, the results of which he compressed into the well-known volume on "Mosses and Ferns" (1895). This book ran into its third edition in 1918. In point of detailed observation of archegoniate plants, and particularly of their development, Campbell thus proved himself a most prolific observer.

BUT the scientific stature of an investigator is not so truly measured by the volume of his output as by the acceptance of his conclusions, and their passage into the web of his subject. In January 1890, in a short memoir on "The Affinities of the Filicineæ", Campbell introduced a new aspect into the problem with which it dealt. In opposition to the views then current, he held that the relatively massive eusporangiate ferns were primitive types, while the more delicate Leptosporangiatæ were derivative. By thus inverting the current evolutionary sequence, he provided a more probable key than this to the origin of a vascular flora of the land. Others at once saw the cogency of Campbell's reasoning, while palæontology rapidly supplied its own essential substage of fact. His view was confirmed later by his own treatise on the Eusporangiatæ (1911). When consider the early date of Campbell's first statemer his generalization takes a high place in the history comparative morphology.

PROF. CAMPBELL has been a great traveller in que of material for research. Latterly he has assembl his impressions and conclusions into "An Outline Plant Geography" (1926). With modesty he offe his volume, though he confesses in the preface th he can scarcely claim rank as a plant geographe We may gratefully receive these collected impressio of a first-class observer. As a water-colour artist has also been able to record pictorially much that has seen. His sketches form a counterpoise to t vast number of his detailed drawings of plan structure and development, so many of which ha been borrowed for use in current texts.

Rights and Duties of Science

IN an article "Rights and Duties of Science" in t *Manchester School* of October 1939, Prof. M. Polan examines the Marxist claims, and particularly tho of Prof. J. D. Bernal in "The Social Function Science", for a radical reconsideration and readjus ment of the duties of science, and of the assuranc accompanying these claims that they will not impa the vital rights of science. The main points at issu are comprised in the relation of pure and applie science. A distinction between these is not admitte in Marxism, which attributes such a distinction i capitalist countries to the inner conflict of a type society which deprives men of science of the cor sciousness of their social functions. Stating th liberal view of the distinction between pure an applied science, and concerning the relation of scienc and society, Prof. Polanyi points out that, to th liberal, science represents in the first place a bod of valid ideas. Science consists of autonomou branches, ruled by their several systems of ideas, an these systems have proved permanent while wave of civilization have come and gone. In a shiftin world the mind clings persistently to the rare struc tures of sound and consistent ideas, and in thes structures all scientific interest resides.

THE direct appeal of a subject does not in itse signify scientific interest. Prof. Polanyi emphasize the mutual reactions between science and practic knowledge, and urges that attempts to direct researc towards results of possible practical applicabilit cannot lead to a growth of science that is of muc value. A consistent policy on these lines woul stop the development of science altogether, turr ing in effect the efforts now directed to scientifi research into attempts to discover empirical solution for practical problems. Prof. Polanyi condemns, fc example, cancer research, and urges that all progres depends on the freedom of the systematic branche of science to pursue their own specific scientific aim Universal adoption of a policy of endowing researc for practical aims would bring science to a standsti and gradually exhaust its practical applications.

SOCIETY, in the liberal view, cultivates science as organism of ideas which powerfully attracts the nds of intelligent people, and also to increase the re of knowledge available for practical application. is position of science in society is a significant ample of the principles of liberty, being indeed rely a special feature of the position of thought in iety. Freedom is not only possible but also a social essity when we admit that the realm of thought sesses its own life. Prof. Polanyi dissents from of. Bernal's desire to put science into the consciously ganized service of human welfare, arguing that the r attitude leads to the approval of oppression of ellectual liberty, if it is perpetrated only in pursuit approved political aims. Prof. Polanyi is on firm und in criticizing a somewhat propagandist atti-le in regard to Soviet Russia, but his sincere plea the re-establishment of man's right to pursue th regardless of social interests would have more lity if he would recognize the present lopsidedness scientific development. The reorientation of entific effort for which so many scientific workers calling involves no threat to fundamental research, ich, indeed, it is desired to instigate in fields at sent neglected.

ather Reports in the United States

CCORDING to a report which has been issued by ence Service, the United States Weather Bureau making the experiment of having both aviation ecasts and general forecasts not specially suited the requirements of aviation made by a gle staff, in the case of the new district ce of the Weather Bureau at Kansas City ort. Up to now, aviation forecasts have been de by special staffs at airports, while the other casts were made independently at Weather reau offices located in the different towns. If this eriment, which began on October 1, proves cessful, it is intended to extend it to other stations the Weather Bureau. The Kansas City district ce programme includes also a new feature that recently been introduced at Washington and timore and which has proved very popular, mely, a 'breakfast time' broadcast forecast. It is ected that this will be extended to many other erican cities in the near future. It is not stated at time is taken as 'breakfast time' for the purpose hese broadcasts, but presumably it is too late to ke the forecasts meet the requirements of farmers, must arrange what work shall be done during day at an early hour and could only take account orrespondingly early forecasts. There was before War a demand by British farmers for such 'pre-akfast' forecasts; but an obstacle in the way their realization is that an hour or two must se between the taking of the observations on ch the forecasts must be based and the time at ch they are made, to allow the information be collected, decoded, charted and critically mined, and a very large number of observers ld have to begin their day's work at about m.

Penetration of the Skin by Heat

IN a paper entitled "The Penetration of Rays through the Skin, and Radiant Energy for the Treatment of Wounds", read before the Royal Society of Arts on November 22, Sir Leonard Hill gave a useful review of our knowledge of the extent to which luminous, thermal and other radiations can penetrate the skin. He also referred to some of his own recent work on the differences in the penetrating power of heat radiation according to the nature of its source. Experiments on the production of artificial fever by means of short-wave oscillators show that the body temperature can be raised to 105°–106° F. in an hour or so.

WITH what some of his listeners may have thought a curious irrelevance to the subject, Sir Leonard delivered himself of a judgment about radium treatment, to wit "The world would, I think, be little the worse off if all the radium in the country now buried for security from bombing in deep holes, remained therein. Very big monetary influences will cry out against this". The question may well be asked whether Sir Leonard really believes that these monetary influences determine the practice of radium therapy in Great Britain. About 15,000 patients received such treatment in 1938. Are the results of so little value to cancer and other patients that Sir Leonard's advice should be taken on this subject? The Cancer Act is the country's reply to such a question.

Quantitative Estimates of Sensory Events

THE final report of the committee appointed to consider and report upon the possibility of quantitative estimates of sensory events has appeared (Sections A and J, British Association, Dundee, 1939). This committee was appointed in 1932 after Sections A and J of the British Association had held a joint session dealing with the problem. It has been reappointed each year since. In 1938 a long interim report was presented containing: (*a*) a historical statement; a summary of recent experimental work; (*b*) a statement arguing that sensation intensities are not measurable; (*c*) various notes on this statement; (*d*) a statement arguing that sensation intensities are measurable. A subcommittee was appointed to consider whether the views put forward were really irreconcilable. This subcommittee presented a draft report to the British Association this year. It now seems that agreement is impossible. This is scarcely surprising when there is disagreement as to the meaning of 'measurement'. If it is postulated that this term must be limited to its applicability in physics, then this would rule out the use of the word in relation to much psychological work. Two extreme views hold the field, and a close examination of these views by a member who holds an intermediate view leads to the conclusion that they cannot be reconciled. The report therefore consists of the views of individual members. The discussion is of value, even apart from the data here presented, as illustrating some of the difficulties inherent in such problems.

Royal Gardens of Queen Anne

A NUMBER of interesting manuscripts belonging to Lieut.-Colonel H. E. Disbrowe-Wise have lately been abstracted by Mr. F. J. Chittenden (*J. Roy. Hort. Soc.*, **64**, Pt. 10; October 1939). They relate to the part played by Henry Wise in the upkeep and rearrangement of the Royal Gardens in the reign of Queen Anne. Wise and his partner, George London, were the proprietors of the great Brompton Nursery, and directed the establishment of most of the large gardens of England at the beginning of the eighteenth century. They were responsible for the introduction of French influence in garden design, but they evidently eliminated some of the frivolities of Versailles horticulture, and used only the stateliest elements in the spacious parks, terraces and avenues of Hampton Court and other Royal demesnes. Details and costs of the upkeep are revealed by the manuscripts. Henry Wise received £1,600 a year from 1702, for the upkeep of Hampton Court, the gardens at Windsor and the plantations at Kensington. A catalogue of the varieties of wall fruit reveals some affinity with modern names, and an important side of garden activity is shown by a description of five new pears which bore fruit in the year 1715. Each of the new varieties appears to have been "very rich and melting", and doubtless played its part in the general improvement the results of which we enjoy to-day.

National Central Library

WINTER is the reading man's season. Then, as the Student says in Goethe's "Faust":

> "the pleasures of the mind
> Bear us from book to book, from page to page.
> With them the winter nights grow kind and bright,
> And every limb is warmed with happy life."

But if we want unusual books, such as, say, Bolingbroke's idea of a "Patriot King", can we get them? The answer is given by the great National Central Library in Malet Place, London. It lends books through the local libraries and regional bureaux and has access to 21 million volumes in other institutions. It can do work of national importance in helping research in science and medicine. Some irreplaceable matter has been removed to Hemel Hempstead, but the non-bibliographical books remain at the London headquarters. The latest report of the Library shows that it lent during 1938–39 more than 21,000 books to urban libraries, and more than 12,000 to country ones. The 'outlier' libraries, from which readers can borrow through the National Central Agency, now include, we notice, the British Postgraduate Medical School and the Library of Radiological Periodicals (Dr. Bernard Leggett).

Health in British India during 1937

THE state of the public health in British India and some of the Indian States during 1937 is dealt with in the recently issued "Annual Report of the Public Health Commissioner with the Government of India for 1937" (Government of India Press, New De 1939. Price Rs. 3 or 5s.). The mid-year estima population for British India was 272,406,436, an crease of more than three and a quarter millions co pared with the previous year. The birth-rate 34·5, and the death-rate 22·4 per mille, each a sli decrease over the previous year, and the infan death-rate per 1,000 live births was 161·7. Pla mortality, with 28,169 deaths, was appreciably hig than in 1936, but deaths due to cholera and smallp 99,054 and 54,810 respectively, showed large creases, so that there was a total reduction of m than 90,000 deaths from these epidemic diseases. W regard to plague, it is remarked that within rec years the fatality-rate has considerably decrea and that the disease is often so mild that patie remain at work during the attack. Malaria respiratory diseases cause the largest mortali roughly about 1,000 people die from malaria ev day throughout the year. Dysentery and diarrh caused 267,479 deaths, or more than two and a times the number of cholera deaths. With regard vaccination and its protective power against sm pox, figures show that the greater the number vaccination 'marks' the smaller is the case mortal rate, and that mortality is much the highest am those having 'no marks', which may be presumed mean absence of vaccination. The volume also c tains much information on maternity and ch welfare and on the research work of various colle and institutes.

Animal Welfare

SINCE 1931 the Universities Federation for Ani Welfare (formerly the University of London Ani Welfare Society) has published annually the Ani Year Book, a journal which has contained m useful hints on the care of animals and given evide of strenuous propaganda on behalf of the well-be of wild and domesticated animals. The Year B has now been replaced by *U F A W Quart Journal*, which continues the policy of its predece but affords means of closer contact between members of the Federation and others interested its benevolent activities. Articles of general inte in the first number discuss the ideal pet-shop an population study of rabbits. A strong and justifia plea is made for the better regulation of the impo tion and trade in Mediterranean tortoises, of wh some 150,000 are said to be imported into Gr Britain annually, often under the most objectiona conditions. It may be added, for the information readers in whose family circle a tortoise makes appearance, that pamphlets on the care of these have been issued by both the English and Scot Societies for the Prevention of Cruelty to Anima

Cave Animals

WITH the appearance of "Pars 14" (published 1938 but only recently received by NATURE) great "Animalium Cavernarum Catalogus", compi by Dr. Benno Wolf and published by Dr. W. Ju reaches completion. Anyone who has followed velopment of this work must have been astounded the number of inhabited caves which it revealed, the extent and variety of cave faunas (the index the animals itself occupies 96 pages), and at the st number of papers which have been written about em. The completed work is in three volumes, the st including introduction and bibliography (pp. 8); the second containing a list of the caves, with erature references to each and the names of the imals recorded from each (pp. 616); and the last ntaining a systematic list of the animals, with ferences to the caves in which they have been found d to the recorders (pp. 918). The three volumes e thoroughly indexed, one index of 46 pages ferring to the caves, the other (96 pp.) to the imals. The bibliography is itself alphabetically ranged so that it serves as a guide to authors. The pplement carries the information about cave unas up to the end of 1935.

ork of the Central Midwives Board

The Central Midwives Board, which controls and gulates the work of practising midwives, has issued annual report for the year ended March 31, 1939 M. Stationery Office. 4*d*. net). The number of men practising as midwives in England and ales in 1938 was 16,761, some 700 less than in the evious year. During the year covered by the report, w training and examination rules of the Board me into operation. The training rules require actising midwives to attend courses of instruction m time to time. A report on the examinations ld during the year is included, together with notes various decisions by the Board on midwives' ining, etiquette and practice. The report also fers to preparatory arrangements made by the ard for an efficient midwifery service during a tional emergency.

ospital Schools in the United States

Special educational facilities should obviously be ovided for children who must spend weeks, months even years in a hospital or sanatorium. Some tempt to meet this need has been made in the ited States, and information concerning this rvice has been collected (U.S. Department of the terior. *Bulletin*, No. 17; 1938). It is estimated at fifty or sixty thousand children in American spitals need educational facilities, but less than ght thousand appear to be receiving tuition. It is inted out that the hospital school has three values: erapeutic, vocational and general educational. It ds physical recovery by keeping the child's mind cupied and away from his misfortune.

bliography of Seismology

We have just received vol. 13, No. 1, items 4260–78 of the Bibliography of Seismology, published by e Dominion Observatory at Ottawa. In this number ere are fifteen collaborators from Europe, North merica and New Zealand, notable absences being uth America and U.S.S.R., where it is known that ismological work is being done. In addition to the particular studies of individual earthquakes, mathematical seismology and general earth structure, a considerable number of the listed papers deal with microseisms and geophysical prospecting. The latter becomes increasingly important as details are worked out and apparatus becomes more applicable to the particular problems involved, needing to be robust, sensitive, and yet transportable. It is noteworthy that item 4342 is of six patents concerned with seismic prospecting, four being U.S. patents, one Canadian and one U.S.S.R.

Seismology in the Antarctic

We learn from Capt. N. H. Heck that it is proposed to instal a seismograph, if possible on a rock foundation, at a base of the forthcoming United States Expedition to the Antarctic. This, along with the stations in South Africa, South America, Australia and New Zealand will be extremely useful in determining epicentres in the southern hemisphere where seismographic stations are all too few, and on the continent of Antarctica in particular, the seismic history of which is little known. Miss Bellamy's catalogue of 1913–1930 shows seven epicentres actually located on the continent, and the Milne seismograph of the British Antarctic Expedition from March 1902 until November 1903 (lat. 77° 51′ S., long. 166° 45′ E.) recorded 135 earthquakes, of which approximately 75 were local though none was strong enough to be felt by the explorers.

Earthquake in the New Hebrides

On instrumental reports from the seismographic stations of Georgetown, Tucson, St. Louis, Honolulu, Pittsburg, Manila, Weston, Fordham, Pasadena, Hong Kong, Phu Lien, Apia, Huancayo and Lincoln, the United States Coast and Geodetic Survey in cooperation with Science Service and the Jesuit Seismological Association has determined the epicentre of the earthquake of October 17, 1939, as having been provisionally in islands of the New Hebrides group in the Pacific Ocean. More precisely, the epicentre was situated in the sea between the islands of Malekula, Ambrim and Pentecost. This is a seismic area particularly liable to deep focus earthquakes, and this shock was no exception, being situated at a depth probably near 100 km.

Royal Academy of the Lincei

The Secretary of the Royal Academy of Italy announces that the Royal Academy of the Lincei has been amalgamated with the Royal Academy of Italy, which has taken over all the activities of the Lincei. As from July 1, 1939, the publications of the Academy of the Lincei will form part of the combined *Atti della Reale Academia d'Italia*, which will be divided into *Rendiconti* and *Memorie* of the class of moral and historical sciences and of the class of physical, mathematical and natural sciences. The publication of the *Notizie degli Scavi* will be continued without interruption by the Italian Academy. The Royal Academy of Italy will be pleased to send its publications to those institutions which received the publications of the Royal Academy of the Lincei under a system of exchange.

Chemical Club

The Chemical Club, 2 Whitehall Court, London, S.W.1, has arranged a series of 'talks' similar to those held at the Club last winter. They will, however, be briefer, and will be held after luncheon in view of the War. The first talk of the season will be given by Mr. James Kewley, chief chemist of the Royal Dutch Shell Group, on Monday, December 11, at 2 o'clock at the Club. The title will be "The Intrusions of Petroleum", and it is expected to deal with the increased range of products being manufactured by the petroleum industry which 'intrude' upon the organic chemical market. At the annual general meeting of the Club on November 14, a resolution was adopted that the facilities of the Club should be thrown open during hostilities, at a nominal subscription, to those temporarily engaged in London on Government work.

Chadwick Public Lectures

In September last it was decided, in consequence of the War, to postpone the Chadwick Public Lectures which were to have been delivered this autumn. The Trustees have now resolved to resume the lectures, and the first lecture is to be delivered on Tuesday, December 12, at 2.30 p.m., at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, W.1, when Sir William Savage is to speak on "The Health Aspects of Canned Foods". The lectures for the spring programme, 1940, will deal generally with public health matters and the War, and will be announced in due course.

National Institute of Sciences of India

At a meeting of the Council of the National Institute of Sciences of India, held on October 6 in the rooms of the Royal Asiatic Society of Bengal, Calcutta, the following were elected fellows of the Institute: *Ordinary Fellows:* Dr. K. Banerjee, reader in physics, University of Dacca; Prof. F. R. Bharucha, professor of botany and head of the Department, Royal Institute of Science, Bombay; Dr. R. N. Ghosh, reader in physics, University of Allahabad; Prof. H. K. Mookerjee, University professor of zoology and head of the Department, University of Calcutta; Prof. V. V. Narlikar, professor of mathematics and head of the Department, Benares Hindu University; Dr. C. G. Pandit, officiating director of the King Institute of Preventive Medicine, Guindy, Madras; Major C. L. Pasricha, professor of pathology and bacteriology, School of Tropical Medicine, Calcutta; Prof. L. Rama Rao, professor of geology, University of Mysore; Dr. M. Sharif, entomologist, Haffkine Institute, Bombay; Dr. K. Venkataraman, director of the University of Bombay Laboratories of Chemical Technology and Textile Chemistry. *Honorary Fellows:* Dr. E. V. Appleton, secretary of the Department of Scientific and Industrial Research of Great Britain; Prof. Charles W. Edmunds, p fessor of pharmacology and therapeutics, Univers of Michigan Medical School; Prof. R. A. Fish Galton professor of eugenics in University Colle London; Prof. Waldemar Lindgren, emeritus p fessor of geology, Massachusetts Institute of Tec nology, whose death on November 3 is announc on p. 970.

Royal Society Officers and Council

The following is a list of those elected as offic and council of the Royal Society at the anniversa meeting held on November 30: *President*, Sir Willi Bragg; *Treasurer*, Prof. T. R. Merton; *Secretari* Prof. A. V. Hill, Prof. A. C. G. Egerton; *Forei Secretary*, Sir Albert Seward; *Other Members Council*, Prof. F. C. Bartlett, Prof. P. G. H. Bosw Prof. F. T. Brooks, Dr. C. G. Darwin, Prof. H. Fox, Dr. H. J. Gough, Dr. A. D. Imms, Prof. C. Ingold, Prof. G. B. Jeffery, Prof. R. T. Leiper, Pr H. S. Raper, Sir Owen Richardson, Prof. E. Rideal, Dr. F. J. W. Roughton, Prof. W. W. Topley, Prof. R. Whiddington.

Announcements

Dr. J. B. Mennell, president of the Section Physical Medicine of the Royal Society of Medici has been awarded a gold key by the American Co gress of Physical Therapy for distinguished resear on physical therapy during the last year.

Dr. Alfred Froehlich, formerly professor pharmacology in the University of Vienna, has be appointed pharmacologist to the May Institute Medical Research of the Jewish Hospital, Cincinna

The name of the National Baby Week Council, body which came into existence during the War 1914–18, is now changed to "National Baby Welfa Council", this name being more commensurate wi the increased scope of work falling to the Counc lot under war conditions. The address of the Nation Baby Welfare Council is 29 Gordon Square, Londo W.C.1.

The Women's Medical Association of New Yo offers a Mary Putnam Jacobi fellowship to a woman doctor, American or foreign, to carry or complete some special problems in medical researc Application should be made by March 1, 1940, the secretary, Dr. Phebe L. Dubois, 150 East 73 Street, New York City.

In his latest quarterly report the Registrar-Gener states that the number of live births in England a Wales during the thirteen weeks ended June 30 w 222 more than in the corresponding quarter of 193 and amounted to an annual birth-rate of 16 p thousand of the population. The number of deat corresponded to an annual rate of 11·7, and t mortality of infants under one year of age to a annual rate of 48, which was 8 below the average the preceding ten second quarters.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 982. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

alysis of Protein by Means of Deuterium-containing Amino-Acids

As is well known, the analysis of amino-acids giving colour reactions is very difficult as most of the thods known lead to inevitable losses. This ficulty can, however, be overcome in the following y.

To the hydrolysed protein, of which the leucine ntent for example is to be determined, is added a own amount of leucine labelled by introduction deuterium in the (C—H) position. After mixing, me leucine is isolated from the mixture by the ual methods.

The next step is the determination of the deuterium ntent of the leucine mixture isolated. Where the otein does not contain leucine, the leucine sample covered should be pure 'heavy' leucine; while m the protein containing normal leucine a mixture 'heavy' and normal leucine is recovered.

From the deuterium content of the leucine mixture lated we can calculate the proportion in which e 'heavy' leucine added is diluted by the leucine iginating from the protein.

The mixture of amino-acids which is the result of e usual acid hydrolysis consists (with the exception glycine) of optically active forms, whereas the ual methods for synthesis of amino-acids containing uterium leads to racemic mixtures. It is necessary erefore, either to perform a resolution of the synetic product into the *d*- and *l*-forms, or to racemize e amino-acid to be estimated in the hydrolysate. e last path, being by far the least expensive, is llowed here.

Deuterium-containing *dl*-leucine was prepared by ating *l*-leucine with 33 per cent sulphuric acid ntaining, say, 7–10 per cent D_2O in a sealed pyrex be to 170° for twenty-four hours[1].

After removal of SO_4^{--} and repeated evaporation the water and re-dissolving in pure water, all uterium in combination with oxygen and nitrogen removed, and a portion of deuterium is left which nnot be removed by boiling water. As the leucine now optically inactive, as was determined in two ses, the stable linked deuterium has obviously tered the molecule during the racemization and linked to the α-carbon. Under the treatment entioned, the destruction of leucine did not exceed o per cent. The determination of the deuterium ntent of combustion water from the leucine is rformed by the gradient-tube method of Linderrõm-Lang[2].

3·0 gm. dry hæmoglobin was hydrolysed and cemized by treatment with 33 per cent sulphuric id in a sealed ampoule at 170°. The hydrolysate s mixed with 0·392 gm. 'heavy' leucine. Sulphuric id was removed, the amino-acid mixture dried and powdered. The powder was extracted with dry propionic acid (method of Przylecki and Kasprzyk) which extracts the hexon bases, proline and part of the leucine. Propionic acid was removed and the leucine isolated as copper salt and purified by recrystallization from water. The excess density of the water formed by combustion of the 'heavy' leucine was 518 parts in a million, that of the leucine mixture isolated 225 parts in a million. The amount of 'heavy' plus normal leucine was:

$$0{\cdot}392 \times \frac{518}{225} = 1{\cdot}262 \text{ gm.}$$

The amount of leucine originally present in the protein was

$$1{\cdot}262 - 0{\cdot}392 = 0{\cdot}870 \text{ gm.},$$

which corresponds to 29 per cent of the hæmoglobin.

A second estimation gave 30 per cent. An estimation of the leucine content of gelatine gave 8·5 per cent.

These results should, of course, be regarded as examples only. It should be possible to adopt the method for a series of amino-acids, for example, alanine, valine, isoleucine and aspartic acid, for which to my knowledge no quite reliable estimation methods are known.

HANS H. USSING.

Laboratory of Zoophysiology,
University of Copenhagen.
Nov. 3.

---

[1] Ussing, H. H., NATURE, 142, 399 (1938).

[2] Linderstrøm-Lang, K., Jacobsen, O., and Johansen, G., *C.R. Lab. Carlsberg* (Sér. Chim.), [illegible], 17 (1930).

A Mucolytic Enzyme in Testis Extracts

WE have recently described a polypeptide, isolated from peptic protein hydrolysates, which is chemotactic to leucocytes and increases the permeability of capillaries[1]. It is probably closely related to Menkin's 'leukotaxine'[2]. As a result of this work we became interested in another permeability-increasing substance, known as the 'spreading factor'[3]. This substance, which is present in large amounts in testis extracts and certain bacterial filtrates, is a protein and is active in dilutions so low as 10^{-8}. It acts by increasing the permeability of the dermal layer of the skin, as demonstrated by the flattening of the wheal and the rapid spread of intradermally injected solutions of dyes, bacterial toxins and particulate matter in suspension.

So far, nothing has been known about the mechanism of the action of the spreading factor. From its properties, it seemed to us likely that it was an enzyme acting on some substrate in the skin, causing the removal of a barrier to the rapid diffusion of intradermally injected fluids. We have therefore examined extracts of testis, purified by the method of Morgan and McClean[4] for the presence of different hydrolytic enzymes. Our purified testis extracts contained 0·3 per cent of dry material which produced marked spreading in dilutions of 10^{-4}.

Though the testicular extracts were found to contain a proteolytic enzyme of cathepsin character, it seemed improbable that the action of spreading factor was proteolytic, since active preparations of crystalline trypsin (kindly supplied to us by Dr. H. Holter and Prof. Linderstrøm-Lang) did not give any reaction characteristic of spreading factor.

Histological evidence of the existence in the skin of a mucin-like inter-fibrillar substance[5] led us to examine the possibility of the enzymatic action of spreading factor solutions on mucins of different origin. We found that the extracts had a remarkable action on synovial fluid, the viscosity of the latter, measured in an Ostwald viscometer, falling to 1/300 of its original value (being then approximately that of water) when 5 c.c. of the fluid was incubated at 37° for 30 minutes with 0·5 c.c. of testicular extract. This effect was found to be due to the action of an enzyme on a polysaccharide in the synovial fluid, with the liberation of reducing substance (see accompanying table). No liberation of reducing substance was found in a control experiment in which synovial fluid was incubated for 18 hours at 37° with heat inactivated spreading factor solution.

AMOUNTS OF REDUCING SUBSTANCE IN γ, EXPRESSED IN GLUCOSE EQUIVALENTS (METHOD OF MILLER AND VAN SLYKE[6]), IN SAMPLES OF 1 C.C., TAKEN AT DIFFERENT TIME INTERVALS FROM 20 C.C. SYNOVIAL FLUID INCUBATED AT 37° WITH 2 C.C. OF TESTICULAR EXTRACT

0 hours	34
½ ,, ...	32
1 ,, ...	65
2 ,, ...	105
4 ,, ...	158
6 ,, ...	192
18 ,, ...	274

With Elson and Morgan's[7] test the reducing substance gave the colour reaction for *N*-acetylglucosamin. Quantitative determinations on 10 c.c. synovial fluid incubated for 18 hours at 37° with 1 c.c. of testicular extract demonstrated the appearance of 245 γ/c.c. of *N*-acetylglucosamin. The control experiment set up under identical conditions with heat inactivated testicular extract gave entirely negative results. The split products obtained by dialysis gave a Bial reaction for glucuronic acid. Furthermore, while synovial mucin is precipitated by dilute acetic acid, forming characteristic strings, synovial fluid after incubation for 30 minutes at 37° with 1/10 of its volume of testicular extract yields very much less precipitate with acetic acid, while after 60 minutes the solution remains clear. Since the enzyme brings about the disappearance of the most characteristic property of synovial mucin, it can be called a mucinase.

Testicular mucinase was found to act also on a polysaccharide present in vitreous humor, the liberation of reducing substance (expressed in glucose equivalents) from 15 c.c. of dialysed vitreous humor incubated for 18 hours with 1·5 c.c. of testicular extract being 71·5 γ/c.c.

Further work is in progress on the properties of the enzyme and its substrates, especially on the relationship of the latter to the polysaccharides from umbilical cord, vitreous humor and synovial flu isolated by Meyer and Palmer[8] and Meyer, Sm and Dawson[8].

Since the properties of the mucinase are identi with those of spreading factor, and since the occurre of spreading factor in bacterial filtrates has so been found to go parallel with their mucinase conte we think it probable that mucinase and spread factor are identical. We are undertaking furt experiments in the hope of being able to prove t point conclusively.

E. CHAIN.
E. S. DUTHIE

Sir William Dunn School of Pathology,
Oxford.
Nov. 4.

---

[1] Duthie and Chain, *Brit. J. Exp. Pathol.*, 20, 417 (1939).

[2] Menkin, *Physiol. Rev.*, 18, 366 (1938).

[3] Hoffman and Duran-Reynalds, *Science*, 72, 508 (1931); McCl *J. Path. and Bact.*, 33, 1045 (1930); 34, 459 (1931). Madinavei *Biochem. J.*, 32, 1806 (1938).

[4] Morgan and McClean, *J. Soc. Chem. Ind.*, 51, 912 (1932).

[5] Bensley, *Anat. Rec.*, 60, 96 (1934). Sylven, *Virchows Arch.*, 280 (1938).

[6] Miller and van Slyke, *J. Biol. Chem.*, 11, 583 (1936).

[7] Elson and Morgan, *Biochem. J.*, 28, 988 (1934).

[8] Meyer and Palmer, *J. Biol. Chem.*, 114, 689 (1936). Meyer, Sm and Dawson, *J. Biol. Chem.*, 128, 319 (1939).

Vitamin A Content of the Livers of a Hundred Healt Dogs

ALTHOUGH under natural conditions largely car vorous in its dietary requirements, the domesticat dog will accept with apparent relish a diet m fitted for an omnivorous or even vegetarian anim Flesh, milk, cereals and vegetables make up the bu of the ration, the proportions of these varying acco ing to the fancy or perhaps the financial circumstan of the owner. Thus the amount of vitamin A ava able to the dog will vary greatly.

Holmes *et al.*[1] found that under the conditic obtaining on a fur farm from which they obtain their material, the vitamin A content of the liver the mink and the racoon was less than that of w specimens of these species. However, they a showed that two wild opossums, captured and fed captivity for six months on a diet of high vitamin value, were able to store the vitamin to a mu higher extent than three wild opossums which h been captured at the same time as the above tv and were destroyed.

Bradfield and Smith[2] found considerable variatio in the vitamin A content of the liver in dogs whi were being fed, under controlled conditions, on equ amounts of vitamin A. Chevalier and Choron[3] show that in 100 guinea pigs fed on the same diet, var tions occurred in the vitamin A content of the li of from 5–10 blue units per gram to 300 blue un per gram. Simmonet *et al.*[4] found considerable var tions in the vitamin A reserve of the liver of clinically normal dogs.

That the liver of newborn puppies contains lit vitamin A reserve was shown by Busson and Si monet[5], who found their liver to be inactive ev when that of the dam contained an ample store.

The dogs used for the present work were unwant dogs, which had been destroyed by coal gas poisoni They were not bled. The histories of these anim were not obtained. They were probably all city do and were presumed to be healthy.

Technique. A piece of liver was removed within a w hours after death, placed in cold storage over- ght, and on the following day 5 gm. was weighed it in duplicate, minced with scissors, 15 c.c. of per cent caustic potash added, and kept in cold ore if not being dealt with immediately.

The vitamin was extracted according to the method Davies[6]. The unsaponifiable portion was dissolved 10 c.c. of chloroform, and the blue units determined the use of a Lovibond tintometer. In the large ajority of cases, an amount of the chloroform lution was taken such as would give a reading of ue units between 3 and 6, but readings slightly yond this range were used as the basis for cal- lating the results in a minority of cases.

Results. Great variation in the liver reserve of gs has been found to occur. Whether this is sociated with the amount of vitamin available in e food, or with the ability to absorb and store it the liver, is not here indicated. The average of ese reserves was found to be 678 B.U./gm., but, as inted out by Moore[7], the average figure may be isleading owing to the wide variations, and the edial figure is a more reliable one to take as an dication of a standard. The medial figure in our ries (taking an average of the six central figures) 153·5 B.U./gm.

The exact age of these dogs was not known. Six nich were only a few months old gave values 9, 10, , 47, 62 and 70 respectively. At the other extreme life, greater variation in the vitamin store appeared occur. In seven old dogs the values were 26, 36, 3, 171, 206, 340, 1125.

In twenty-three lean or poor-conditioned dogs, the erage vitamin A content was 415·8 B.U./gm., with range of from 11 to 2800, and in three very fat gs the figures were 8, 171, 447. From these limited ta there does not appear to be an association tween the vitamin A reserve and the body condition the dog.

Moore[7] showed that in the rat a condition of treme emaciation did not necessarily lead to a minution of the vitamin A reserves of the liver, d one of us (R. G. L.) found large reserves in the ers of hens and geese that had been starved to ath by their owner.

R. G. LINTON.
A. BROWNLEE.

oyal (Dick) Veterinary College,
Edinburgh.

olmes, A. D., Tripp, F., and Satterfield, G. H., *Amer. J. Physiol.*, 123, 693 (1938).
radfield, D., and Smith, M. C., *Amer. J. Physiol.*, 124, 168 (1938).
hevalier, A., and Choron, Y., *C.R. Soc. Biol.*, 120, 1223 (1935).
imonnet, H., Busson, A., and Asselin, L., *C.R. Soc. Biol.*, 109, 358 (1932).
usson, A., and Simonnet, H., *C.R. Soc. Biol.*, 109, 1253 (1932)
avies, A. W., *Biochem. J.*, 27, 1770 (1933).
oore, T., *Lancet*, ii, 669 (Sept. 24, 1932).

Monogenic Broods in *Armadillidium vulgare* Latr.

VANDEL[1] has found that in the woodlouse, *Tri- oniscus provisorius*, there occur both amphogenic oods (broods containing approximately equal mbers of both sexes) and monogenic broods oods consisting of one sex only or very nearly so). e accounts for the occurrence of arrhenogenic oods (broods consisting of males only) and thely- nic broods (broods containing only females) by suggesting that in woodlice the female is the heterozygous sex (chromosomes XY) and that the segregation of the sex chromosomes in monogenic females is controlled by the cytoplasm. Thus in arrhenogenic females every egg receives an X chromosome and the Y chromosome always passes into the first polar body. Such a female, therefore, produces broods containing only males.

One of the main arguments for accounting for monogenic broods in this way is that the male has no effect on the type of brood produced. Vandel's evidence for the male having no effect on the type of brood produced is that in several cases all the females of any one brood mated with either 'ordinary' males (from amphogenic broods) or with 'exclusive' males (from arrhenogenic broods) produced either all arrhenogenic or all thelygenic broods. Sister females thus resembled each other in producing the same type of monogenic brood no matter what type of male they were mated with.

Amphogenic and monogenic broods have also been found in the woodlouse *Armadillidium vulgare* Latr. by Howard[2] and Vandel[3]. By mating males of *Armadillidium* to two or more females I have also been able to show that the male has probably no effect on the type of brood produced. The same male mated to two different females may produce both arrhenogenic and thelygenic broods or both amphogenic and monogenic broods. The data are given in the table.

Parents of brood		Constitution of brood	
Male	Female	Males	Females
B	*A*	1	36
B	*AB*	22	9
AM	*AB*	34	8
AM	*AJ*	6	50
AL	*CB*	1	37
AL	*CC*	0	25
AL	*CD*	64	0
AN	*BK*	45	0
AN	*U*	0	56
SB	*DA*	0	30
SB	*EA*	46	47

It seems, therefore, very probable that it is the female which determines the type of brood produced. It has also been possible by using different genetical types to show that neither arrhenogenic nor thelygenic broods are due to parthenogenesis.

The above data also have another interest. The three females, *CB*, *CC*, and *CD*, are all from the same brood. One brood may, therefore, contain both arrhenogenic and thelygenic daughters. Also female *BK*, parent of an arrhenogenic brood, was a daughter of a thelygenic female (female *A* in the table). Such facts will have to be considered in suggesting schemes for the inheritance of arrhenogeny and thelygeny. It seems possible that while the male has no effect on the sex ratio in a brood, he does have an effect in determining the types of females produced.

H. W. HOWARD.

School of Agriculture,
Cambridge.
Nov. 15.

[1] Vandel, A., *Bull. Biol. France et Belg.*, 72, 147–86 (1938).
[2] Howard, H. W., NATURE, 142, 1038 (1938).
[3] Vandel, A., *C.R.*, 208, 1050–52 (1939).

Hypertensin: the Substance Causing Renal Hypertension

AN increase in blood pressure is produced by compression of the renal artery[1] or by injection of the venous blood of the kidneys[2]. The filtrate obtained after adding 3 vol. of acetone to the serum of this blood contains a pressor substance which is insoluble in ether and amyl alcohol, soluble in glacial acetic acid and is destroyed only after three hours boiling in normal hydrochloric acid. The same substance is formed on incubating for fifteen minutes at 37° the kidney protein renin[3] with blood serum or its pseudo-globulin fraction. This substance, which we name hypertensin, is different from adrenalin, tyramin, pitressin and urohypertensin. Renin appears to be a proteolitic enzyme of the papain type, which liberates hypertensin from a blood protein belonging to the pseudo-globulin fraction.

J. M. MUÑOZ.
E. BRAUN-MENÉNDEZ.
J. C. FASCIOLO.
L. F. LELOIR.

Instituto de Fisiologia,
Buenos Aires.

[1] Goldblatt, H., Lynch, J., Hanzal, R. F., and Summerville, W. W., *J. Exp. Med.*, 59, 347 (1934).

[2] Houssay, B. A., and Fasciolo, J. C., *Bol. Acad. Nac. Med. Buenos Aires*, 34 (Sept. 1937); *Rev. Soc. Argent. Biol.*, 13, 284 (1937), *C.R. Soc. Biol.*, 127, 147 (1938). Braun-Menéndez, E., and Fasciolo, J. C., *Rev. Soc. Argent. Biol.*, 15, No. 4, 161 (1939).

[3] Tigerstedt, R., and Bergman, P. G., *Skand. Arch. Phys.*, 8, 223 (1898). Hessel, G., *Klin. Woch.*, 17, 843 (1938). Helmer, O. M., and Page, I. H., *J. Biol. Chem.*, 127, 757 (1939). Pickering, G. W., and Prinzmetal, M., *Clin. Sci.*, 3, 211 (1938).

Relation of the Nucleolus to Secondary Constrictions

IN discussing the relation of the nucleolus with the *SAT* chromosomes, investigators do not appear to notice that the 'constriction' is probably *due* to the nucleolus, rather than an active producer of that body[1]. I imagine the chromosome in a close spiral. The nucleolus develops at a definite point in the chromosome and pushes the spirals apart until that part of the chromosome becomes a straight thread and apparently much thinner than the remainder of the chromosome. When the *SAT* chromosome in Navashin's Crepis[2] was not able to develop a nucleolus because the nucleolar material had already been removed by another chromosome, it had no satellite either. The darkly staining portions just below the thin stalk in McClintock's Zea chromosomes[3] could also be explained by the spirals beyond the nucleolus being pushed more closely together.

That a nucleolus can interfere mechanically with a chromosome is seen clearly in the salivary glands of Chironomus, the chromosomes in which often have enormous nucleoli. Here the usually fused homologues are seen to be separated in the region of the fused nucleoli and the chromatin of each homologue also is often much dispersed[4,5].

A. M. MELLAND.

Department of Zoology,
University of Cambridge.

Nov. 14.

[1] Gates, R. R., NATURE, 144, 794 (1939).

[2] Navashin, *Cytol.*, 169 (1934).

[3] McClintock, B., *Zeit. Zell. und Mikr. Anat.*, 21, 294 (1934).

[4] Metz, C. W., and Poulson, D. F., *J. Morph.*, 63, No 2, 363 (1938).

[5] Melland, A. M., unpublished.

IT is true, as Miss Melland states, that the nucleo
as it grows can interfere mechanically with t
structure of a chromosome. It can, for examp
stretch the filament which connects the satellite w
the body of the chromosome. This is done by
spiralizing the filament. Nevertheless the filame
appears to be a spiral of a lower order than the spi
chromonemata which make up the body of t
chromosome. It is already present in anaphe
chromosomes before the nucleolus begins to appe
The same is true of secondary constrictions whi
give rise to nucleoli. These features of chromoso
structure are for this and other reasons not produc
by the growing nucleolus merely pushing the gy
of the spiral chromonema apart.

It is not possible to discuss the subject more
detail here. A series of papers are now in the pr
dealing with nucleolar production in a number
plant genera. The conditions vary in some respe
from genus to genus, but there is evidence of vari
kinds that the nucleolar secondary constrictions
well as the nucleolar body in a *SAT* chromosome
definite loci of the chromosome, and that the secon
ary constrictions are already determined before t
nucleolus begins to appear in telophase.

R. RUGGLES GATES.

King's College, London,
at the University, Bristol.

Nov. 17.

Calcium in Ciliary and Muscular Movement

IT is interesting to note that the *unbalance* obtain
by reducing the calcium content of physiologi
solutions can to some extent be offset by the additi
of small quantities of lipoids to the solution. Th
frog heart rendered hypodynamic, or even arreste
by Ringer solution less varying amounts of calciu
chloride, can be made to beat normally again
adding small quantities of sodium oleate, of sodiu
palmitate, of impure lecithin, or of ox blood thromb
to the Ringer, the *p*H being maintained unaltere
The effect was not observed with very pure lecith
or very pure kephalin, but a similar effect w
obtained with lyso-lecithin, which first reduces t
beat and also contracts the heart. Similarly, Cla
and others[1] have shown that frog heart render
hypodynamic by prolonged beating in Ringer soluti
shows increased activity when given extra calciu
sodium oleate, impure but not pure lecithin, impu
but not pure kephalin, or serum. Ox blood thromb
serum, and all but the purest samples of phospholip
contain traces of soaps which may well account
the activity of these substances in offsetting calciu
deficiency. Mytilus cilia will beat for some time
artificial sea water at *p*H 6·5, but are quickly arrest
if they are put in a similar medium at the same
without calcium (removed as chloride)[2]. The cilia
beat is restored in such a calcium-free solution
the same *p*H if traces of one of the following su
stances are added: sodium dodecyl sulphate (t
magnesium present rendered the oleate and palmite
of sodium insoluble and therefore ineffective), hex
decyl-trimethyl-ammonium bromide, lyso-lecithin, i
pure lecithin, or ox blood thrombin. Triolein, sodiu
butyrate and sodium glycerophosphate showed
restorative effect. In considering these facts, it shou
be noted that calcium is found to be more acti
under lipoid than under protein monolayers.

Heilbrunn[3] maintains that at least in some typ cells stimulation causes a liquefaction of the gel- e cell cortex with release of calcium, some of which transferred to the cell interior, which ultimately ates or clots by a process similar to the clotting blood. Fat-solvent anæsthetics favour release of cium from the cortical plasmagel but prevent ernal clotting. Plasmagel is formed by a clotting- e reaction from plasmasol, and Heilbrunn calls this cess the 'surface precipitation reaction'. Mitosis l fertilization are processes fundamentally akin to itation, according to Heilbrunn, who says that y involve liquefaction of the plasmagel and a sequent clotting of the plasmasol which only omes fluid again at the first appearance of the ndle. Needles dipped in serum are more active producing parthenogenesis than those undipped[2]. rombin accelerates mitosis in tissue culture[3], and arin inhibits it[3]. Heparin at 1 : 100,000 also ibits the formation of fertilization membranes in hinus eggs[4]. The similarity of the effects of ion- ance on muscular, ciliary, and amœboid move- nt are well known[5]; calcium is released during scular activity[3] and at the tip of an advancing œboid pseudopod[6]; and most modern authors ee that gelation and solation are primarily re- nsible for amœboid movement.

t is submitted that the observations recorded ve are essentially in agreement with the hypo- sis of Heilbrunn that has just been discussed, and gest that it can be extended to ciliary movement. ther studies of ion balance in the cases of living ues and of inanimate lipo-protein systems are essary if these suggestions are to be followed up.

eilbrunn[3] also points out that many partheno- etic agents cytolyse Echinus eggs by destroying iquefying the plasmogel cortex of the egg, and also ate the cell interior when used at higher con- trations than those required for normal partheno- esis. Thus an agent that stimulates at low con- trations cytolyses at higher concentrations. A allel to this is the action of stronger solutions of ium dodecyl sulphate, of hexadecyl-trimethyl- monium bromide, or of lysolecithin on Mytilus cilia, e the arrested cilia first start to beat and continue beat in calcium-free solutions for some time after olysis has all but destroyed the form of the in- idual cilia.

he cytolysis by sodium dodecyl sulphate and by xadecyl- methyl- monium mide sug- s that the ry surface rgely lipoid ature[7]. It also been nd that pro- monolayer orbents or persants, h as sub- uted 4-4′-dihydroxy diphenyl or stilbene com- nds which affect protein films at 1 : 2,000,000[7] tannic acids, do not affect the beat of Mytilus at low concentrations. The cilia are relat- y insensitive to cytolysis by saponin or by ra venom; the former penetrates films of ain sterols[8] and the latter releases lyso-lecithin n lecithin by lecithinase action, and lyso-lecithin lf has been found to cytolyse the cilia. Similarly Paramecia are affected by both lipoid and protein film adsorbants[7].

These facts suggest that all cells which show movement have some lipoid constituents in their surfaces, that the movement normally requires calcium, and that calcium lack can be offset by external supplies of certain lipoids. If Heilbrunn's suggestions are correct, cytolysis and stimulation liquefy the cell membrane and liberate calcium, which coagulates the cell interior by a process related to the clotting of blood. A study of ion balance in lipo-protein systems and of the role of lipoids in muscular action should help elucidate the problem.

G. S. CARTER.
O. GATTY.
J. H. SCHULMAN.
H. WALSTON.

Department of Zoology,
Department of Colloid Science,
Department of Pathology,
Cambridge.

[1] Clark, A. J., "The Metabolism of Frog Heart". Oliver and Boyd, p. 96 (1938).

[2] Gray, J., *Proc. Roy. Soc.*, B, 93, 115 (1922).

[3] Heilbrunn, L., "An Outline of General Physiology". Saunders (1937).

[4] Tennet, *Amer. Naturalist*, 72, 97 (1938).

[5] Gray, J., "Experimental Cytology". Cambridge (1931).

[6] Pollack, J., *J. Gen. Physiol.*, 11, 539 (1928).

[7] Schulman, J., and Rideal, E. K., NATURE, 144, 100 (1939).

[8] Schulman, J., and Rideal, E. K., *Proc. Roy. Soc.*, B, 122, 29 (1937).

Spectrum of the Torch Discharge

THE so-called 'torch discharge'[1] (*Flammenbogen*[2]) in air, which can be created at a single electrode in the ultra high-frequency undamped oscillation circuit ($10^7 \sim 10^8$ Hz.), has been the subject of some investigations, but the main interest has been directed towards its chemical aspect; no attempts seem to have been made to study its spectrum. With the view of gaining an insight into the mechanism of the discharge, we have carried out an extensive examination of the spectrum.

In the flame part of the discharge, the spectrum consists chiefly of the O_2 (Runge), NO(γ) and OH bands, while in the neighbourhood of the electrode the N_2 and N_2^+ bands, as well as some easily excitable lines of the electrode material, come out with strong intensity. From all portions of the flame a continuous band extending from about 6000 A. up to the red end is emitted; its origin is unknown, but one may be able to infer fresh interpretation as to the mechanism of the chemical reactions going on in the discharge. With increasing current density NH (*Q* branch of the 3360 band) also makes its appearance, and the metallic lines of low excitation potentials

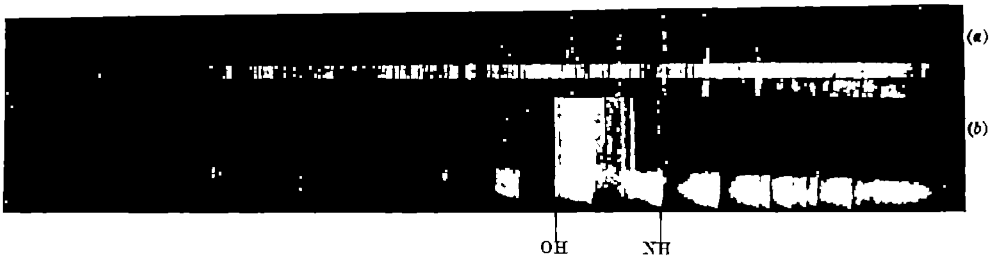


Fig. 1.

extend into the flame (Fig. 1*a*). The spectrogram of the pure oxygen band, which is obtained in the torch flame in oxygen at atmospheric pressure, is reproduced in Fig. 1*b*.

If the torch is struck in a closed vessel containing air, the absorption bands due to NO_2 appear in the visible and near ultra-violet region, and the NO (0,0), (1,0) bands become 'self-reversed'.

It is to be noted that the torch spectrum is found to be essentially the same as that of the high-tension D.C. arc[3] (*stromstarke Glimmentladung*[4]), so that, so far as the nature of the spectrum is concerned, no features distinctively characteristic of the ultra high-frequency oscillations can be detected.

A complete analysis of the Runge band will be published elsewhere.

YOSHIHIRO ASAMI.
TAKEO HORI.

Laboratories of Physics and
Electrical Engineering,
Hokkaido Imperial University,
Sapporo. Aug. 28.

---

[1] Mochalov, *C.R. Acad. Sci. U.R.S.S.*, 18, 329 (1938); 20, 297 (1938).

[2] Rohde and Schwarz, *Z. Phys.*, 85, 161 (1933).

[3] Grotrian and Runge, *Phys. Z.*, 15, 545 (1914).

[4] Thoma and Heer, *Z. tech. Phys.*, 13, 464 (1932).

Comparing Resistances of Four-Terminal Resistors

Two communications regarding the comparison of four-terminal resistances, the first by Mr. Arvon Glynne and a further one by Prof. John Dowling, have recently appeared[1] in NATURE.

I would like to point out that the method describ by Mr. Glynne is already well known and will found in Law's "Electrical Measurements", publish by the McGraw-Hill Book Company, first editic 1917, on p. 190, where the identical formula is giv

There is considerable practical difficulty in app ing this method, first owing to the presence of therm electric effects at the terminals, which are usua different for each position of the galvanometer, a secondly, owing to the dependence on the constan of the connexion between the two resistances unc test. In order to obtain accurate comparisons, would be necessary to compensate for the therm electric effects and to make the change-over fr position one to position two with great rapidity. T cannot easily be done when the resistance *B* has be altered for the two balances.

To overcome these difficulties, I modified t method[2], and the complete instrument was exhibit at the Physical Society in January 1938. This meth has been in continual use for precision comparis since then, with the addition of a circuit for co pensation for thermal E.M.F.'s at the terminals. T compensating circuit avoids the use of two zeros the galvanometer—one for each balance.

D. C. GALL

H. Tinsley and Co.,
Werndee Hall,
South Norwood,
London, S.E.25.

---

[1] NATURE, 144, 595 and 865 (1939).

[2] *J. Sci. Instr.*, 15, No. 7 (July 1938)

Points from Foregoing Letters

HANS H. USSING describes a method of analysing protein by means of amino-acids containing deuterium. The author claims that the method overcomes the difficulty met with in most types of amino-acid analysis, which usually lead to inevitable losses and are therefore only approximate. He also suggests that his method can be used for such an amino-acid series as alanine, valine, isoleucine and aspartic acid, for which no very reliable methods of estimation are at present known.

E. Chain and E. S. Duthie report on an enzyme occurring in purified 'spreading factor' extracts from testis hydrolysing rapidly a polysaccharide in synovial mucin with liberation of reducing sugars. A large and rapid decrease in viscosity occurs during the early stages of hydrolysis and the mucin becomes non-precipitable by dilute acetic acid. The possible identity of this enzyme with 'spreading factor' is discussed.

The vitamin A content of the liver of a hundred presumably healthy dogs was found by R. G. Linton and A. Brownlee to average 678 'blue units' per gram of liver tissue, with a medial figure of 153·5 and a range of 4·5 to 19,625.

In *Armadillidium vulgare* Latr. there are found broods consisting of one sex only. H. W. Howard finds that the male parent probably has no effect in determining the type of brood produced. This supports Vandel's theory that the segregation of sex chromosomes is determined by the cytoplasm of the female.

J. M. Muñoz, E. Braun-Menéndez, J. C. Fasciolo and L. F. Leloir report that renal hypertension is caused by the formation of 'hypertensin', a substai which is different from other known pressor su stances. It has been found in venous blood ischæmic kidneys and can be prepared *in vitro* by t interaction of renin and pseudo-globulins of norm serum.

A. M. Melland stresses the probability of t nucleolus *producing* the secondary constriction in chromosome, rather than the nucleolus *arising* fr that constriction. R. Ruggles Gates, commenting this letter, points out that while the growi nucleolus can separate the gyres of a chromoso spiral, yet the nucleolus takes its origin at a p determined locus of the chromosome whether t latter has a satellite or a secondary constriction.

The unbalance obtained by reducing the calci content of physiological solutions can to some exte be offset by the addition of small quantities of lipo to the solution in the case of the beating of fi heart and of Mytilus cilia. According to G. S. Car *et al.*, the use of adsorbants and dispersants of prot film and of lipoid film suggests that ciliary a muscular cell membranes have some lipoid c stituents on their outer sides. It seems that the r of lipoids in questions both of ion balance and muscular activity needs investigation. The data not inconsistent with the hypotheses of Heilbru concerning mitosis and excitability.

D. C. Gall gives an earlier reference and comme upon a method of comparing four-terminal resistanc recently described. Attention is also directed to improved method.

RESEARCH ITEMS

gan Colour-Vision

ATA of colour-vision among Polynesian Tongans re collected by Ernest and Pearl Beaglehole in the urse of a field trip to Tonga, employing the Ishihara s (seventh edition). Results are recorded in *Man* November 1939. 135 Tongans were examined ale, 67; female, 68). Five males appeared to be l-green blind; but no case of female red-green ndness was detected. No cases of blue-yellow ndness, or of complete colour-blindness, were ected in either sex. A comparison of the per- tage of red-green blindness in Tongan males (7·46) h comparable results in Whites (8·03), American groes (3·7), American Indians (1·7), taken in con- ction with the weight of evidence from all test ults available, suggests a possible racial difference he incidence in males of red-green colour-blindness. the five Tongan males with defective colour vision, were completely green-blind. The proportion of en-blindness to red-blindness among Whites, groes, and American Indians as reported is also the approximate ratio of three to one. Another uliarity in Tongan subjects is the response of tain of them in the test to plates which can scarcely read by normal subjects. These Tongans (10 male, female) were otherwise normal. In regard to eral colour discrimination a number of colour- mes were collected—cream-white, skin-white, low or gold, yellow, red, black. There is no cific colour-name for blue, nor possibly for green her. Many descriptive colour-names are in use, as example, colour-sea = blue; obscure, indistinct = wn; *kupesi*, stencil for marking bark cloth = dark wn; *loufusi*, banana leaf = deep green. Degree saturation is expressed by such qualifying words *mama*, light, *fakapo' opouli*, dark. The absence of tain terms, for example, for blue, does not imply oor colour discrimination, but is due to a difficulty finding words to describe them, and arises from a tural origin.

nee Archæology

N planning the work of the Nebraska Archæological rvey established in 1929, Dr. W. D. Strong sug- sted a line of attack which would establish a time uence from known historic to unknown prehistoric. e Pawnee for various reasons offered the most suit- le material for the first systematic attempt at lating a historic archæological complex in Nebraska. ring the nineteenth century, with two or three parent exceptions, Pawnee villages centred about confluence of the Loup with the Platte River, nding on terraces or second bottoms well out of ch of the floods. Beyond the tree-fringed water- urses are the dry, formerly grass-covered uplands table only for hunting; but it was the fertile er-bottoms, with abundance of wood, water, arable und and shelter, which determined the location their villages. The extreme limits of Pawnee tlement were on a 120-mile stretch of river valley, ng which they shifted continually, but leaving it y for seasonal hunting. The sites show a somewhat adent aboriginal culture, yielding also iron, copper, ss and glassware. Within this area but with more ited distribution are found sites with a more abundant, superior culture and smaller quantities of white contact material. Generally the sites are large (50–100 acres or more), compact and selected with an eye to defence, some having earth-walls and ditches for protection. Excavation on these proto-historic sites has produced evidence which has been assigned to a 'Lower Loup focus', while another culture, possibly contemporary, has been revealed at Leary in south-west Nebraska, to which the name Oneota culture has been given. The relations of Lower Loup, Oneota and historic Pawnee have been discussed by Waldo R. Wedel (*Smithsonian Misc. Collect.*, 97, 7; 1938) in the light of analysis of material culture and examination of the documentary evidence of early travellers. By some it is maintained that Lower Loup is more closely related to Oneota than to historic Pawnee, but analysis of cultural traits points to the closer relation of Lower Loup and historic Pawnee, the probability that the former is ancestral to the latter, after a period of decadence, being rendered stronger by the absence of any evidence that settlements, of the size and importance indicated by the sites, were made here by a sedentary, horticultural people other than the Pawnee since the arrival of Europeans.

The House-Sparrow in Canada

THE house-sparrow (*Passer domesticus*) has been long established in Canada, and a recent investigation by Richard Lee Weaver suggests that it reached its peak of abundance several decades ago, and since then has in some parts declined in numbers (*Canadian Field-Nat.*, 53, 95; October 1939). In general, the northern limit appears to be determined by the limit of systematic cultivation, although occasional colonies persist beyond that boundary in the neighbourhood of settlements. Occasionally, too, specially favourable conditions induce a northward movement, such as established the birds at Churchill, on Hudson Bay, but in such cases the severe winters cause many deaths, and at Churchill the danger of extermination is circumvented only because the sparrows inhabit in winter the railroad roundhouse, where they get shelter and food from man. The change in locomotion from the horse-traffic of early days to the motor-car has made extraordinary differences in the sparrow population in towns, for the hordes of sparrows which once, according to a note by the Ornithological Editor, made sidewalks unusable and in another way interfered with church services, have disappeared with the disappearance of horses and the droppings which formed a main food supply in winter.

Reproduction of the Spotted Hyæna

SOME unestablished peculiarity about the sexual anatomy and physiology of the spotted hyæna (*Crocuta crocuta*) led writers of antiquity to assert that it was hermaphrodite. Scientific study of the subject has been meagre, but this statement no longer holds good in view of the investigation of L. Harrison Matthews, who travelled to East Africa to study the animal and records the results of the examination of 103 individuals (*Phil. Trans. Roy. Soc. Lond.*, Ser. B, No. 565, 230, July 1939). This random sample had a sex ratio of 61·1 per cent of males. The anatomical puzzle arose from the peculiarity of the female genitalia, which possess a clitoris, perforated by the urinogenital canal, so similar to the penis of the male that male and non-parous females are indistinguishable externally. There is no annual breeding season for the female in Tanganyika Territory, all stages of sexual activity being found at the same time. In the absence of fertilization, a dicestrous cycle of about a fortnight occurs. Following fertilization, gestation lasts about 110 days, the lactation period extends over six months, and the complete sexual cycle lasts nearly a year. The author suggests that the peculiar male facies of the female may be produced by an excess of androgenic substances, accompanied probably by a deficiency of œstrogenic ones, derived from the ovary. The limit of life of the spotted hyæna appears to be about ten years.

Choice of Water by the Honey Bee

C. G. BUTLER of the Rothamsted Experimental Station has described the habit of bees collecting water from many undesirable sources that are often choked with decaying organic matter (*Bee World*, November 1939). It seemed, therefore, of interest and importance to discover what attracts bees to such sources of water. In his experiments most of the salts essential to animal life were tested in various concentrations against distilled water. Only in the case of very dilute sodium chloride and ammonium chloride were the bees attracted more than to distilled water. The optimum concentration was between 0·15 per cent and 0·07 per cent; with progressively stronger solutions the bees showed increasing preference for distilled water. Rain water, from a leaf-choked gutter, was next taken and tested against distilled water and the salt solutions. More than 90 per cent of the bees chose the rain water. Further experiments showed that bees were being attracted to this source of water by smell alone, and that their liking for very dilute salt solutions has little or nothing to do with their finding a source of drinking water. It is suggested that it is best to fill apiary drinking fountains with rain water to which is added sufficient sodium chloride to make it into a 0·1 per cent solution.

Water Movement and Radial Growth in Trees

W. R. C. HANDLEY has recently published some observations on the effect of prolonged chilling on these processes (*Ann. Bot.*, N.S., 3, No. 12, 803; 1939). By subjecting woody shoots of young saplings of ash and sycamore to continuous cooling to 2° C. during the season of growth, radial growth was almost completely inhibited, though not extension growth (which was, however, later in starting and proceeded more slowly). When cooling was extended to 0° C., leaf-wilt occurred owing to still further reduction in water conduction. Turgidity recovered on raising the temperature again to 2° C.

Wound Hormones in Plants

J. English, J. Bonner and A. J. Haagen-Smit (*Proc. Nat. Acad. Sci.*, 25, 323–329; 1939) have isolated a crystalline substance of composition $C_{12}H_{20}O_4$ which is capable of inducing renewed cell division and cell extension in parenchymatous cells. This substance was isolated from fresh bean pods. The activity of the substance is about a hundred times that of the original material, but this varies considerably. This variation is probably due to the fluctuation in the amount of co-factors in the t material. Such co-factors have been identified dur the chemical preparation, while sucrose and glutar acid were found to increase greatly the activity the di-basic acid $C_{12}H_{20}O_4$.

Aphid Vectors of Sugar-cane Mosaic

THE aphid *Aphis maidis* has been recognized fo considerable time as a transmitting agent the sugar-cane mosaic virus. H. D. Tate a S. R. Vandenberg have shown, however (*J. Ag Res.*, 59, No. 1, 73–80, July 1939), that two ot aphids, *Carolinaia cyperi* and *Hysteroneura setar* which may occur on the crop in Porto Rico, are a vectors of this particular disease. These inse inhabit the weeds *Cyperus rotundifolia* and *Eleus indica* (goosegrass), which are common in sugar-ca plantations, and doubtless play a considerable p in the spread of mosaic under field conditions. fourth kind of aphid, *Sipha flava*, was unable transmit the virus. The results supply yet anot instance of the close relation between a virus and insect vector.

Indirect Damage by Narcissus Leaf Diseases

RESULTS of several recent investigations into damage caused by fungi the general attack of whi upon their host plants appears to be slight ha often revealed more extensive indirect damage. Su a state of affairs has now been demonstrated P. H. Gregory for several leaf diseases of the narcis ("R.H.S. Daffodil Year Book", pp. 49–53, 193 Leaf scorch, caused by the fungus *Stagonosp Curtisii*, white mould, which results from the paras *Ramularia vallisumbrosæ*, grey mould (*Botrytis n cissicola*) and fire (*Sclerotinia polyblastis*) are wi spread in the commercial bulb districts of the sou west of England; but it is not certain whether th invariably cause substantial loss of the crop. Gregory has shown that their indirect effects, at a rate, are quite substantial. The leaf spotting fu spread upon the foliage after the time of floweri and often curtail photosynthesis, so that subsequ flower crops are affected. Spraying the foliage w Bordeaux mixture resulted in increased bulb weig enhanced flower quality, and, most important of considerably greater flower crop. Gains in flo production as high as 70 per cent over unspra foliage have, in fact, been recorded. Further measu of plant hygiene, such as the removal of infec foliage and flowers, are recommended, whilst rout lifting and replanting of the bulbs usually era cates the diseases if fresh foliar infection does occur.

Structure of Complex Fluorides

AMONG compounds of the type R_2MX_6 (R = NH_4; M = Si, Ge, Sn, Ti, Zr, Mn) only the fl silicates have been prepared in crystalline modifi tions possessing the fluorite-like arrangement of and MF_6^{--} ions known as the ammonium chlo platinate type. J. L. Hoard and W. B. Vinc (*J. Amer. Chem. Soc.*, 61, 2849; 1939) have examin by the X-rays the atomic arrangement in crystals ammonium and potassium fluogermanates. T crystals possess one-molecule hexagonal units structure, and the crystal structure is an aggreg of univalent cations (K^+, NH_4^+) and nearly regu octahedral anions (GeF_6^{-2}) with Ge – F = 1·77 Each cation is surrounded by nine nearly equidist rine atoms and three others at somewhat greater tances. The structure is of the same general type that of the hexagonal modification of ammonium silicate; it is found only in the case of complex rides, for which at ordinary temperature it is ally preferred to the cubic ammonium chloro- tinate structural type.

ucture of Water in Ionic Solutions

HE effect of the presence of ions on the structure water molecules has long been the subject of estigation and discussion. In a recent article *Chem. Phys.*, 10, 869; 1939), G. W. Stewart orts data on the variation of the X-ray diffraction tern of water with concentration of dissolved ctrolytes (NH_4Cl, LiCl, NaCl, KCl, and $MgCl_2$), and ws the following direct conclusions from a con- ration of the displacements of the major and or diffraction peaks: (i) the increase in con- tration of ions causes the amount of 4-co-ordinated ter structure to decrease and produces a more sely-packed arrangement, with a consequent rease in density; (ii) the effect of the ion on the ter structure is not confined to that shell imme- tely adjacent to the ion; and (iii) the alteration structure is apparently similar to that produced by reasing the temperature of water. Further, from asurements on the alteration of the minor dif- ction peak by fifteen strong electrolytes, selected ause of their wide variation in type and in arent molal ionic volume, he shows that the liquid ucture of water varies with ionic concentration at ate comparable with the rate of variation of the arent molal ionic volume. It seems, in fact, that alteration in liquid structure has an effect on the arent molal ionic volume much more important n has the electrostatic effect based on the Debye- ckel theory. On the basis of these interesting data author draws a picture of the solvent and its ration in density by the ion solute which agrees h the conception of Bernal and Fowler (*ibid.*, 1, ; 1933). Water at temperatures just above the lting point has a co-ordination number greater than t in ice, and the packing is correspondingly closer the liquid. This difference explains the latent heat fusion, and the increase in density of water on lting. The structure of liquid water is not rigid, in a crystal, and the relation of any molecule to neighbours is constantly changing. Co-ordination ds are broken and re-made. The water is homo- eous only if a representative group of molecules is sidered. The effect of ions is not to contract the ucture but to increase the co-ordination number, l thus change the closeness of packing.

llar Structure and Stellar Energy

N interesting paper with the above title has been blished by W. H. McCrea (*Occas. Notes, Roy. Astro.* ., No. 6; October 1939). He gives a short summary the present position on attempts to utilize known ysical laws to explain the mechanism of energy- eration responsible for the maintenance of stellar inosity. The problem is to discover a mechanism energy-generation that will be consistent with the ysical conditions prevailing in the star. The blem of stellar structure can be stated in its erality as follows: given in some region of space quantity of matter of known chemical composition l given its initial physical state, what will be its sequent history? The problem would be soluble in principle if the physicist knew how the material components can interact with each other and with radiation, including the various ways in which the interaction could generate energy. The following points seem to be fairly well established. In the brighter stars of the main sequence, the energy-generation is provided by the formation of helium from hydrogen, and these stars have a large hydrogen content, their central temperatures being about 20 million degrees. While there is no evidence that the synthesis of heavier nuclei in stars occurs, it is certain that some of these nuclei have an essential role as catalysts in the synthesis of helium. Stars of the main sequence, the masses of which are not too great, ultimately contract and become white dwarfs. The giant stars present a difficulty if, as is predicted by the theory of stellar structure, they have relatively low central densities and temperatures. Gamow's suggestion of processes in which there is resonance between an energy level of a nucleus and the energy of a penetrating particle has not been substantiated, and it seems certain that there is an essential distinction between the structure or mode of energy-generation or both in the giants and main-sequence stars. Among the problems awaiting solution are the ultimate fate of massive stars, the mechanism of energy-production in giants, and the origin of heavier nuclei in stellar material.

Sunspots and Magnetic Disturbances

H. G. ARCHENHOLD has recently published a paper on the influence of the variability of the mean latitude of sunspots on the recurrence tendency of magnetic disturbances (*Mon. Not. Roy. Astro. Soc.*, 99, 9; October 1939). As is well known, the rotation of the sun varies with the latitude; also, the mean latitude of sunspots changes systematically during a sunspot cycle. In the first years, that is, after a sunspot minimum, the mean equator distance of the spots is about 20°, and at the end a little more than 5°. The synodic period of rotation corresponding to these latitudes is 27·5 and 26·9 days, respectively, and if terrestrial magnetic phenomena are connected with the areas of sunspots, there should be a sensible difference between the recurrence intervals in years of low and high sunspot latitudes. Chree and Stagg used the magnetic character figures of the years 1906–1925 and could not detect any effect in the case of terrestrial magnetism, but Archenhold has utilized data going back to 1847 and arrives at a different conclusion. As the data are not uniform, he found it necessary to employ different methods of analysis for different periods, and very full details are given of the procedure adopted. For all the groups dealt with he finds a recurrence interval of 27·02 days for the years before sunspot minima and of 27·52 days after the minima. The mean error of the first value is ±0·13 day, and that of the second is ±0·05 day. The difference of 0·5 day between the recurrence intervals in years before and after sunspot minima is thus 3·6 times the mean error, ±0·14 day. From the beginning of the cycle to the end, the recurrence interval shortens continually, and this is what would be expected because of the decrease in the mean equator distance of the sunspots. When sunspot zones occur near the equator and also in higher latitudes, the shorter recurrence interval of the equator belt prevails, because of the greater effectiveness of disturbed areas near to the equator on the earth's magnetism.

MEDAL AWARDS OF THE ROYAL SOCIETY*

Copley Medal

The Copley Medal has been awarded to Prof. Thomas Hunt Morgan.

The establishment of definite laws of heredity, and the discovery of the mechanism, the gene, by which hereditary qualities are carried on from generation to generation, has revolutionized our outlook on the function of the nucleus of the cell and of the chromosomes it contains; it has enabled us to understand the significance of the maturation of the germ cells and of fertilization as they occur in higher animals and plants, and thus led to a very rapid development of nuclear cytology. The theory of the gene has given us a new outlook on the determination of the development of an animal or plant. But nowhere has genetics produced greater changes than in our attitude to evolution. The observations that mutations arise *de novo* at a definite rate, that the number of different mutations occurring in a single species may be very large and that the mutations in allied species are essentially identical, have shown us for the first time the materials which are available as a basis for evolutionary change. The quantitative nature of genetics has made it possible to examine the effects which result after many generations from the establishment of a community by a few individuals of different hereditary composition, and to estimate the effect of a definite advantage attaching to one particular quality on the ultimate composition of a population. It has thus put the theory of natural selection on a sound theoretical basis. Furthermore, it has enabled us to observe indirectly the effects of natural selection in wild populations, and to plan experiments to determine its effects.

The practical applications of genetics are as important as its influence on theory. The whole of the breeding of many cultivated plants including maize is now firmly based, and the process of improvement immensely hastened by cytological examination. Genetics is already influencing animal breeding, and in its modern developments is throwing much light on the possibility of controlling hereditary diseases in man.

In the development of genetics, the work of the Morgan school has been paramount. It is to Morgan that we owe that exploitation of *Drosophila melanogaster*, which is the basis of most modern developments. To him we owe the theory of the gene, which is fundamental, and the explanation of 'crossing-over', which forms the basis of the conception of the linear arrangement of the genes and the chromosomes. From these starting points all other work springs, and much of this work comes from Morgan himself, his associates and his students. Morgan has done more than any other man to establish genetics and thus to revolutionize our ideas in many different fields of work, in practical affairs as in pure theory.

Royal Medals

A Royal Medal has been awarded to Prof. Paul Adrien Maurice Dirac.

Dirac's chief work has centred around the fundamental principles of modern theoretical physics. The
new quantum mechanics was discovered by Heis
berg in 1925. Dirac at once realized the great i
portance of this discovery, started to work out
fuller implications and by a remarkable combinati
of originality, mathematical skill and uncan
instinct, rapidly established himself as a great lea
in this field. His earliest efforts were directed
wards tidying up the intermediate field between tl
of the new quantum mechanics and the Newtoni
An early and very important paper was on
fundamental equations of quantum mechanics. T
was a generalization for which he introduced a n
algebra, that of non-commutative numbers.

Probably Dirac's greatest achievement was that
ending the conflict between quantum mechanics a
relativity mechanics by showing how to make
fundamental equations of quantum mechanics
variant under a Lorenz transformation, at any r
to a first approximation which has not yet be
improved on. This led to a revision of the theory
the hydrogen atom which confirmed Sommerfel
formula for the fine structures of spectrum lines a
X-ray levels. This formula had been derived hithe
from a mixture of empirical results and theoreti
guidance, but had not been deduced from gene
fundamental principles. The idea of a quanti
electron spin also fitted naturally into the n
theory. The harmonization of the quantum a
relativity mechanics also required the introducti
of the strange conception of negative energy sta
(holes) and this is generally regarded as a predict
of the existence of the positive electron (positr
since discovered by Anderson.

A Royal Medal has been awarded to Pr
David Keilin.

Prof. Keilin's contributions to entomology exte
over nearly thirty years. In the main they conce
the higher Diptera: with critical ability and a gr
capacity for detailed observation he has demonstrat
the very close correlation that exists between lar
structure and habits in these insects.

Prof. Keilin's main contributions to biochemis
have been his studies on the respiratory pigme
cytochrome, published in a series of papers fr
1925 onwards. He has shown that cytochrome
composed of at least four components related
hæmatin. One of these is in all probability
enzyme previously known as indophenoloxidase. T
catalytic activity of this enzyme depends entirely
co-operation with the other three components
cytochrome. The complete cytochrome system for
within the cell a highly active catalytic mechani
which by utilising molecular oxygen can easily oxid
hydrogen atoms of certain substrate molecules wh
have been activated by dehydrogenase syste
This shows that the enzyme component of cy
chrome may be identified with the previously und
covered oxygen-transporting enzyme of Warburg a
his co-workers.

Other work of Prof. Keilin in this field has includ
the characterization of certain oxidizing enzy
which make use of molecular oxygen, and the p
paration in a pure condition of the polyphe
oxidase of mushrooms. The latter has been sho
to be a copper protein compound. Recently he

---

* From the remarks made by Sir William Bragg in presenting the medals for 1939.

o isolated in a pure state copper protein com- unds from blood corpuscles and liver (hæmo- prein and hepatocuprein), which may be of bio- ical importance though they are not apparently ncerned in oxidase reactions. Keilin has thus pro- led us with an integrated picture of cellular piration which is an enormous advance on the ich less systematized knowledge that we had fore his work was published.

DAVY MEDAL

The DAVY MEDAL has been awarded to Prof. MES WILLIAM MCBAIN.

McBain's claim to special recognition rests essen- lly on the circumstance that he created, and has the development of, a new and important chapter physical chemistry—the study of colloidal electro- es. It was as the result of a long series of precision asurements on the electrical and thermodynamic operties of soap solutions that McBain originally fined this new class of materials, which combine a special way the properties of colloids and ctrolytes. The definition and constitutional theory oved to be the key to the orderly exploration, ich thenceforth proceeded with continually grow- impetus, of a large and fruitful field—incidentally e of considerable technical importance. The terials include soaps, nearly all modern synthetic tergents, a number of inorganic substances such silicates and tellurates, as well as many dyes, oteins and bio-colloids.

In the continued investigation, in which numerous rkers have contributed to the general develop- nt of the subject, McBain has been a leader, and work has thrown much light not only on the cial properties of the ionic micelle, but also on the ysical properties of colloidal particles as a whole. the course of this work a great variety of experi- ntal methods has been developed—chemical, ctrical, optical and mechanical methods—which novel in their application and are in some cases vel in themselves. Reference may be made to the antitative study of 'solubilization' and the elabora- n of the air-borne ultracentrifuge in illustration of Bain's versatility of technique.

In addition to the composition and organization a colloidal particle, its interface with the con- uum has a decisive influence on its properties, and s gives special importance to the section of McBain's work which deals with the structure, composition and depth of macroscopic interfaces, especially of the surfaces of colloidal electrolyte solutions. Here also he has devised many methods of study, one of the most striking being the 'microtome' method whereby the outermost layer of a solution can be peeled off with a rapidly moving knife blade so that the surface concentration of solute can be directly determined.

HUGHES MEDAL

The HUGHES MEDAL has been awarded to Prof. GEORGE PAGET THOMSON.

Thomson's researches have been spread over a wide range of experimental and theoretical physics. Most of his earlier experiments were connected in some way or another with positive rays, and in this field he obtained a number of valuable results. Probably the most important of these is his discovery that the small-angle scattering of protons in hydrogen could not be accounted for by treating the protons and electrons as point charges obeying the inverse square law of force.

The scope of his work in pure physics is indicated by the titles of three books he has written or, in one case, helped to write. These are: "The Atom", "Wave Mechanics of the Free Electron" and the third edition of "Conduction of Electricity through Gases". The last is a joint effort with his father, and is the most important work there is on the subject. Within this range his work is both experimental and theoretical, but the experimental part predominates both in quantity and in importance.

Thomson has also made notable contributions to aeronautics. They include research work for the fighting air services during the War of 1914–18, a book entitled "Applied Aeronautics" (1919), and various contributions to Government publications.

Thomson's most distinguished work is based on Davisson's discovery—finally established in 1927—that electrons were reflected by single crystals as if they were possessed of the characteristics of waves. By brilliant experiments and able reasonings thereon, Thomson has opened out a new field of research which has been singularly fruitful and is still full of promise. He has been able to prove by direct experiment the correctness of Louis de Broglie's ideas of wave mechanics, not merely qualitatively but also quantitatively.

THE GREAT RED SPOT ON JUPITER

HE presidential address of the British Astron- omical Association was delivered on October 25 Mr. B. M. Peek, who took for his subject the ysical conditions of the planet Jupiter, and in rticular the red spot. It is certain that Schwabe's awings in 1831 showed this spot, and there is evidence at it was known from 1664, the date of Hooke's nous observation, until 1713, from which date a p of more than a century exists in the records. It is difficult to believe that a purely atmospheric enomenon could have continued so long without owing signs of dissipation, but the anomalies of its tion in longitude militate against the view that it arises from a centre of activity more deeply rooted than the atmosphere. It rotates nearly in accordance with system ii, that is, the system which represents approximately the period of features commonly seen outside the equatorial zone, 9h. 55m. 40·632s. An attempt was made by Peek to determine what system of uniform rotation most nearly represents the rotation of the spot from 1891 until 1931, but it is admitted that a simple mathematical expression to represent the motion is difficult to find, and the investigator is obliged to ask the question whether, in spite of its long persistence, the red spot is not a purely atmospheric phenomenon. At this stage of the inquiry it is necessary to define the term 'atmosphere'.

Both Wildt and Peek have shown that beyond a depth of 100 km. the atmosphere of Jupiter must be compressed to the density of the liquid or solid state of the substances composing it. It is possible to conceive of this atmosphere as composed of highly condensed permanent gases, and at greater depths these gases may be solidified. The temperature of the surface of such an atmosphere would probably be in the neighbourhood of 150° K. (– 123° C.), and from the dry adiabatic lapse-rate at the surface of Jupiter it is certain that the temperature must increase rapidly with the depth for the first few kilometres. When, however, the gas laws break down, it is probable that practically isothermal conditions prevail and the isotherm may be about 300° K. Jeffreys' investigations suggest that a thick layer composed of one of Bridgman's high-pressure modification of ice, probably ice vii, lies underneath, and Peek considers the case of an enormous berg, towering above the general level of the layer. Would the viscosity of the ice allow it to drift in longitude like the red spot?

Mr. Peek then develops a suggestion made by Wildt[1] that the spot may be a solid body floating in an 'ocean of permanent gases', and proposes following tentative hypothesis: A solid body which is provisionally called ice, floats in a perman gas *B*, provisionally called nitrogen. If the forn is ice vii, it may be supposed that a small port near the top would gradually change its phase fr ice vii to ice vi, and, owing to the absorption heat, the atmosphere above it would be cooled. T red spot is, it is thought, "a manifestation at visible surface of the thermal effects accompany the change of phase".

Assuming further that the level at which the floats is subject to small variations, the radius gyration about the axis of the planet will vary, a a simple calculation shows that a total range of 10 k would account for all the changes in velocity t the red spot has undergone during the period investigation. While ice and nitrogen illustrate v readily the hypothesis, it is pointed out that phase diagrams of other substances, such as hydro and helium, also suggest suitable conditions, and is unnecessary to assume that ice and nitrogen actually responsible for the phenomenon. It is ho that the matter will be investigated more fully the near future.

---

[1] *Proc. Amer. Phil. Soc.*, 81, 1 (1939).

POSSIBILITIES OF ALTERNATING CURRENTS FOR LONG-DISTANCE TRANSMISSION

IN the *Electrical Review* of October 20, H. Rissik shows that some of our early notions about the transmission of electric power must be modified. In the past no difficulty was at first experienced in utilizing the line conductors to the full extent of their carrying capacity. Transmission distances were short and the power to be transmitted amounted to only a few thousand kilowatts. As time went on and transmission voltages and distances gradually increased, the view became common that any technical limitation to the amount of power that could be transmitted was to be looked for in the nature of the generating plant and transformers, rather than in those of the transmission line itself. It was seen that there was no longer a definite line voltage for a given power and distance giving the lowest transmission costs, which diminished as the voltage that could be used increased. Other characteristics of the electric plant had to be taken into account.

The special problems created by the linking up of immense power networks operating at 132 and 154 kv. and in many cases at 220 kv., involving power interchange over long distances, first became acute in the United States, and they have also arisen in France, Germany and the U.S.S.R. To the pioneer work of American engineers we are indebted for our present knowledge of the essential factors which contribute to system instability. They have also developed methods of improving the stable operation of power systems. It is very creditable that individual electricity undertakings, operating on a very large scale, should have deliberately subjected their power systems to major electrical disturbances in order to verify calculations based upon a new theory. This form of large-scale experimentation was on several occasions undertaken in the United Sta notably in 1928 on the 220 kv. system of the South California Edison Co. and again in 1930 on 132 kv. system of the West Penn Electric Co.

As a result of the experience accumulated dur the last ten years, it has become possible to investig technically methods whereby the stability of sup power trunk lines may be raised to levels wh economics once more becomes the decisive fact It has been for a long time common practice employ a synchronous condenser at the load end a transmission line in order to maintain the termi voltage common at all loads. In 1921 Baum show that this principle could be extended to a long l divided into several sections and having synchron condenser stations located at the points of secti Taken as a whole this transmission line acquires electrical characteristics of its individual sectio As the result of the reactive power compensat effected by the intermediate condenser stations, voltage at each point of section is maintained c stant and equal to the transmission pressure.

Another system is the self-tuned line. To ev frequency of alternating current there correspond wave-length, such that their product equals velocity of propagation of the train of electric wa just as in radio, television and carrier communicat For overhead lines, the velocity of propagation approximately equal to the velocity of light, that about 180,000 miles per second, so that the wa length of a 50-cycle transmission line would be ab 3,700 miles. Skilling showed in 1927 that if transmission distance is just half the wave-lengt the applied frequency, the line inductance and cap ity cancel each other out and the line beha tually as if it possessed resistance only. Such a constitutes a tuned circuit which resonates at frequency of the applied voltage. It would be icult to realize this in practice as at the normal quency of 50 the transmission distance would have be 1,850 miles. This limitation of great length ld be got over by the 'compensated line' system, ere a series excitation scheme is artificially loaded h series capacitance. One successful application of method was from a substation of the New York Power and Light Corporation at 33 kv. installed in 1928. The chief disadvantages of using large static condensers is their expense and their liability to damage by over-voltage.

Another possible method would be to load the line at intervals with shunt reactors, after the manner of the Pupin loading coils used in telephony, over underground cables. Such a dual compensated line would behave as if it possessed resistance only.

OPERATION AND DESIGN OF TROLLEYBUSES

PAPER by G. F. Sinclair, of the London Passenger Transport Board, on the trolley- system was published by the Institution of ctrical Engineers on November 9. The trolleybus been adjudged by the Ministry of Transport an ctric vehicle, and its construction and operation governed by the Ministry's regulations. These w the vehicles to be built one ton heavier than er forms of road passenger vehicle. They can be igned with large seating capacities with accommo- ion up to seventy passengers.

The cost of maintaining a 70-seater trolleybus is greater than that of the much smaller unit, the sel bus. On a mileage basis the capital charges the vehicles, taken over a period of twelve years, uming similar seating capacities, show little ference when the two types are compared. The rage energy consumption for trolleybuses operating an intensive service is approximately 2·75 units car mile, measured at the substation. The price direct-current energy varies from 0·5*d*. to 0·8*d*. unit. At the higher figure the cost per ton-mile high compared with the Diesel bus, but at 0·5*d*. unit the comparison is favourable to the trolley- s. For passenger services in densely populated as, the vehicle with comparable costs, which can form the cycle of starting and stopping to pick and set down the greatest number of fare-paying sengers in the least time, will produce economies. e high acceleration of the trolleybus due to the erload capacity of its motor gives the facility for erating high schedule speeds. The ability to mar- l vehicles in different areas is also a great con- nience. In the everyday movement of the people the road to and from their work, the use of non- p vehicles plays little part. The travelling public ve shown their appreciation of the comfort in vel, the fine riding qualities and quiet operation these vehicles. The residential population and siness people on the routes served by trolleybuses ve greatly benefited from their smooth and quiet ning.

Among the many points interesting to all elec- cians touched on by Mr. Sinclair is the production electric charges on trolleybuses, and the methods suppressing the interference with radio trans- sion signals, whether of sound or vision broad- ts. In service, the electric charges may be duced by the friction of the tyres on the road face, by the rise of potential due to the inductive k from the contactor coils, possibly by the mutual luction from the currents in the transmission mains, lastly when a leakage occurs from the power cir- its to the body of the car. It has to be remembered t it is only in very special circumstances that these conditions can arise. In any event they present little inconvenience to the travelling public. Consider a rubber-tyred vehicle with a metal or composite body; the generation of a charge depends largely on the road surface. With dry clean granite sets, voltages up to 900 can be measured by an electrostatic voltmeter immediately after the vehicle comes to rest. If the roads are asphalt or tar-macadam, only zero readings will be obtained. When the circuits of the electrical equipment are broken, the inductive charges may give voltages up to 300. Neither of these types of charges necessitates special precautions, as the frequency of loading or unloading passengers prevents high static charges from being built up. The use of 'low resistance' tyres, of about 2,000 ohms measured from the tread to the wheel rim, provides satisfactorily for earthing these charges.

It is the possibility of electrical leakage from the 600-volt circuits which has to be guarded against—the vehicle being in reality unearthed. The Ministry of Transport regulations require a daily test of the insulation of each trolleybus. The test is carried out after the vehicle has completed each day's service. Testing apparatus is located at the entrance of the depots. This enables the test to be carried out with the trolleybus in the condition in which it has been operating, an especially important point in wet or snowy weather, as the insulation resistance varies largely with the climatic conditions. For convenience in testing, the frames of the individual 600-volt units are connected by means of cables to a common testing receptacle, which is mounted at the back of the trolleybus underneath the platform. The nightly test is between the conductors and the body or chassis, the secondary insulation being short-circuited. Every fourteen days, each high-voltage circuit is tested individually, including all insulation whether primary or secondary. The insulation of the platform consists of a rubber mat secured to the floor boarding by an adhesive. The handrails have an insulated covering and are provided with secondary insulation, the combined arrangement giving insulation readings of 'infinity'.

The British Standards Institution has recently published a specification setting out the three methods used for reducing the electrical interference with radio broadcasting, etc., generated by the trolleybus equipment. The results of large-scale experiments carried out in London for preventing interference by trolleybuses are described.

On a fleet of more than 1,600 trolleybuses in London, the use of carbon 'shoes' to collect the current from the overhead wires is general. The success of the carbon collectors is due largely to the lubrication of the conductors.

SCIENCE NEWS A CENTURY AGO

Travels in Eastern Turkey

AT a meeting of the Geographical Society on December 9, 1839, a communication was read from Mr. John Brant, H.M. Consul at Erzurum, describing a tour of about 900 miles in the country lying to the south of Mount Ararat and the north of the River Tigris. Brant was accompanied by Dr. E. D. Dickson and A. G. Glascott, R.N., who had mapped the route followed and had also prepared a chart of a section of the high land of Armenia, between Trebizon on the Black Sea, and Mosul on the Tigris, a direct distance of 360 miles, showing the remarkable features of the elevated plateau, which for the greater part preserves a level of 6,000 ft. above the sea. Astronomical positions were determined of the principal places visited, resulting in the correction of many errors. Among the towns visited was that of Van on the east side of the lake of that name. The town had a population of about 35,000, half of whom were Armenians. The lake covers about 900 square miles and is 5,470 ft. above the level of the sea. By a special order of the Pasha, the party were able to visit the castle and caves and they also inspected the cuneiform inscriptions near Van, the Pasha expressing great anxiety to know if the party could translate them. An expedition was also made to the top of the mountain of Supan Tagla, 4,000 ft. above the lake and 9,500 ft. above sea-level, the theodolite being placed on the summit. From this spot could be seen to the north-east the beautiful peaks of the Great and Lesser Ararat, at a distance of 80 miles, rising into the regions of eternal snow.

Electro-deposition of Copper

"CONSIDERABLE interest has been excited in the scientific world," said the *Athenæum* of December 14, 1839, "by Mr. Spencer's new process of copying medals and other works of art, in copper, by the agency of voltaic electricity. It is with great pleasure we hear that this process is already beginning to be employed in certain of our manufactures, and that thus electricity will soon be numbered among the agents employed for practical and useful purposes. . . . In the manufacture of plated articles and ornaments it is often desirable to copy ornamental work, such as leaves, flowers and arabesque mouldings; this is both difficult and expensive, and from these causes often impossible. Mr. Spencer's invention, however, affords a cheap and easy method of performing what is required, and thus, ornaments on rich ancient plate are copied with the greatest perfection and ease, and without injury to the original. The great advantage consisting in the means of obtaining at very small expense, a facsimile in copper of the ornaments required to be copied, which may then be silvered or gilt. . . . The casts of medals, transmitted to us by Mr. Spencer, and also those made by Mr. E. Solly and Mr. J. Newman, and exhibited lately at the meeting of the Society of Arts, were very pure and compact copper, and the surface was as brilliant and perfect as could be desired. The process, indeed, is simple, and so far from its requiring, as is generally supposed, either expensive and complicated apparatus, or deep scientific knowledge, nothing can be more easy, as the observance of a few rules renders the success of the process quite certain, and, as regards the expense of the apparatus, the whole of it may be acquired for a few pence."

UNIVERSITY EVENTS

CAMBRIDGE.—During the vacancy in the profes ship of chemistry, Dr. H. McCombie will be tempo director of the laboratory of general and org chemistry—that is to say, all those parts of chemical laboratory not at present assigned for use of the professors of colloid science, theoret chemistry, metallurgy, and physical chemistry.

In accordance with its usual practice, Tri College, Cambridge, announces the offer of a search studentship open to graduates of other versities who propose to go to Cambridge in Octo next as candidates for the degree of Ph.D. The va of the studentship may be as much as £300 a yea the pecuniary circumstances of the successful c didate require so large a sum. Candidates must have reached the age of twenty-six before May 1. certain circumstances an election may be made an additional studentship. The same College off as usual, Dominion and Colonial exhibitions students of Dominion and Colonial universities wish to go to Cambridge next October as candid for the degree of B.A., M.Litt., M.Sc., or Ph These exhibitions are of the titular value of £ but their actual value is fixed by the College Cou in accordance with the exhibitioner's financial cumstances. A candidate for a studentship or e bition should apply through the principal autho of his university, and his application should re the Senior Tutor of Trinity College (from wh further particulars may be obtained) by May 1, 19

OXFORD.—H. G. Champion, New College, has b appointed to the professorship of forestry, vaca by the death of Prof. R. S. Troup, as from Tri Term, 1940.

Miss A. Pellew, St. Hugh's College, has b awarded the Edgell Sheppee Scholarship in engin ing science.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments o before the dates mentioned:

UNIVERSITY GRADUATES as Teachers of English for Colom British Council, 3 Hanover Street, W.1. (December 15, qu 'Colombia').

SENIOR EXPERIMENTAL OFFICERS (Male), EXPERIMENTAL OFFI (Male), and EXPERIMENTAL ASSISTANTS (Male and Female) by Ministry of Supply—The Ministry of Supply (S.B.3), The Ade W.C.2 (December 20, quoting Appts 015/S.B.3).

WOMAN PROFESSOR IN CHEMISTRY at the Huguenot Unive College, Wellington, Cape—The Secretary, Office of the High (missioner for the Union of South Africa, South Africa Ho Trafalgar Square, W.C.2 (December 31).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Ministry of Health. Memorandum on Influenza. Revised edi Pp. 12. (London: H.M. Stationery Office.) 2d. net.

Air Ministry: Meteorological Office, London. Southport Aux Observatory (the Fernley Observatory of the Corporation of Southp Annual Report, with Results of Meteorological Observations, fo Year 1938. By George A. Lidster. Pp. 32. (Southport: Fe Observatory.)

Other Countries

Smithsonian Institution: Bureau of American Ethnology. Bu 122: An Archaeological Survey of Wheeler Basin on the Tenn River in Northern Alabama. By William S. Webb. Pp. xv+214 plates. (Washington, D.C.: Government Printing Office.) cents.

ditorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 144 SATURDAY, DECEMBER 16, 1939 No. 3659

THE PRESSURE OF POPULATION

HE word 'science' normally connotes physical and chemical science to the public mind and lay press, to whom biological science is part nedicine, and it is not realized that there is also ience of world affairs and economic problems. if the problems of peace, already beginning to gitated, are not this time solved largely in a ntific manner instead of being left to politi- s and international financiers, the result will no better than the unsuccessful attempt at a world which came into being after the ill- d Treaty of Versailles.

ost of the immediate problems arise as the lt of pressure of population, a phrase which fficiently elastic to extend to many problems, of them capable of scientific analysis. One mn of the daily newspaper informs us of number of unemployed in Great Britain in the United States, whilst in another e are statements in regard to the inevitable sequences of the fall in the birth-rate. The rage citizen cannot make up his mind whether e are too many or too few people in England. is at least aware of the economic conditions ch make him unable to afford a larger family self if he has to feed and clothe and educate m ; he also knows that the absence of domestic is another factor against the larger family. cannot understand either, why there should be ample work and a livelihood for a larger ulation in Canada, where there has been so ch unemployment. In the end, he asks the stion, whether there are too many people or fficient capital ?

his is a question which merits the attention of man of science. There are many methods of roach to its study, one of which is the historical. Something may be learned by a comparison of the state of development in England at the end of the eighteenth century and that existing to-day in the Balkan countries.

There was then a population surplus in England ; indeed it was in 1798 that Malthus published his famous essay and predicted a sorry fate for mankind, which he pictured as growing faster than the food supply. Sir William Crookes was equally concerned about the food situation in his now famous address to the British Association at Bristol, only a year or two before the chemists learned how to make nitrates from the air and so put an end to any fear of food shortage. To-day the world can produce such an excess of the staple foods that their value, as the result of competition, shows no profit to the grower over the cost of production.

Statistics indicate a population of about 60 inhabitants per square kilometre for England and Wales in 1800, whereas, according to Prof. Ernst Wagemann, who has recently published (in German) a most exhaustive study of this question, that of the Balkan Peninsula to-day is about 62 ("Der Neue Balkan", Hamburg, 1939).

In 1800 conditions were very bad in England. Bad harvests, the ill effects of war, financial and trade disturbances brought the country near to famine and the brink of ruin. Large land holdings and pasturing were spreading and exerting pressure on the peasantry. There existed an ever-increasing agricultural population surplus which had to be cared for by somebody. In the Balkans this surplus exists to-day. The relative figures are significant. Only 63 per cent of the actual labour supply is being used ; in Bulgaria at least 750,000 men could be withdrawn from agriculture without injuring production. Some 114 persons are employed per 100 hectares of cultivated land against 50 in France and Germany, 17 in the United States. Life is said to be quite comfortable for the peasants who own their own farms.

The population density figure of 60 is small compared with highly industrialized countries; in Belgium it is more than 200, and it is clear that the Balkans are over-populated only in relation to their economic and technical development. As Wagemann puts it, they are "under-technicalized" rather than "under-capitalized".

It is desirable to stress the implication to Britain and British industry of this conception of countries with "too many people". It has long been the policy of Great Britain to expect the world, and her Dominions and colonies in particular, to produce foodstuffs and raw or quasi-manufactured materials, and to leave to Britain the elaboration of these in her technical industries. There are to-day "too many people" in several parts of the world and the belief is gaining ground that only by "technicalization", that is, by becoming industrial, can a balance be effected. In the British Empire we have perhaps opposed the trend too long; the Dominions at least are resolute in their intention to establish industries. It is true that their products cannot compete for cost and even for quality with those produced at home on a large scale and with long experience, but the Australian is prepared to put up with this and to tax English products to make them competitive in order to have work for his people.

The industrial apparatus of the world is already over-developed, and the older countries were, before the war, meeting with difficulties in selling their goods. Indeed it is clear that the solution of the over-population problem is to be sought least of all in the establishment of highly technical 'machine industries'.

The greatest possibilities in the Balkan countries lie in the introduction of crops which require intensive labour for their cultivation, such as tobacco, flax, hemp, rape seed, soya beans, etc., vegetables and fruit which are either easy to export or can serve as raw materials for domestic industries. Further, stable-feeding of stock can be substituted for pasture feeding. Humidity and fertility would permit much to be done in the above directions as the climate is favourable: irrigation and rational farming are claimed to make it possible to double the employment on the land and the yield per hectare in south-east Europe.

Such a change would take many years to fect, but it would largely solve the Balkan po lation problem and at the same time cause a gr increase in the purchasing power of the farm which in turn would react on the industries of countries.

The low intellectual level of the population n be measured by the small consumption of pap less than 10 per cent of that in Germany, wh in turn was much less than it is in the Uni States. The peasants hoard their money, custom which still more restricts the amount capital available for development.

It is not always realized how employment adversely affected even in England by the v great difficulty experienced in getting money new enterprises and new factories, especially o modest scale. The complexity and cost of mod machinery and the regulations of the Factory make it almost impossible to start from sm beginnings as in the past. Sooner or later a meth of solving these financial problems of the sm manufacturer will have to be discovered.

Here also there has been a tendency both on part of banks and individuals to sterilize cre by placing money on deposit. The Governm has been forced to finance much of the cap work of rearmament, and we are undoubtedly consequence advancing towards the nationalizat of capital. The pressure of population can o be met by the existence of enough credit provide new enterprises.

There is much talk of freedom but very littl responsibility, of which we are only just becom conscious. Democracy has "a responsibility guide, to understand, to upbuild and to mak world of the twenty-first century" in the wo recently used by Dr. Nicholas Murray But Each one of us has a part to play, a responsibili the one to invent new processes, a second carry them out, a third to do the manual worl fourth to find the capital moneys for their ins lation, a fifth to bring the products to the pul The chain is a continuous one, the links are equal strength; if anyone fails to do his sh there will be failure of the whole, and his is responsibility. There need not be "too m people" if the responsibility is accepted: all c cerned will have to work together much m than they have in the past. This must be d willingly and not under compulsion.

GROWTH OF THE KINETIC THEORY

e Mathematical Theory of Non-Uniform
ses
Account of the Kinetic Theory of Viscosity,
ermal Conduction, and Diffusion in Gases. By
of. Sydney Chapman and Dr. T. G. Cowling.
. xxiii + 404. (Cambridge: At the University
ess, 1939.) 30s. net.

INCE the days when the kinetic theory of gases was founded by Clausius, Maxwell and ltzmann, great changes have taken place in the pe and bearing of the descendent theory. king a wide view of its present field, the quali- ation "of gases" has become a misnomer. One n see that the ultimate scope of the descendent the kinetic theory of gases must be the whole ld of the properties of matter in bulk, derived m the atomic constitution of matter and from properties of atoms and their interactions. e present scope of the theory falls short of such lusiveness, but not so far short as to leave any ubts for the future.

The old kinetic theory of gases has thus de- loped into the 'atomic theory of the properties matter in bulk'. In so doing it has bifurcated arply into (1) the theory of the properties of atter in equilibrium, and (2) the theory of nsport phenomena and other rates of change, h as chemical kinetics. The first branch is mmonly called, perhaps rather unfortunately, atistical Mechanics. It has grown out of elaborate d repeated rediscussions of Maxwell's two early orems (1859), his distribution law for the lecular velocities of a gas in equilibrium, and law of equipartition of energy among two sets molecules in a gas mixture (the latter a redis- very of a result of Waterston (1845)). The imary result of these rediscussions has been to w that the results do not depend on any cial molecular properties, and so that the uilibrium state in question is independent of the chanisms by which it is set up and preserved. us the field of statistical mechanics is coterm- us with that of thermodynamics, and has entially the same generality. For the same son, statistical mechanics has proved far the ier branch in which to make rapid progress. In t, progress has been so rapid that one may rly say that the complete outline of statistical chanics (the atomic theory of the properties matter in equilibrium), including a rational rivation therefrom of thermodynamics, was tched by Gibbs in 1901 in his "Elementary Principles in Statistical Mechanics". Advances since then have, quite literally, only been concerned with rewriting Gibbs's theory in terms of the quantum theory, and with filling in the details by special applications.

The second branch from the old stem, the theory of transport phenomena, has proved far more difficult to climb. In the nature of things, one must expect that it will be easier to determine a limit than the rate of approach to that limit. The rate, moreover, will necessarily depend on details of the mechanisms of interaction among the many systems concerned. Transport phenomena and other rates of change have been studied profoundly for all states of matter, but a great part of these studies cannot properly be classed as part of an atomic theory of the properties of matter in bulk. Phenomenological theories, of heat conduction, for example, in which a successful description is given in terms of an assumed coefficient (the conductivity), do not qualify for inclusion, since the essential feature of an atomic theory is the *a priori* evaluation of this coefficient in terms of atomic properties. Much progress in the genuine atomic theory of transport phenomena has nevertheless been made, since Maxwell's paper "On the Dynamical Theory of Gases" (1866) first formulated rigorously the discussion of a non-uniform gas. Such genuine progress has not been confined to the gaseous state or to classical transport phenomena (diffusion, viscosity, heat conduction). It is only necessary to recall the subject of chemical kinetics, which has made much progress in the gaseous, liquid and even the solid state. The mathematical difficulties, however, are very great; it is only in the atomic theory of transport phenomena in almost perfect gases (which includes, as it happens, the electronic theory of metallic conduction) that progress has been sufficiently outstanding for the theory to have achieved any appreciable perfection of mathematical form. Along this one spray of the branch, however, complete success has been reached. It is the definitive mathematical theory of atomic transport phenomena in almost perfect gases that is recorded in the book under review, in a perfection of form which is unlikely to be seriously bettered for a long time.

The stages by which this success has been achieved are recorded by Chapman and Cowling in a most interesting historical note at the end of the book. In 1866 Maxwell was able to obtain the first accurate results for the coefficients of heat conductivity and viscosity of a gas by confining himself to molecules which interact like point centres of force repelling according to the inverse fifth power of the distance (Maxwellian molecules). For this particular model it so happens that all the integrations over the circumstances of a molecular encounter can be carried out without a knowledge of the manner in which the molecular distribution law $f(u, v, w)$ deviates from place to place in the non-uniform gas from its Maxwellian value for a uniform gas. In all other cases, a knowledge of the distorted $f(u, v, w)$ is required, and this must be provided by solving the famous integro-differential equation of Boltzmann, first formulated in 1872, or by some equivalent procedure. There matters rested until 1905, when Lorentz solved Boltzmann's equation in the special simple case required for the discussion of the thermal and electrical conductivities of a metal, treated classically. The successful treatment of this special case gave no indication, however, of how to proceed in even the simplest case applicable to an ordinary (non-Maxwellian) gas. It was not until the independent investigations of Enskog and Chapman, 1911–17, that Boltzmann's integro-differential equation for a gas was solved, and the coefficients of diffusion, viscosity and heat conduction for a gas calculated from a proper atomic model conforming to other atomic requirements. The interesting new feature of thermal diffusion (for non-Maxwellian gases) was discovered theoretically by Enskog in 1911, re-derived by Chapman in 1916, and then confirmed experimentally by Dootson. Since then a probably final polish has been given to the theory in 1935 by Burnett, who has found that the correct form of expansion to use in solving Boltzmann's equation is one in terms of Sonine polynomials.

In the body of the book this final form of the mathematical theory is presented at length and applied to actual gases. It is presented in a rather unusual vector and tensor notation described in Chapter i. This makes the following exposition somewhat severe reading, unless the reader first thoroughly masters and familiarizes himself with the notation. A powerful and compact notation is, however, essential to an elegant presentation of the many vital complicated formulæ, and the authors' novel notation appears to be most successful and completely justified.

After a preliminary description of the properties of a gas, the equations of transfer of Maxwell and the integro-differential equation of Boltzmann are derived in a general form on the assumption of molecular chaos, followed by a deduction therefrom of the equilibrium properties of a gas. Further comments on the assumption of molecular chaos will be made at the close of this review. In two short chapters transport phenomena are th
discussed on the basis of the idea of a mean f
path, and the weakness of this method poin
out. The main body of the book (Chapters vii
inclusive) then follows, giving the complete mat
matical deduction of the coefficients for diffusi
thermal diffusion, viscosity and heat conductiv
for simple gases and gaseous mixtures at su
densities that the mean free paths are long co
pared with the molecular dimensions, and negle
ing any quantal effects. An exposition of t
classical theory has long been required;
exposition of such elegance and authority w
worth an even longer wait, and this section, wh
is the kernel of the book, forms a notable additi
to the literature of theoretical atomic physics.

The remaining sections of the book conta
moreover, important additions to the cent
theme. Chapter xvii gives an excellent accou
of the modifications introduced into the theory
transport phenomena by the quantum theo
including a sketch of the electron theory of meta
so far as the transport phenomena involved c
be described in terms of a mean free path (So
merfeld's approximation). Chapter xviii gives t
necessary extension of the theory to the case o
gas of ions subject to electric and magnetic fiel
This is followed by two valuable mathemati
appendixes. There remains to be mentioned or
one further section, Chapter xvi on dense gas
which is to my mind the one section of dubio
value, and certainly not of the classical standa
of permanence achieved in all other sections
the book. The idea of the discussion is to inclu
the effect of collisions in transferring energy a
momentum instantaneously through a distance
one molecular diameter, an effect which is ad
tional to molecular transport over the mean fr
path. The effect naturally exists, but I cann
believe that it plays an important part in modifyi
the viscosity of ordinary gases to that of den
gases and liquids, though it may of course ha
a sensible effect in the first changes as the densi
increases. As presented here, I feel that t
quality of Chapter xvi and its lack of generali
make it rather out of place among the classic
perfection of the rest of the book.

The contemplation of the theory here expound
invites some further not very profound reflectio
on cognate matters of theoretical atomic physi
In the first place, one notices at once that t
atomic theory of transport here given, which is
first sight theoretically complete, excludes in fa
all such interesting forms of transport as turbulen
in boundary layers, heat convection, and ed
viscosity and conductivity on the larger sca
found in the atmosphere and in tidal currents.
is easy to see that they are in effect excluded fro

e theory by the assumption of molecular chaos which the whole atomic theory of transport is nstructed. The next step for a wider atomic eory in which turbulent effects in general can ve their proper place must be to discard, or ther to modify, this assumption—a theoretical vance which, if it could be made successfully, ould lead to results of outstanding importance.

A conclusion of general interest can be drawn m a study of this atomic transport theory and rticularly from a comparison of its exact results th those of the approximate version using mean e paths, a version which effectively also ignores y change in the form of the distribution function , v, w). Having here the exact solution, one ows that an approximate discussion, using , v, w) without modification, is liable to make ors in the numerical coefficients by factors of out 2, although it gives results of the correct neral form. One may safely conclude from this at errors of similar magnitude are liable to cur when a similar use is made of unmodified uilibrium theory in the study of other rates of ange such as chemical kinetics. One can thus tain a reliable warning against too complete a st in approximations of this type, which are herwise impossible to check in the absence of an act theory.

My final reflection concerns the bearing of the atomic transport theory on the possibility of a very general type of extension of statistical mechanics—a possibility in which it is very tempting to indulge unduly optimistic hopes. Contemplating the general results of equilibrium theory, which may be expressed so simply by saying that the equilibrium state of a system is the state of the system of maximum probability subject to certain boundary conditions, such as given volume and given energy, one argues, why should not a non-equilibrium state be derivable almost as simply as a state of maximum probability subject to somewhat different boundary conditions, including, for example, in a conduction problem a condition of given flow of heat. The effective answer seems to me to be provided by the results of the atomic transport theory. Here we know the correct answer to the conduction problem; its dependence on atomic properties is so complex that one can scarcely believe that it can be derivable by any process much less profound than Chapman's or Enskog's analysis. The answer this analysis gives may be in fact a condition of maximum probability for certain given boundary conditions, but that by starting from this condition one can arrive at the correct result in any simple way appears to me most unlikely. To attempt to do so would be to pursue a will o' the wisp.

R. H. FOWLER.

STUDIES OF OLD AGE

oblems of Ageing
ological and Medical Aspects. Edited by E. V. wdry. (A publication of the Josiah Macy, Jr., undation.) Pp. xxx + 758. (London: Baillière, ndall and Cox, 1939.) 45s.

THIS volume on the process of ageing has been sponsored by the Josiah Macy Founda- n in continuance of its interest in degenerative seases and in the hope of focussing attention on a problem which has far-reaching scientific d social implications for a society with a rapidly creasing proportion of older men and women." runs the introduction to a volume of a new aracter.

In our generation we have not yet thoroughly preciated all the problems involved in the crease in the gerontocrasy, due to improved alth and other factors. Is old age a blessing? is volume is written by a group of experts and tempts to deal with the whole range of problems ecting old age. The contributors are E. Allen, L. B. Barker, W. B. Cannon, A. J. Carlson. A. E. Cohn, E. V. Cowdry, M. Critchley, W. Crocker, J. Dewey, L. I. Dublin, E. T. Engle, J. S. Friedenwald, S. R. Guild, G. V. Hamilton, L. O. Howard, A. C. Ivy, H. S. Jennings, E. B. Krumbhaer, K. Landsteiner, C. M. McCay, W. MacNider, W. R. Miles, J. Oliver, T. W. Todd, F. D. Wiedman, and C. Wissler.

Starting with chapters dealing with the ageing of plants, in which we learn that trees may live as long as 7,000 years, the book works through Protozoa and insects to vertebrates and man, dealing not only with longevity records but also with more psychological questions such as human cultural levels.

Some chapters follow upon various tissues of the body in detail, such as skin, the endocrines and the reproductive systems. Last come discussions of a more general nature, among which we may mention change in personality with age, and seniority from a clinician's point of view.

As may be expected, there is some unevenness in treatment, but the editor has been successful in keeping this to a minimum, and producing a readable continuum. It is invidious to select from such a work, but mention may be made especially of the section upon chemical aspects of growth, in which among other chemical points, a reference is made to the startling experiments which have shown that the life-span of rats may be altered by diet. In a generation when all eyes are turned towards the attempt to impr rapidity of growth, it is revolutionary to ha observations which hint that such speed may be good for longevity.

The level of writing is high and there is mu information presented, so that the book necessar forms a standard work of reference. The print must be congratulated upon an excellent standa of production.

CHEMISTRY OF CHEMICAL WARFARE

The War Gases

Chemistry and Analysis. By Dr. Mario Sartori. Translated from the second enlarged Italian edition by L. W. Marrison. Pp. xii + 360. (London: J. and A. Churchill, Ltd., 1939.) 21*s*.

THE first Italian edition of this work was published in 1933, and in 1935 there appeared a German translation by Dr. Klumb which was reviewed in NATURE of April 11, 1936, p. 598. A considerable number of books on gas warfare have been written in the last twenty years, but they mostly deal with its military and medical aspects and give comparatively little information about the chemistry of war gases. Dr. Sartori, on the contrary, confines his attention mostly to the chemistry of these substances, but also deals briefly with some of their other properties.

In this second edition, the author has introduced a few pages on the physiopathological properties, and then has dealt in a general way with the physical properties, especially the vapour tension and the related properties: volatility, boiling point and persistence. The volatility is defined as the weight of the substance contained in a cubic metre of saturated vapour at a certain temperature. Consequently, it must be proportional to the product of the vapour tension and the molecular weight. On pp. 6 and 7, however, there are tables of the vapour tension and volatility respectively, and it is evident that the figures are not proportional, even when allowance is made for the differences in molecular weight. At the end of the book there is a more extensive table in which these two properties are given in adjacent columns, and the same discrepancy appears again. Apparently, some of these volatilities were calculated from values for the vapour pressure very different from those given both in the tables and in other parts of the book. It is remarkable that this fairly obvious error has been repeated from the first to the second Italian edition, and has not been noticed by either the German or the English translator. There is a similar discrepancy in t persistences of dichloroethyl sulphide (must gas) and bromobenzyl cyanide (*CA*) as given the table on p. 11.

In the last line of the last table on the last pa of the text the molecular weight of phenarsazi cyanide, $NH(C_6H_4)_2AsCN$, is given as 27 whereas the German edition gave it as 27 The correct figure is 268.

Numerous additions have been made in t second edition; the substances dealt with ha increased from forty-nine to sixty-four, but t additional fifteen war gases do not appear to of much practical value and have evidently be introduced to make the work more complete. is not to be expected that important new develo ments will be published at present. After t War of 1914–18 much of the accumulated inform tion was released, but the international tensi during recent years has led to a return to secre It is also improbable that much advance, if it can called advance, has been made by the vario chemical 'defence' research institutions, as th is no satisfactory method of testing these poiso They cannot be tried on human beings except mild doses, and the results with animals may quite different. The Germans published the resu of tests with cats, and more recently the America have released some results with dogs and mice. might be expected, the results do not run parall

There is a good deal of additional informati in this edition, and there must now be about thousand references to original papers. The bo is evidently the result of years of work and v be found an indispensable guide through t scattered literature of the subject in spite of so inaccuracies in the numerical data. For ea substance the available information is given the properties, laboratory preparation, man facture and analysis. The translation has be well carried out and the get-up is good, as it to be expected from the firm of Churchill.

ARTHUR MARSHALL.

RESPIRATORY ENZYMES

espiratory Enzymes
y University of Wisconsin Biochemists, under
e direction of C. A. Elvehjem and P. W. Wilson.
p. v + 236. (Minneapolis: Burgess Publishing
o., 1939.) 3.25 dollars.

THE rapid developments during recent years in our knowledge of respiratory enzyme ystems have created a demand for a book which, hilst giving an accurate and coherent account of ese developments, indicates the nature of the exerimental work leading up to them and shows the anner in which they are interrelated. Much of he relevant information which has been summarized so far, is to be found in authoritative but omewhat scattered review articles. It would bviously be a convenience to the student and o the experimental worker to have at hand a easonably accurate account of the present state f the subject, in which sufficient of the older ork is discussed to provide a proper perspective r the appreciation of the value of recent contributions.

The volume under review presents such a summary. It consists of a series of articles, reproduced from typescript, bearing on various aspects of respiratory enzyme systems, each article being written by a member, or by a number of members, of a group of workers engaged in enzyme research at the University of Wisconsin. A historical introduction to the subject by Prof. Elvehjem is followed by chapters on dehydrogenases and oxidases. Then come articles on coenzymes, cytochrome, flavoproteins, etc., an article on the specific and non-specific poisons of respiratory processes and one on hydrogen transport systems. Finally, there are useful chapters on oxidation-reduction potentials, and on the physical-chemical theory of enzyme reactions.

The chapters vary considerably in style and in the thoroughness with which their subject-matter has been treated. Some overlapping has been inevitable. The volume has obviously been compiled with great care, and the reviewer has noticed no misrepresentations of fact or of interpretation. The book should be very helpful to the student and to the worker about to commence research on respiratory enzyme systems. J. H. Q.

THE FAUNA OF THE SEASIDE

The Littoral Fauna of Great Britain
A Handbook for Collectors. By Dr. N. B. Eales.
p. xvii + 302 + 25 plates. (Cambridge: At the
University Press, 1939.) 12*s*. 6*d*. net.

A COUPLE of generations ago, the science of zoology ran a serious risk of being embedded in paraffin. This calamity was happily averted, and the young naturalist hies again to the seahore; but the first line of Dr. N. B. Eales's preface suggests that the poisonous breath of the examiner follows him even there. It may be so; but the fresh air, and the spirit of Edward Forbes and Sir John Graham Dalyell cleanse and sanctify the place, and keep it as sweet as ever. In Edward Forbes's day and for years afterwards, we led the way in the literature of natural history. Forbes and Hanley, Yarrell's "Birds" and Gould's, the early British Museum catalogues, the Ray Society volumes and the Challenger Reports had no rivals. Alas, it is not so now. We might have undertaken the new "Systema Naturæ", but Berlin took the "Tierreich" in hand. There is a "Fauna of the North Sea", but it is written in German; there is an excellent "Faune de France", but none of the British seas.

Dr. Eales has not attempted the task, too big for one pair of hands, of writing a British Fauna, but she has compiled a careful and copious account of the fauna of the sandy beach and the rock-pools; and the shore-fauna is liberally interpreted, for while the sea-mouse must stay outside, the feather-star and the purple heart-urchin, and pinna and the oyster itself are allowed to enter in. Philip Henry Gosse did the same thing more than eighty years ago, and the two little green volumes of his "Manual of the Marine Zoology for the British Isles" were used and loved by many. His plan was different from Dr. Eales's; for he included all the species as best he could but only defined the genera, while Dr. Eales defines the species, but only a selection of these. Gosse's illustrations were the best part of his book; they were only thumb-nail sketches, but they were drawn from life, and every one is unmistakable. The "littoral fauna" defines itself; and yet it took Edward Forbes to show its peculiar character. How in doing so he made good use of Örsted's "De regionibus marinis" and Audouin and Milne-Edwards' "Recherches pour servir à l'histoire naturelle du littoral de la France"; and how very beautifully he himself wrote about it all, and especially about his own so-called "Celtic province", is an old story and a fine chapter in the history of science.

To write like Edward Forbes or to draw like Gosse is no longer given to mortal man. But after the fashion of our own day Dr. Eales has done her work well and handsomely, and many a stude will find precisely what he wants in her book. would cavil over one thing only—the extren correctness, or modernity, of Dr. Eales's nome clature. When Dr. Marion Newbigin wrote h "Life by the Seashore" she apologized for keepi to many old-fashioned and familiar names, witho which such a book as Gosse's "Sea-anemone could no longer be understood. But Dr. Eales w have no half-measures; we must call the on familiar Trochus millegranus *Cantharides clelana* and Saxicava rugosa *Hiatella gallicana*, and so o whether we like it or no.

D. W. T.

MORE ABOUT MICROBES

Microbes by the Million

By Hugh Nicol. (Pelican Special, S28.) Pp. 248 + 8 plates. (Harmondsworth, Middx.: Penguin Books, Ltd., 1939.) 6*d*.

THIS is a wonderful six-pennyworth, and a very interesting and instructive little book. It is written in simple language understandable by ordinary folk, with a considerable sense of humour, and conveys much accurate information on microbes, what they are and what they do.

Commencing with an introduction dealing with the nature of microbes and describing their several kinds—fungi, protozoa, bacteria and algæ—successive chapters deal with the phenomena of their life and the processes associated with their growth and development. In the last hundred pages, chapters are devoted to microbes in the home, in the soil and in the garden, the mechanism of formation of fairy rings, the discharge of its spores by the fungus Sphærobolus, the miracle of the bleeding host, and to a microbe foray on the Norfolk Broads.

Chapters at the middle of the book deal with laboratory technique, and a number of simple experiments are described for the study of microbes in the soil and their influence upon plant and crop life and development, and on the microbiology of disinfectants. All this is set out in interesting fashion, and the reader who has mastered the contents of this little book should have a good idea of the essentials of microbiology and of the importance of microbes for the growth of plants, in the firing of hay-stacks and in the production of silage, and as sources of certain perfumes, drugs, dyes, foods and drinks. A brief but useful chapter is also devoted to stereochemistry—'looking-glass chemistry' as the auth terms it—and Pasteur's work on the tartaric aci is related. No errors of moment have been detecte and the book is adequately illustrated with number of line drawings and six excellent plate

On the pasteurization of milk (pp. 138–140 the author tells but a part of the story, and giv an unfair and inaccurate idea of the objec of the process. Professors do not seem to me with his approval (p. 52), nor do doctors an the medical profession, who are arrogant an ignorant, and—most unkindest cut of all—co cerning milk pasteurization, have "become alli of the merely commercially-minded wholesaler which may seem strange unless one understand medical mentality (p. 139)". A more kindl outlook might have been expected, for so microbiologists owe much to the work of medic bacteriologists.

We gather that the author in writing this boo intended not only to instruct his readers in so and general microbiology, but also desired t extend the 'philosophy' of microbiology to scienc in general, and to impart ideas on the impacts o science upon the social order. In an epilogue, h discusses experimentation and the various meanings given to the term 'experiment', and the valu of statistical analysis of experimental work, bu we think that in his illustrative examples he i less happy than in other parts of the book. Hi remarks on company finance and on the 5½ pe cent *C* stock of the London Passenger Transpor Board, introduced in discussing ratios, also seen out of place and ill-conceived.

With these few criticisms, we leave the book i the hope that it will be widely read and appreciated

R. T. HEWLETT.

PRELIMINARY RESULTS OF THE MARKING OF WHALES BY THE DISCOVERY COMMITTEE

By George W. Rayner

FROM the outset of its investigations, the Discovery Committee has considered whale marking to be a method of considerable importance in approaching many of the problems to be olved in a study of the life-history of whales. It was, however, found difficult to design an efficient mark, and it was not until 1932 that a suitable orm was produced. The mark then adopted consists of a stainless steel tube fired at the whale by means of a 12-bore gun ; it is designed to penetrate the blubber and to remain embedded until the whale is captured and dismembered by the whalers. This form of mark was given a trial during the whaling season of 1932–33 and the results forthcoming during the ensuing year were so encouragng that an extensive programme of whale marking was planned and carried out during 1934–35 and the three following seasons.

In 1934 the Committee's ship, the R.R.S. *William Scoresby*, was commissioned solely for whale marking purposes and spent the whole of the 1934–35 season on the Antarctic whaling rounds lying eastwards of the Greenwich meridian nd extending almost as far as the longitude of Western Australia. At the same time a hired whale atcher operated for about six weeks in the middle f the season from South Georgia, where the area covered was much more restricted. This programme, with the *William Scoresby* working for the whole season on the pelagic grounds to the east and the whale catcher covering a small area round South Georgia in an intensive manner, was repeated during the following two seasons, 1935–36 nd 1936–37. In 1937–38 the programme was modified ; only the *William Scoresby* operated and her work was planned to fill in gaps and to amplify, in the light of results already obtained, that accomplished previously. She commenced earlier in the season to the north of South Georgia and worked eastwards to the Greenwich meridian, then westwards again along the ice edge before the whaling season commenced. She then marked whales across the mouth of the Weddell Sea and made two incursions into the Bellingshausen Sea.

On Chart I is depicted the distribution and ntensity of the marking carried out since 1932–33. There is an area of intensive marking around South Georgia, with a small area around the Shag Rocks, 120 miles westward of the northern point of South Georgia, where very many whales—more than six hundred—have been marked. There are further two extensive areas in which relatively large numbers of whales have been marked, one off Queen Mary Land (85° E.–95° E.), and a second off Enderby Land (15° E.–50° E.). In addition, whales in lesser numbers have been marked over an immense area connecting and extending the regions of more intensive marking ; on the chart the continuous longitudinal lines show where this marking has been relatively dense, the broken lines where it has been scattered. The areas of more intensive marking correspond to some extent with the grounds mostly frequented by the whalers.

The whales supporting the Antarctic whaling industry are, in order of their importance, Blue, Fin and Humpback, the last being relatively unimportant. The majority of the Humpback whales marked have been found off Queen Mary Land. Whales marked around South Georgia have been predominantly Fin, and in the area around the Shag Rocks exclusively so.

Numerically the results are given in the following table :

Species	No. marked	Returns No.	%
Blue	668	33	4·94
Fin	3902	118	3·02
Hump	548	36	6·59
Sei	28	—	—
Right	8	—	—
Sperm	56	—	—
Totals	5210	187	—

In addition to the three commercially important species, it will be seen that an insignificant number of the less important and rarer species have also been marked. The number of marked whales reported as captured is 187, and these have been taken at intervals after marking varying from a few hours to fifteen hundred days.

Since it is not certain how many marks drop out or are missed by the whalers, the percentage figures are not an absolute indication of the percentage of marked whales killed, but they are very instructive as to the relative effect of whaling on

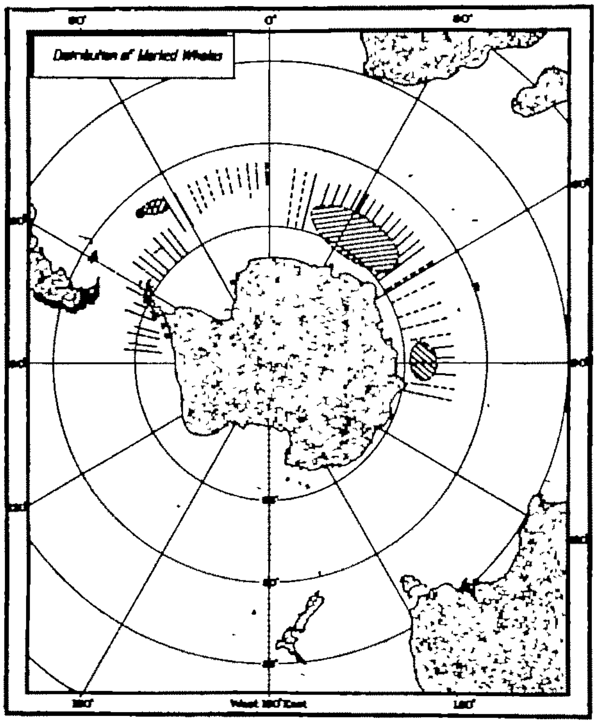


CHART I.

the stocks of the different species. The Blue whale is the species most eagerly sought after by the whalers, although the Fin whale is far commoner. The percentage figures show how the stock of Blue whales is being depleted at a considerably faster rate than that of Fins—5 per cent of the marked Blue whales have been reported killed as opposed to 3 per cent of the marked Fin whales. The percentage of marked Humpbacks taken compared with the figures for the other two species is striking, and it is evident that this whale is being killed off at a surprisingly faster rate than the other two. Soon after whale marking commenced, whaling during the southern winter was resumed off the north-west coast of Australia. This fishery is based on Humpbacks and considerable numbers were taken. Marks recovered showed that these whales were of the same stoc as those marked in Antarctic waters off Quee Mary Land (see Chart II). This stock of whal was, therefore, exposed to a double persecutio which accounts for the comparatively high percen age figure of returned marks. Still more recentl whaling, again exclusively based on Humpback has broken out during the winter season to th south of Madagascar. This double persecution Humpback whales, which their habits rend particularly easy, cannot fail to have a very marke effect on the comparatively small stock, which bearing a burden relatively more than double th of the Fin whale stock and considerably high than that of the Blue stock, already regarded overtaxed.

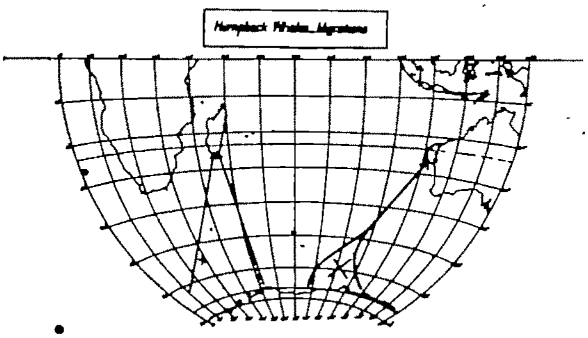


CHART II.

The marks recovered have yielded a gre deal of information on the movements an migrations of the three commercially importa species. Very little indeed had been known pr viously about the wanderings of whales, and wha has been conjectured has rested almost wholly o circumstantial and indirect evidence. The recovere marks demonstrate two main general features whale movement, complementary or contradictor in character as one may care to consider them. O one hand, whales return to the same part the Antarctic season by season on regular track of migration—they may be said to have a stron homing instinct. On the other hand, they tend t spread around the Antarctic from one region t

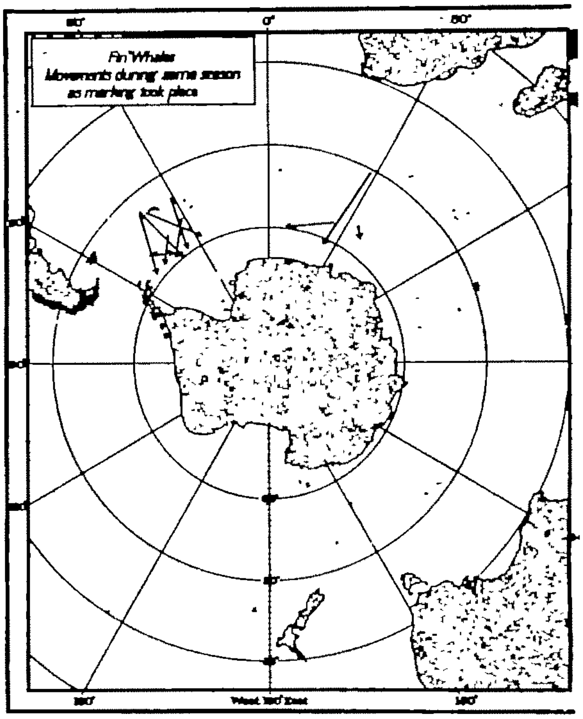


CHART III.

other, a form of movement going on slowly and adually and so far only demonstrable among ues and Fins. One might say that, among the neral body of whales keeping to their regular annels of movement, a few are affected with a anderlust leading them to seek new oceanic stures and fresh companions.

On the accompanying charts the general trends movement and migration are indicated by the rows, the crosses show places where whales have en taken very near the position where they were arked. Possibly more was known about the grations of the Humpback whales than of any er species, and a north and south migration ng the western coast of Australia has been contured for some time past. Marking has confirmed is and has demonstrated almost the full course this migration. Humpback whales marked in Antarctic have been taken in the southern nter off the north-west coast of Australia after ervals up to three and a half years, whilst they ve appeared in the southern summer on the tarctic grounds near Queen Mary Land one, o and three years after marking. One may nfidently say there is an annual north and south gration of Humpback whales along the track own on Chart II. In the western part of the dian Ocean a similar north and south migration idently exists between the Antarctic and the gion of Madagascar. There is shown the return the same area of the Antarctic and the recovery in the tropics during the southern winter. It is most noteworthy that there has been no interchange of Humpbacks between these two regions.

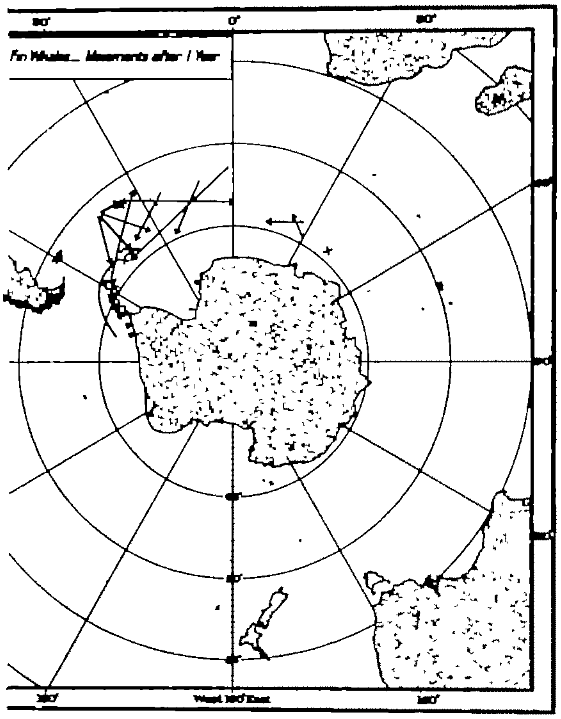


CHART IV.

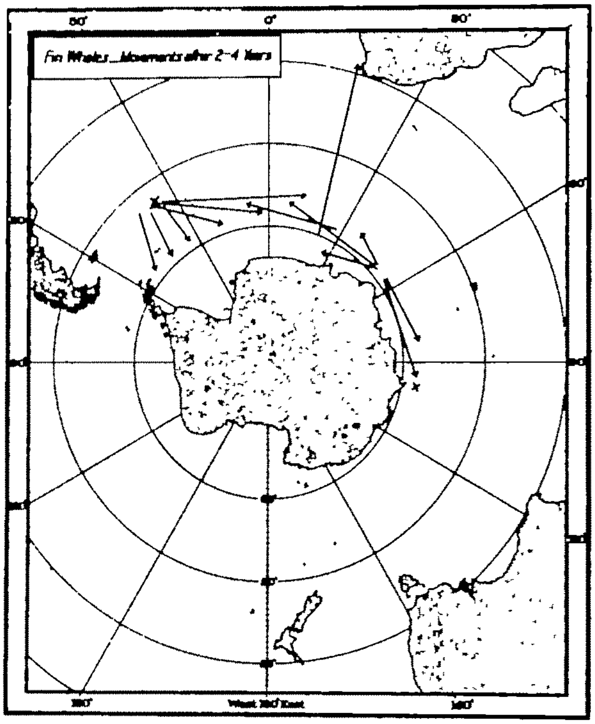


CHART V.

The movements of Fin and Blue whales have been plotted on the accompanying charts according to the time elapsing between marking and capture. Chart III gives the movements of Fin whales during the course of the whaling season, and it shows a general movement southwards towards the edge of the pack ice. A number of Fin whales marked around South Georgia have been taken there during the same season, but never after an interval longer than a few days, so one may consider Fin whales found in these waters to be migrating whales. Further, none of the large numbers of Fin whales marked near the Shag Rocks has been taken the same season by the South Georgia whalers, so there can be little easterly movement here during the season. There is strong evidence that there are regular tracks along which different bodies of Fin whales move on their migrations southward, and it is probable that these tracks may shift a little from season to season.

The movements of Fin whales after a year's time are shown on Chart IV. There has been in many places a return to the same place as marking took place. Further, some arrows show movements which mean essentially a return to the same area both in the east and in the South Georgia – Weddell

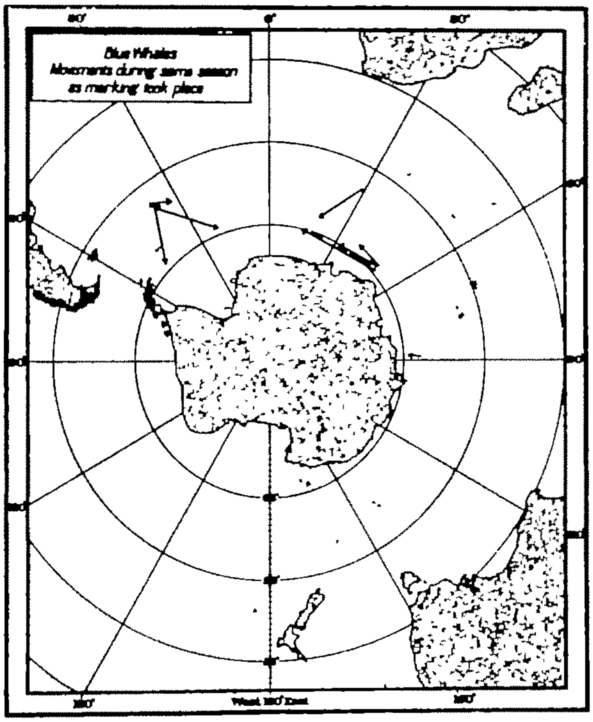


CHART VI.

Sea region. Whales marked around the Shag Rocks have turned up in force near South Georgia and many have been taken to the south again, evidently repeating their movements of the previous year. But wider movements are to be seen, indicating the beginning of spreading. Whales have come into the Scotia Sea area from regions as far apart as the Bellingshausen Sea and the neighbourhood of Bouvet Island, whilst a considerable movement outwards towards the east has taken place.

After longer periods, Chart V, the same description holds good, but the spreading movement is gathering force. There is still a return to the old grounds, but whales have spread outwards from the Enderby Land region eastwards and westwards, and the eastward movement from South Georgia has progressed farther. There are now links connecting more than 180° of longitude, but this movement around the Antarctic may be likened to a relay race in which no individual competitor completes the whole course; in fact, it may be suggested that a complete circumnavigation of the continent may take more than a single generation. The significance of this is that whilst the Fin whales of the Antarctic remain specifically one stock, economically several distinct local stocks may be recognized.

One marked Fin whale has been taken at Saldanha Bay, South Africa, after 2¼ years, and this is the first direct evidence of the migration of Fin whales from the Antarctic towards the tropics. This whale is of particular interest, for wh
marked it was logged as a calf accompanying
mother.

The movements of Blue whales are in ma
respects very similar to those of Fin whales, b
the picture is not so clear. Around South Geor
many marked Blue whales have been taken t
same season as they were marked, but never af
an interval longer than a week, so Blue wha
found here must be on the move and do n
remain long in the vicinity of the island. Th
general movement is southerly and to the west
east (Chart VI). This same general southe
movement is shown on the grounds to the ea
but off Enderby Land there is strong evide
of a definite westward moving stream of B
whales.

After one year, Chart VII, there are returns
the same area as was visited the previous seas
but there is also considerable spreading. Ende
Land whales now show considerable movement
the east which may be considered complement
to their westward movements during the summ
After longer periods of time the spreading mo-
ments shown are actually less than those for
period of about twelve months, but through
the homing instinct is well maintained; it is e
to see that mixing between the different region
going on quite slowly, although it is sufficient
the identical specific characteristics to be retai
throughout the whole population.

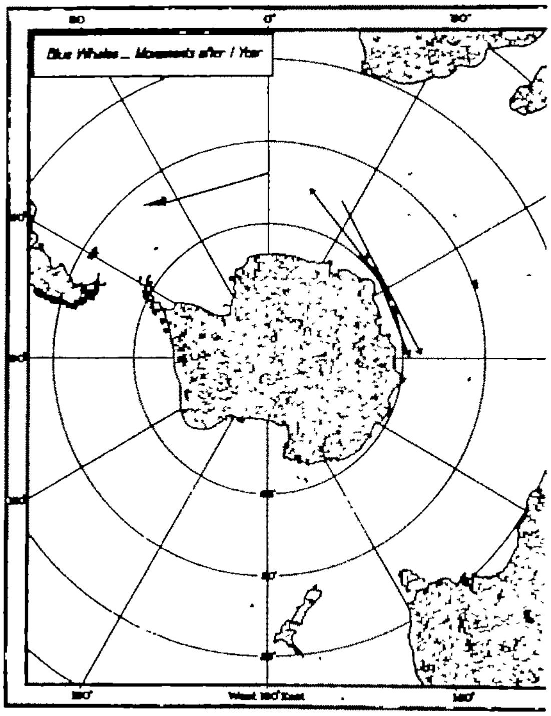


CHART VII.

THE ANTIMONY TREATMENT OF KALA-AZAR

By Sir Leonard Rogers, K.C.S.I., C.I.E., F.R.S.

THE progress during the last quarter of a century, due to many workers, in the treatent of the deadly kala-azar of north-east India d the Mediterranean basin has not attracted the tention it deserves. The epidemic form spread o hundred miles up the Brahmaputra Valley in e last two decades of the nineteenth century, th a case mortality of 96 per cent, and it caused reduction of 31·5 per cent in the population of e Nowgong district in one decade. In 1890 M. Giles incorrectly reported kala-azar to be e to hookworms; in 1897 L. Rogers failed to fferentiate the fever from malaria, but established a house or site infection, which enabled dds-Price to stamp it out of tea estates. The tension of the epidemic to the east was thus ecked for two decades, until the influenza outeak of 1918 caused kala-azar to break out again the Sibsagar district.

In 1903 Leishman and Donovan independently scovered the human stage of the causative otozoal parasite (*Leishmania donovani*), which nald Ross called after them when the flagellate age was discovered by culture by Rogers in 04. Work in the Calcutta Medical College spital also proved that the malarial cachexia of vining (1835) is nothing but a sporadic form of la-azar. The very similar *Leishmania tropica* is e cause of oriental sore, and it was the discovery 1913 by Vianna in Brazil of the effectiveness of rtar emetic intravenously in that infection that l to its successful trial in the Mediterranean in fantile kala-azar in Sicily by Cristina and Caronia ported early in 1915. Rogers immediately ported that he had independently obtained good sults with tartar emetic in the India kala-azar ter trying other antimony preparations, and in tober 1915 both he and Muir published their sults. Further trials showed that both sodiumtimony tartrate, and a colloidal solution of timony sulphide, made by Fisher of the Madras lucational Service, were equally effective and ther less toxic than the potassium salt.

This important discovery came in time to able McCombie Young to control the Sibsagar tbreak through two to three months' intravenous jections of tartar emetic in 80,000 village cases Assam by 1921, with a recovery rate of 88 per nt, against 4 per cent in the early Nowgong idemic. Moreover, the next census showed no ll in the Sibsagar population. Muir also found at systematic treatment of cases in the Kulna hospital led to the disappearance of cases coming from the surrounding villages, and thus kala-azar became an easily controlled disease, given sufficient medical staff, as tartar emetic is very cheap.

It remained for the chemists in India and Europe to seek for even more efficient antimony preparations, and they naturally turned to the less toxic pentavalent ones. The first of these was introduced (and patented) by Dr. U. N. Brahmanchari in Calcutta in 1921, under the name of urea stibamine. This proved less toxic and more effective, and it enabled more than 90 per cent of cases to be cured by intravenous injections within a few days, although so late as 1928, R. N. Chopra, professor of pharmacology in the School of Tropical Medicine, Calcutta, reported this preparation to vary widely in its antimony content and to be uncertain in its composition. In the meantime, von Heyden in Germany prepared a series of pentavalent antimony salts, which were comprehensively tested by L. E. Napier in the hospital of the Calcutta School of Tropical Medicine. Both von Heyden 471, or stibosan, and 693, neostibosan, proved effective, and the latter proved to be the best, with more than 90 per cent of cures after eight daily intravenous injections. In 1937 a final advance was made by the introduction by Kikuth and Schmidt of solulostibosan, which Struthers and Lin in China, and Yates and Napier in Calcutta, found to be equally effective by the much more convenient intramuscular injections, especially in the young children so frequently attacked by kala-azar.

The value of neostibosan is shown by a systematic treatment of all the kala-azar cases in a group of Bengal villages by Napier, with a reduction from 121 and 127 in the first two years, to 12 and 3 in the fifth and sixth years and later to nil. Further, between 1923 and 1933, the Assam Government treated more than 300,000 cases, and relied largely on urea stibamine, which was adopted as the preferable drug in 1935. Between 1925 and 1936 the treated cases in Assam fell to one sixth and the deaths to one ninth of the former rate.

Unfortunately for such a poor country as India, the more rapid effects of the pentavalent preparations over the original trivalent tartar emetic is offset by a curative course of the former costing 160 times as much as the latter, according to Napier, who in 1925 found a course of stibosan to cost £2 5*s*. and one of urea stibamine £3—a prohibitive sum for poor villagers in India. Napier found the village cases near Calcutta to amount to 33 per thousand population, a rate which would give one million in Bengal. The true number must be much less, as in large areas the prevalence is far less than near Calcutta. Owing to their much more scattered distribution in Bengal than in Assam, and the absence of qualified doctors in India villages, the problem of treatment in Bengal more difficult, and requires for its solution a f cheaper preparation, which is equally effective the pentavalent antimony ones. With such a dru and sufficient village medical staff, kala-azar coul be reduced to small proportions.

OBITUARIES

Sir William Prout, K.C.M.G., O.B.E.

THE death of Sir William T. Prout occurred on November 18, at his residence at the Manor House, Lingfield, Surrey. He was born in 1862, the son of Mr. William Prout of Mauritius, and was educated in the University of Edinburgh, graduating in medicine in 1884. He served as a medical officer in Mauritius until his transfer as an assistant Colonial surgeon under the Colonial Office in the Gold Coast in 1888, serving later in the Gambia until his promotion to the post of principal medical officer in Sierra Leone in 1895, where he was an official member of Legislative Council until his retirement in 1906.

During his service in these territories, Prout acquired valuable knowledge and experience in the treatment of tropical diseases, publishing original papers on yaws ("Diseases of Warm Climates" Davidson); *Filaria volvulus* (*Arch. Parasit.*, May 1901); filariasis in Sierra Leone (*Brit. Med. J.*, 1902), etc. He was actively interested in the preventive aspect of tropical medicine, and in the improvement of conditions of life for both Europeans and natives. It was largely due to his initiative that application of the principles of tropical sanitation became increasingly employed in West Africa and elsewhere, with the corresponding improvement in life and health which has been such a marked feature in the early years of this century.

Following his retirement from West Africa in 1906, Prout became honorary lecturer in tropical medicine in the University of Liverpool. He was appointed medical adviser to the Colonial Office in 1912, and later became consulting physician to the Colonial Office until his retirement in 1929, serving during the War of 1914–18 with the R.A.M.C. in Egypt, and being twice mentioned in dispatches. He was one of the original members of the Advisory Medical and Sanitary Committee of the Colonial Office of which he remained a member until his death, and was an ex-president of the Tropical Section of the Royal Society of Medicine, a fellow of the Royal Medical Society, Edinburgh, and a fellow of the Royal Society of Tropical Medicine.

The honour of C.M.G. was conferred on him in 1905, that of knighthood in 1924, and K.C.M.G. in 1928, while he also received an O.B.E. (military) for his war service.

He married Miss Mary Mackenzie in 1888 and had two children, a son being killed during the War of 1914–18.

A. E. HORN.

Mr. P. H. Grimshaw, I.S.O.

PERCY HALL GRIMSHAW found the bent of his li when in 1895 he forsook a clerk's stool in a bank Leeds to fill a post in the Royal Scottish Museum Edinburgh. His earlier interests had been botanic but the chance that, of his colleagues in the Natur History Department, Dr. R. H. Traquair was pa ticularly interested in fossil fishes and Dr. Eag Clarke in birds and mammals, turned his attenti to the lower forms of animal life, and he singled o for investigation the insects and particularly t Diptera. His papers, mostly published in the *Anna of Scottish Natural History* and its successor t *Scottish Naturalist*, which for many years he assist in editing, added greatly to the knowledge of t distribution of insects in Scotland, and he travell widely on the mainland and in the outer islands collect material for his "Diptera Scotica" and oth contributions.

One of his interesting discoveries was the presen in Great Britain of a bot-fly (*Cephenomyia rufibarb* parasitic on red-deer, and his study of the life-histo of the destructive heather-beetle (*Lochmaea suturali* made in connexion with the Committee of Inqui on Grouse Disease, suggested the few measures control which seem to be possible.

When he was appointed keeper of the Natu History Department of the Royal Scottish Muse in 1930, Grimshaw continued the development of t educational appeal of the exhibits, and under supervision was created a Children's Gallery whi for the attractiveness and suggestiveness of collections would be difficult to beat.

On his retiral from the keepership in 1935 he w decorated with the Imperial Service Order. He di suddenly on November 14, at the age of sixty-ni years.

JAMES RITCHIE.

Prof. Anton von Eiselsberg

PROF. ANTON FREIHERR VON EISELSBERG, eminent Vienna surgeon, who died last October, w born at Steinhaus in Upper Austria on July 31, 18 He received his medical education in Vienna, Wu burg, Zurich and Paris, and qualified in Vienna 1884. After serving as assistant to Prof. Billroth, pioneer in visceral surgery, he was appointed succ sively professor of surgery at Utrecht (1893), Köni berg (1896) and Vienna (1901), where he retired 1931. Besides being a first-class operator and markable teacher, he was the author of numerous perimental and clinical publications, of which the ost important were on the occurrence of tetany after erations for goitre (1890), diseases of the thyroid 903), and the modern treatment of fractures 905). He was also co-editor of the *Archiv für inische Chirurgie*, which dedicated to him its 0th volume on the occasion of the twenty-fifth niversary of his professorship in 1926, and of the *itteilungen aus der Grenzgebiete der Medizin und irurgie*. During the War of 1914–18, in which he as appointed consultant to the Austro-Hungarian avy, his services were much in request especially regards abdominal wounds and amputations.

Eiselsberg had many friends in Great Britain, where was elected Hon. F.R.C.S. Edin. in 1905, Hon. R.C.S. England in 1913, where he delivered the nterian Lecture in 1932, and honorary fellow of the yal Society of Medicine in 1928. His autobiography, der the title of "Lebensweg eines Chirurgen", peared a few months before his death.

J. D. Rolleston.

Prof. R. I. Meyer

Prof. Richard I. Meyer, whose death, at the e of seventy-four years, occurred on June 18, was e of the best known inorganic chemists in Germany. rn in Berlin on August 24, 1865, he built up a putation early in life by his researches on rare rths, thallium and scandium; his discovery of andium in tungsten and tin slags enabled him to oduce this element—then considered one of the rest—in sufficient quantity for its thorough chemical d physical investigation. From 1897 onwards, for enty-five years, Meyer was associated with Prof. thur Rosenheim in Berlin in the conduct of a ivate scientific chemical laboratory in which, under e guidance of these two men, university students rried out valuable research work in inorganic emistry—a branch of chemistry frequently neg- ted in the official university laboratories in rmany, which were almost without exception ected by organic chemists.

On his retirement from this laboratory in 1922, of. Meyer was entrusted by the German Chemical ciety with the organization of the eighth edition "Gmelin's Handbook of Inorganic Chemistry" ich, in this new form, is as outstanding in its ld as is the famous "Beilstein" handbook in organic emistry. The achievement of this high standard lue to the comprehensive editorial programme laid wn by Meyer, to his discriminating choice of co- rkers, and to his careful supervision of every detail the publication of the first twenty or so volumes. en after withdrawing from the editorship, he helped writing the manuscript of the introductory volume rare earths; his name, however, was omitted from title page when the volume appeared in print—a e which quite frequently befell 'non-Aryan' authors Germany after 1933.

Not only in his editorial activities were Prof. yer's organizing abilities of high value, but also in work as one of the members of the International Committee on Atomic Weights—for the reports of which he was largely responsible—and as a member of the International Committee on Inorganic Nomenclature. Everybody who came in touch with him was delighted to find not only a chemist of wide erudition and outlook but also a highly cultivated man of great personal charm who was as interested in questions of art, especially music, as in science. It was a matter of intense pleasure and pride to him to see this part of his inheritance come to full development in his highly gifted only son, who became a successful orchestral conductor.

No obituary article on the work of this excellent chemist appeared in any German journal; no official representative of the German Chemical Society attended the funeral of the man who had so devotedly worked for many years in the society's publishing offices. Nevertheless, his name will be gratefully remembered inside and outside Germany as the first editor-in-chief of the new "Gmelin" by present and future generations of chemists who will consult this monumental work.

Prof. F. Y. Loewinson-Lessing

Science, not only in the Soviet Union, but also the world over, has suffered a great loss in the death on October 24 of Prof. F. Y. Loewinson-Lessing, member of the Academy of Sciences of the U.S.S.R. and director of the Petrographical Institute in Moscow.

Franz Youlievich Loewinson-Lessing was born in St. Petersburg on March 9 (February 25, Old Style), 1861. After graduating in 1883 at the University of St. Petersburg, he worked for some years as an assistant at that University. In 1892 he was appointed professor of geology, petrology and mineralogy at the University of Dorpat (Youriev) and in 1902 was the first holder of the chair of geology, petrology and mineralogy in the newly founded St. Petersburg Polytechnic Institute. In 1925 he was elected a member of the Russian Academy of Sciences and director of the Geological Museum. He was the founder and first director of the Petrographical Institute. He was an honorary or foreign member of a number of scientific societies at home and abroad, including the Geological Society of London.

Prof. Loewinson-Lessing was the leading petrologist in Russia and was well known internationally. The bulk of his work was published in Russian, but he also contributed quite a number of papers to English, American, French and German periodicals. Although his main interest was in the petrology of igneous rocks, he published a number of papers dealing with mineralogy, geology and ore-deposits. His books include "Tables for the Determination of Rock-forming Minerals" (English translation, 1893), "Petrographical Tables" (1905, 1911), "Text-book of Crystallography" (1911, 1923), "Introduction to Geology" (1923), "Progress of Petrology in Russia" (1923), "Petrology" (1925), "History of Petrology" (1936, English translation forthcoming). Altogether he was responsible for more than two hundred papers and books.

Prof. Loewinson-Lessing's field work covered almost the whole of the territory of European and Asiatic Russia. He began his work in Karelia and the Caucasus and then extended his activity to the Crimea, the Ural Mountains and Siberia. His petrographical descriptions of the rocks of these regions were used as models by other petrologists. Field description, petrography and petrochemistry of rocks are well blended in all his works. In the domain of theoretical petrology, he is well known for his chemical classification of igneous rocks and his syntectic-liquational hypothesis of magmatic differentiation. In spite of the stress laid by him on liquation as a factor of differentiation, his views on this subject were rather eclectic.

As a teacher, Prof. Loewinson-Lessing was excellent. It is a matter for wonder that he could, in addition to all his research activities and his official duties, contrive to hold numerous classes for students. His lectures were always inspiring and he never lost his freshness of outlook or his mastery of presentation. During a half-century of teaching he trained hundre of geologists and petrologists. He will be affectio ately remembered for his kindness and his help a inspiration by all his colleagues and pupils, amo whom the present writer is proud to inscribe hims

S. I. Tomkeieff.

We regret to announce the following deaths:

Prof. Viggo Christiansen, emeritus professor neurology in the University of Copenhagen, preside of the International Congress of Neurology h last August, on November 3, aged seventy-o years.

Dr. J. F. Lewis, past president of the Ro Photographic Society, on November 28, ag seventy-two years.

Sir Ernest Scott, emeritus professor of history the University of Melbourne, and president in 19 of the Australian and New Zealand Association the Advancement of Science, aged seventy-one yea

NEWS AND VIEWS

Indian Archæology and Indian Problems

Sir Leonard Woolley's Birdwood Memorial Lecture to the Royal Society of Arts, on December 1, was in effect an addendum to his official report to the Government on the organization of archæological studies in India; and it should receive no less careful consideration than the major document when in due course it appears in print. For in the freer atmosphere of the lecture hall, Sir Leonard evidently felt at liberty to allow his trained faculty of scientific imagination to play on the archæological material which had come before him, and to submit the result to his audience in a selection of the problems and possibilities which the study of Indian archæology presents to his mind as calling urgently for investigation—problems no less fascinating in the vistas of the advancement of knowledge they open up than they are evocative of dismay when contemplation turns to the vastness of the field in time and space to be covered. Nor was any short cut offered which might lead by an easy way to the solution of these problems. While Sir Leonard paid due tribute to the work of Lord Curzon in setting up the Archæological Survey of India, and the work which has since been carried out in the triple function of conservation, excavation and publication, he went on to point out with the greatest emphasis that no further advance on sound lines is possible until the essential preliminary groundwork has been completed and a backbone has been built up in a sequence scheme of Indian cultural history. This is the essential task to which effort must first be directed.

It was suggested in Nature of October 28, p. 721, that the inauguration of a new era in India's history might fittingly be marked by the institution on a sound and lasting basis of a scheme of research a study on broad lines of the racial and cultural histo of India. In such a scheme archæological investigati would inevitably take a foremost place. As S Leonard said, "The whole country from north south is strewn with standing monuments of t greatest interest and the greatest beauty and t utmost historical value." He then pointed out th in his analysis of the cultural elements of the ancie monuments of India, certain factors had emerg from which he proceeded to draw conclusions s nificant for the India of to-day. In the architectu of the monuments, he showed, the Mogul strain, wor ing in stone, and the Dravidian, a style derivati from the technique of the worker in wood or ev the jeweller, constituted a clash in styles reflecting political and moral breach between two elemen still represented in the population of to-day. Nev theless, the clash had been resolved in the triump of the Taj Mahal, the Delhi fort, and more especia in Fatehpur Sikri, which showed conclusively th the genius of the two peoples "can combine fruitfu and fertilely". Novel views of the relation of nor and south, thrown out as suggestions presented the results of Sir Leonard's inspection of specifi sites, offer a field of research which, when once t essential groundwork has been completed, mig offer to the Indian peoples a source of unity in pri in their joint cultural achievement in the past.

School of Oriental and African Studies

Notwithstanding the transfer of the School Oriental and African Studies of the University London to Christ's College, Cambridge, the buildi of the School's new premises in the University London area is being pushed forward, and should npleted, if nothing untoward intervenes, by May xt. It was intended that the School should open re for the session 1940–41. In the recently issued nual report for the session 1938–39, the first of rd Harlech's chairmanship of the Governing Body, s recorded that, in response to an appeal which he, Mr. Ormsby-Gore, when Secretary of State for Colonies, had put forward, the Colonial Office s promised a sum of £4,380 per annum in subntion of the work of the School, while a grant of ,500 has been made by the University Court for remainder of the quinquennium for the establishnt of five posts—one lectureship in Japanese, one Turkish, and three in Arabic dialects, while a later nt of £500 for a period of not less than three years s made for a lecturership in Sinhalese. The number students, though representing a slight decrease, s still more than four hundred. While the mbers from Great Britain and the Empire owed a decrease, there was a considerable dition to those from Germany and the United ates.

In the course of the report, reference is made the valuable assistance towards African studies ven by grants from the Rockefeller Foundation ich during the last seven years have amounted in ms allocated to public bodies and to individuals a total of £18,000. It will be remembered that was through the assistance of a grant from this urce, spread over five years, that the International stitute of African Languages and Cultures was abled to plan and carry out its valuable scheme of ganized African research in the field, of which the nefit is now becoming apparent not only in the onographs in course of publication but also in e projects for further research which directly or directly have sprung from that scheme.

r. Jean Paul Marat

In a recent paper (*Hippocrate*, 7, 379; 1939) Dr. enri Candiani protests against the unjust and cruel eatment which Marat has received not only from urrilous pamphleteers but also from reputable storians such as Michelet, Taine and Carlyle. While t attempting to refute all the legends and calumnies ncerning the "Friend of the People", Dr. Candiani nfines himself to the scientific and medical aspects his hero. So far from being a charlatan or merely a rse-leech, as Carlyle called him, he was a properly ualified medical man of St. Andrews who, during s residence in London, had a good practice in Soho hen that district was a fashionable quarter. His Essay on Man" (1775), more than half of which is voted to anatomy, is a philosophical and psycho-gical work, in which he has been recognized as the ecursor of Cabanis, Broussais and Gall. In his Essay on Gleets", published the same year, he iticized certain errors of treatment current at the me, including the use of hard and irritating bougies, r which he substituted softer instruments. In 1776 made an important contribution to ophthalmology his "Enquiry into a Singular Disease of the Eyes", in which, as Prof. Truc of Montpellier has shown, he gave a description of astigmatism which preceded the classical account of Thomas Young by more than twenty years. But it was as a pioneer in electrotherapy, on which he wrote in 1782 and 1783, that Marat chiefly deserves mention in the history of medicine. According to Dr. W. G. Turrell of Oxford, his work on this subject was on far more scientific lines than the writings of any of his predecessors or even than the publications of many of his successors. In conclusion, Dr. Candiani describes Marat as a conscientious experimenter, resolutely hostile to absurd theories or hasty generalizations.

Food of Game Ducks

VARIOUS causes have contributed to reduce, to a serious extent in some cases, the numbers of game ducks in the United States and Canada, and the interest of the public and the self-interest of the multitude of shooters alike demand that measures should be taken for the encouragement and multiplication of the duck population. The U.S. Department of Agriculture has responded to the demand by the publication of a pamphlet (Washington, D.C.: *Tech. Bull.* No. 634; 1939) of 156 pages and 153 plates, with the aim of spreading dependable information on which programmes for the improvement of breeding and feeding grounds may be based. To minimize waste of funds and loss of effort through the introduction of unsuitable foods, it is essential that the important plant and animal foods of the various species be known and that consideration be given to the range of particular species and environmental and other limiting factors. By making use of data accumulated through many years by the Biological Survey, the authors, A. C. Martin and F. M. Uhler, have presented a thorough-going treatise which from three aspects gives a lead to duck conservation and propagation. The first section presents a census of foods, based upon analyses of nearly 8,000 stomachs or gullets of eighteen species of game ducks, and indicates the regions in the United States where each food is preferred. The second part, by means of photographs and concise descriptions, is designed to facilitate recognition of these foods; and the third part contains practical suggestions on the propagation of the food of waterfowl and the development of feeding grounds.

Fauna of the Marquesas Islands

ISOLATED in the central Pacific Ocean, farther from the continents than any others, with one exception, themselves the relics of volcanoes perhaps of Pliocene age, the Marquesas Islands afford a perfect setting for the study of an oceanic island fauna. The study has been carried out with thoroughness by A. M. Adamson, who spent fifteen months collecting on the Islands and has made a survey of the literature bearing on the problem (*Bull. Bernice P. Bishop Museum, Honolulu*, 159, 93; 1939). Marquesan animals are related to those of the island groups lying to the west and south-west, Samoa, Society, Cook, etc., but they show little affinity to the fauna of Hawaii. The faunal drift has been ultimately from the Indo-Malayan region, with a sprinkling of Australian forms, but whether the Islands were populated by oceanic dispersal or by way of hypothetical land bridges seems difficult to decide, and the author gives the arguments for and against both possibilities. Whatever the origin of the fauna, it dates from not later than early Tertiary times, and as might be expected isolation has resulted in the development of a high proportion of species distinctive of the Islands, although between the isolated islands of the group, variations are pronounced only in certain families. Naturally the fauna contains a varied assortment of species, particularly mammals and birds, introduced by man, some, such as the so-called 'native' rats and pigs, probably by the early Polynesian voyagers, and all the other mammals, with the doubtful exception of dogs and mice on some of the Islands, by white adventurers.

European Rural Life

A PUBLICATION of much interest has been produced by the International Institute of Agriculture in Rome. It is entitled "Documentation for the European Conference on Rural Life, 1939", but in spite of its title it contains much of real value and much that has not previously been collected into one volume. Especially valuable is the long chapter on land reclamation and improvement in the different countries of Europe, including statistical information. This leads to a chapter on the improvement of crops, stocks and rural industries, where again various State efforts are discussed. In addition, there are useful summaries of land tenure systems in Europe and a full discussion of the present and potential density of agricultural populations as well as discussion on the economics of farming in different countries. The publication runs to nearly four hundred pages, and has various references to other sources of information.

Music in Mental Diseases

DR. ARTHUR H. HARRINGTON, late superintendent of the State Hospital for Mental Diseases, Howard, Rhode Island, states that in some public institutions in the United States the value of music systematically applied with a therapeutic purpose has been recognized as an aid in institutional activities (*Mental Hygiene*, **23**, 601 ; 1939). He has found that though technical instruction for groups of patients has only a very limited value, and does not produce sufficient return for the time and effort expended, mass and group singing of properly selected compositions under proper direction with the psychological aim always in mind, has a definite therapeutic value. Instrumental music of a subdued type seems to have a desirable psychological effect at meal-times, when it produces quiet and repose. In Dr. Harrington's experience the physical act of singing increases a number of bodily functions, stimulates respiration and heart action, gives increased oxygenation to the tissues and often has a favourable effect upon morbid mental states.

Memorandum on Influenza

THE Ministry of Health has issued a revis edition of the Memorandum on Influenza, fi published in 1919 and revised in 1927 (Memo. H. Stationery Office. 2*d*. net). It is pointed out th since the great and fatal pandemic in 1918–1 influenza epidemics in England and Wales ha shown a decided preference for the first quarter the year. The disease is caused by a filterable vir and the incubation period is about 48 hours. Infecti is conveyed from the sick to the healthy by t secretions of the respiratory surfaces. Beyo adequate ventilation, with perhaps gargling with antiseptic solution after close contact with infectio little can be done for personal protection. At t first feeling of illness, the patient should go to b in a room by himself, keep warm, and seek medic treatment.

Health Problems of Industry

THE investigations carried out under the directi of the Industrial Health Research Board, Medic Research Council, during the year ended June 19 are contained in the nineteenth annual report of t Board, recently issued (H.M. Stationery Office. 6 net). These include a research on the toxicity of va ous volatile organic substances, now increasingly us as solvents in industry, work on mental integrati with special reference to accidents and vocation fitness, and on vocational aptitudes, and research on the physiological problems of heating and ventil tion. Environmental conditions, such as lighting a vision, noise and deafness, and the effects on heal produced by inhalation of dusts met with in industr have also been investigated, and summaries of t results obtained are included in the report.

National Research Council of Japan

A RECENTLY received report of the Nation Research Council of Japan (**2**, No. 8) covers t period April 1938–March 1939. In addition to pa ticulars of the serial publications issued, the repo includes summarized accounts of the annual gener meeting and of the various divisional and committ meetings, with notes on the thirteenth conference the International Union of Chemistry and the Tent International Congress of Pure and Applied Chemist and other international meetings at which the Counc was represented. Besides details of the officer members and committees of the Council, the repo includes a long obituary notice of Baron J. Sakur by Dr. N. Matsui (see also NATURE, Aug. 5, 193 p. 234), reviewing not only his scientific work b also his work in promoting research activity Japan and her international cultural relations. Appe dixes list serial publications received from abroa and tabulate those of the Council already issue

Phytopherol: a Standardized Solution of Vitamin

VITAMIN E is now being manufactured in Gre Britain on a commercial scale and has been p within the reach of all by the British Drug House who issue it as capsules of an oily solution containi mgm. *dl*-α-tocopherol per 5 minims. The booklet ued by this firm contains a brief survey of the emistry, physiological function, and general clinical plications of vitamin E. It is pointed out that not ly may vitamin E be effective in combating sterility the female in cases of habitual or threatened abor-n, but also that types of pregnancy toxæmia and emature separation of the placenta as well as menorrhoea and vulvovaginitis may also respond vourably to administration. It may be effective male impotence and may produce descent of topic testes. About three pages of the booklet s devoted to a description of work on the relation-ip of vitamin E and the anterior pituitary, carried t in the B.D.H. Laboratories by Barrie.

rthquake near Seattle

THE United States Coast and Geodetic Survey, in -operation with Science Service and the Jesuit ismological Association, states that an earthquake as experienced in the State of Washington, U.S.A., November 13, 1939, at approximately 7h. 45m. 49s. C.T. Reports of the earthquake were received from e seismographic stations at Georgetown, Chicago, rdham, Pasadena, Pittsburgh, Tucson, St. Louis, tte, Weston, Williamstown, Sitka, College, Phila-lphia and Lincoln. From these reports, the epicentre s been calculated to have been near lat. 47° 35′ N., ng. 123° 15′ W., which is to the west of Bremerton d south-east of Mount Olympus. No damage has en reported. It is well known that the western le of the American continent is more liable to rthquake shocks than the eastern side, though both regards frequency and intensity the State of lifornia appears to have suffered more in the past an the State of Washington or any other of the ighbouring States.

he Colonial Service: Appointments and Promotions

THE following appointments and promotions in the lonial Service have recently been announced: . G. Cowley, agricultural officer, Kenya; C. J. awkins, agricultural officer, Nyasaland; M. A. G. anschell, agricultural superintendent, British uiana; J. Paine, agricultural superintendent, Gold ast; T. A. Phillips, agricultural officer, Nigeria; . W. T. Webb, agricultural officer, Nyasaland; . S. T. Bowden, veterinary officer, Malaya; R. A. amilton, assistant meteorologist, Nigeria; J. A. eid, research student, Institute of Medical Research, ederated Malay States; D. L. Blunt, director of griculture, Nyasaland, to be director of agriculture, enya; C. J. McGregor, agricultural officer, to be nior agricultural officer, Tanganyika Territory.

he Parliamentary and Scientific Committee

THE Parliamentary Science Committee has now en re-formed on a new basis and will henceforward e known as the Parliamentary and Scientific Com-ittee. Following a meeting on November 8, it was greed to form an emergency committee forthwith d to invite all former officers and members of the ecutive committee to serve on it. A meeting of this emergency committee was held at the House of Commons on Wednesday, December 6. Following the resignation of Mr. S. F. Markham as chairman in view of his forthcoming service abroad, Captain L. F. Plugge, M.P., was elected to the chairmanship. Prof. B. W. Holman and Mr. Alan E. L. Chorlton, M.P., will remain as vice-chairman and deputy-chairman respectively, while the new secretary is Mr. Christopher Powell. It was reported at the meeting that promises of support had been received from a large number of the organizations which previously supported the Parliamentary Science Committee.

Courses in Technical Optics

COURSES in technical optics, adapted for students with an initial training in physics or mathematics, are now being given as usual at the Imperial College of Science and Technology, South Kensington. The Technical Optics Section was founded in 1917 to meet the demands of the optical instrument industry and the Services for assistants with an optical training; and although a good many students have taken the course since that time, the present demand exceeds the supply. There are vacancies for a few more students who are prepared to begin work at once. The work is of a varied character, embracing many aspects of optical knowledge in its application to industry and to other sciences, and is of great national importance.

Cecil Peace Prize

A CECIL PEACE PRIZE of £100 is offered yearly for an essay on some subject connected with the maintenance of international peace, and having some bearing on the principles or work of the League of Nations. It is open to all undergraduates, without distinction of sex or nationality, of any university or university college in Great Britain or Northern Ireland, who have not attained the age of twenty-five years on the last day for submitting essays. The subject for the year 1940 is "What were the reasons for the 'failure' of the League of Nations in the years following 1930; and what steps should be taken after the present war to strengthen international authority?" The essay must be sent to the Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1, so as to arrive on or before November 1, 1940. Further information can be obtained from the Secretary.

Institution of Electrical Engineers

THE meetings of the Institution of Electrical Engineers will be resumed in London during the second half of the current session if the present conditions continue. This applies to the ordinary meetings, informal meetings, meetings of the three technical sections and of the London Students' Section. As regards activities in the provinces, the various committees will decide in the light of local conditions whether they are able to carry out programmes of meetings, visits and functions. The first ordinary meeting of the programme for the second half of the session will take place on January 25, at 6 p.m., when a discussion on "Fire-Fighting Equipment for Electrical Installations", based on the E.R.A. Report on this subject, will be introduced by Messrs. H. W. Swann, J. Hacking and R. A. McMahon.

Announcements

SIR ARTHUR SMITH WOODWARD, lately keeper of the Department of Geology, British Museum (Natural History), has been awarded the Hayden Memorial Geological Medal of the Academy of Natural Sciences, Philadelphia. This Medal, which is awarded every three years, has been given in recognition of Sir Arthur's notable contributions in the field of vertebrate and invertebrate palæontology. The Hayden award was founded at the Academy in 1888 as a memorial to Ferdinand Hayden, a member of the Academy's staff and director of the United States Geological Survey; former recipients of the award include Edward Drinker Cope, Thomas H. Huxley, William Berryman Scott and Andrew C. Lawson.

SIR GEORGE STAPLEDON, professor of agricultural botany in the University College of Wales, Aberystwyth, and director of the Welsh Plant Breeding Station, has been presented with the Gold Medal and certificate of honorary membership of the Royal Agricultural Society of England for distinguished services to agriculture.

THE Minister of Agriculture and Fisheries has appointed two additional members to the war-time Poultry Advisory Committee recently set up to give advice on matters affecting the interests of the poultry industry under war-time conditions. They are Captain Guy Clifford, a Lancashire poultry farmer, who is vice-president of the National Poultry Council and chairman of the Lancashire Utility Poultry Society, and Prof. T. J. Dalling, professor of animal pathology in the University of Cambridge.

MR. G. ANDREW, formerly lecturer in the Geological Department of the Fuad el Awal University, Cairo, has been appointed Government geologist in the Anglo-Egyptian Sudan.

MR. G. O. JONES has been appointed research fellow in the Department of Glass Technology in the University of Sheffield.

FOR many years it has been the practice of Emmanuel College, Cambridge, to invite suitably qualified candidates to make application for a research studentship to which the College elects in July. For the time being the governing body feels it is unable to make such an award. In certain circumstances, however, it is prepared to supplement awards of other bodies to research students who are making application, even if provisional, for admission to Emmanuel College. Applications must reach the Master, Emmanuel College, not later than June 30 in any year.

ACCORDING to a report from a corresponde which is printed in *The Times* of December 12, t Institute of Experimental Physics of the Univers of Warsaw has been totally demolished. The wh installation of the Institute has been dismantled a all the instruments for scientific research have b sent into the Reich.

A LIBRARY devoted to the history of medicine l been established at the Yale University School Medicine. Its basis will be formed by the collectic of the late Dr. Harvey Cushing and of Dr. John Fulton, who is Stirling professor of physiology in t Yale Faculty.

ON October 17, Dr. Thomas Parren, surgec general of the United States Public Health Servi received the Sedgwick Medal of the American Pub Health Association for distinguished service in pub health, the presentation being made by Dr. Willia Rosenau, a former medallist.

EPILEPSY has been made a notifiable disease California since September 19.

THE sixth Australasian Medical Congress (Briti Medical Association), which was to have been he in Perth next September, has been postpon indefinitely.

THE issue of the *Nederlandsch Tijdschrift Vc Geneeskunde* of November 4 contains an account the proceedings of the autumn meeting of the Dut Society of the History of Medicine, Mathematics a Natural Science held at Leyden on October 22.

THE October issue of the *Bulletin de l'Office Int national d'Hygiène Publique* contains the statisti for Palestine of the population, birth-rate, gene and infant mortality, and the incidence of infectio diseases according to religious groups from 19 until 1937.

A CLASSIFIED index of entomological contributio to the *Scottish Naturalist*, from 1871 until the end 1938, appeared in that journal from July un November 1939. It covers a large proportion of t records of Scottish insects during the period question and has now been issued in complete fon consisting of sixty-six pages and cover. Copies, pri 2*s*., may be had from Messrs. Oliver and Boyd, Lt Tweeddale Court, 14 High Street, Edinburgh, 1.

THE variations in the number of marriages a births in Germany within recent years are shown l the following official figures: In 1932 the marriag numbered 517,000, in 1933 639,000, and in 19 720,000. In 1935 there was a fall to 651,000 and 1936 to 610,000, followed by a rise to 620,000 in 193 There has also been a recent increase in the numb of births. In 1933 they numbered 971,000, in 19 1,119,000, in 1935 1,164,000. in 1936 1,179,000, a in 1937 1,275,000.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1016. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

-Ray Measurements on Wet Insulin Crystals

THE importance of water f crystallization in maintaining the regular strucure of protein crystals has lready been shown in the -ray examination of wet nd dry crystals of three ifferent proteins: lactolobulin, hæmoglobin and hymotrypsin[1]. It is now ossible to add insulin to his list. Although the riginal photographs[2] of ir-dried insulin crystals recorded no X-ray reflections ith spacings smaller than A., those of the wet rystals examined in their mother-liquor show reflecions with spacings of 2·4 A. r less, which indicate that ere there is regularity in he structure down to tomic dimensions.

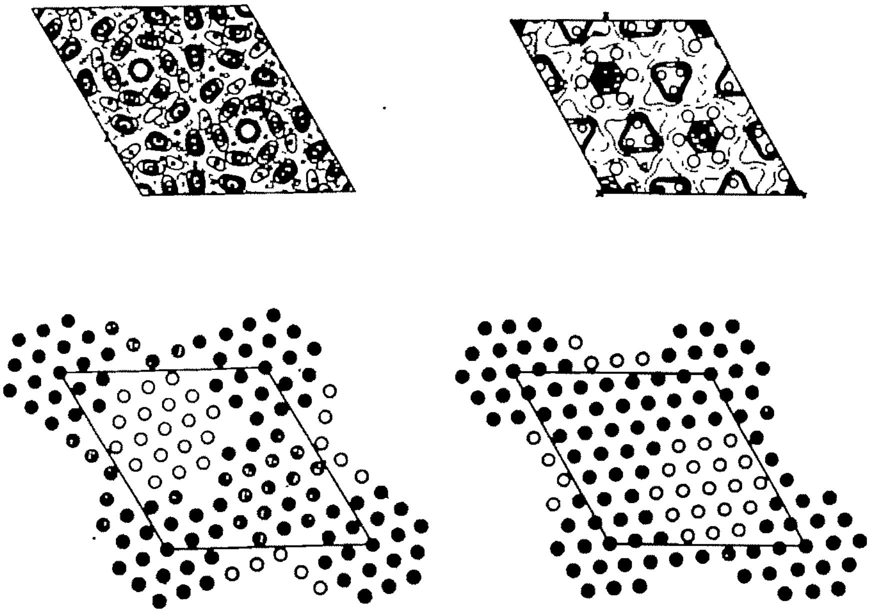


Fig. 2.

ABOVE: PATTERSON PROJECTIONS ON THE BASAL PLANE OF THE STRUCTURE OF (LEFT) WET AND (RIGHT) DRY INSULIN.

BELOW: ARRANGEMENT OF HEXAGONAL ARRAYS OF POINTS, (LEFT) EXPANDED (CF. WET INSULIN) AND (RIGHT) CLOSE-PACKED (CF. DRY INSULIN).

The new measurements ave been made on three ifferent samples of insulin rystals. The first of these vas given to us by Dr. . N. Macbeth (Organon aboratories), and consisted of crystals in their mother-liquor. The others were recrystallized by us t two different pH values, approximately 5·2 and 6·2 respectively. In these cases the mother-liquor was essentially a mixed sodium potassium phosphate buffer prepared as previously described[2]. All the crystals were similar in appearance to those obtained earlier. Their density, measured by flotation in a sodium dihydrogen phosphate solution pH 4·5 and in a sodium citrate buffer solution pH 5·7, varied between 1·276 and 1·283, lower than the values up to 1·315 found for the dry crystals. In an attempt to check the molecular weight calculation, preliminary X-ray measurements have been made on crystals immersed in both these density solutions and in dilute $M/15$ sodium dihydrogen phosphate solution.

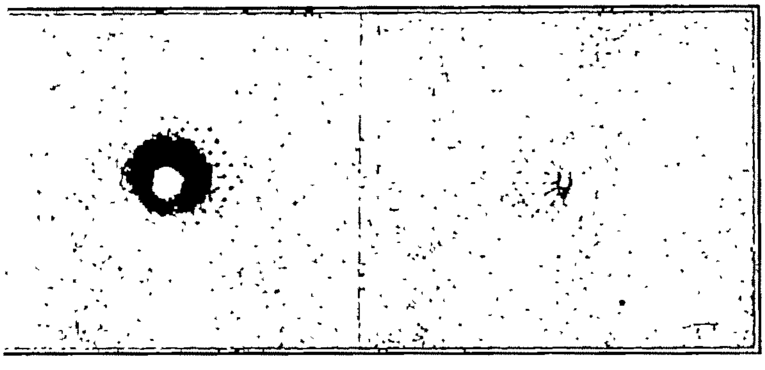


Fig. 1.

X-RAY PHOTOGRAPHS OF ZINC INSULIN SHOWING (*hk0*) REFLECTIONS. LEFT: WET CRYSTAL IN MOTHER-LIQUOR; RIGHT: ORIGINAL AIR-DRIED CRYSTAL. (SCALE NOT IDENTICAL.)

The crystal lattice of the wet insulin crystals photographed in their mother-liquor proves to be a moderately expanded form of that found for the dry crystals. The unit-cell dimensions for the hexagonal unit-cell (correct to 0·5 per cent) are: $a = 83\cdot0$ A., $c = 34\cdot0$ A., as against $a = 74\cdot8$ A., $c = 30\cdot9$ A., for the air-dried crystals, or for the rhombohedral true unit-cell, $a = 49\cdot4$ A., $\alpha = 114°\ 16'$, wet, and $a = 44\cdot4$ A., $\alpha = 114°\ 28'$, dry. Using the mean density 1·28 found above, and assuming that the molecular weight of the insulin present is 37,600 as measured on the dry crystals, it is possible to calculate the wet-cell molecular weight as 52,400, and the weight of the liquid of crystallization present as 14,800—28 per cent of the total.

How much meaning this calculation has is doubtful in view of the increasing evidence that the protein crystal lattice itself is penetrated by ions and molecules from the various immersion media. To a first approximation, the crystal structure proves to be unaltered by immersion in the citrate density solution or in the dilute phosphate solution *p*H 4·5. But X-ray photographs of crystals immersed in the phosphate density solution show both a small shrinkage of the crystal lattice, of the order of 3 per cent, and an absence of X-ray reflections with spacings less than 7 A., as in the case of the air-dried crystals. Whether this alteration is due alone to the concentration of ions in the immersion medium, or to this factor combined with the low *p*H, it is clear that here there has been a withdrawal of water from the crystal which has produced a disorganization of the structure comparable with the effect of drying.

These changes are accompanied by changes in the intensities of the X-ray reflections which should provide the means for their fuller interpretation. As is shown in Fig. 1, the X-ray intensities from the wet insulin crystals differ strikingly from those given by the dry crystals. A preliminary Patterson projection on the basal plane (0001) indicates that the differences are to be correlated mainly with a change in the relative orientation of the molecules as a whole (Fig. 2). The main interatomic distances about the origin are similar to those observed for dry insulin but are shifted through a small angle relative to the original pattern. It seems relevant to the general problem of protein structure that the new Patterson peak positions also approximate closely to one of the systems of close-packing of hexagonal aggregates postulated by Bernal[3] to account for the original peak positions. The new system is derived from that of Bernal by sliding the molecular groups relative to one another, leaving spaces to be occupied by water at definite positions in the lattice in the neighbourhood of 0, $\frac{1}{3}$; 0, $\frac{2}{3}$, etc. In agreement with this, the X-ray reflection $33\bar{6}0$ is much the most sensitive to changes in the crystal immersion medium. It is present for the dry crystals, absent for crystals photographed in their mother-liquor, and again present for crystals in the phosphate density solution, although the intensities of most other comparable X-ray reflections are here unchanged compared with the wet crystals. Such controllable variations in the X-ray intensities given by a protein crystal ha been sought for some time, and here, in insulin, ought now to be able to follow further chang produced both by alterations in the immersi medium and by replacement of the bound zinc cadmium or nickel.

DOROTHY CROWFOOT
DENNIS RILEY.

Department of Mineralogy,
Oxford.
Nov. 9.

---

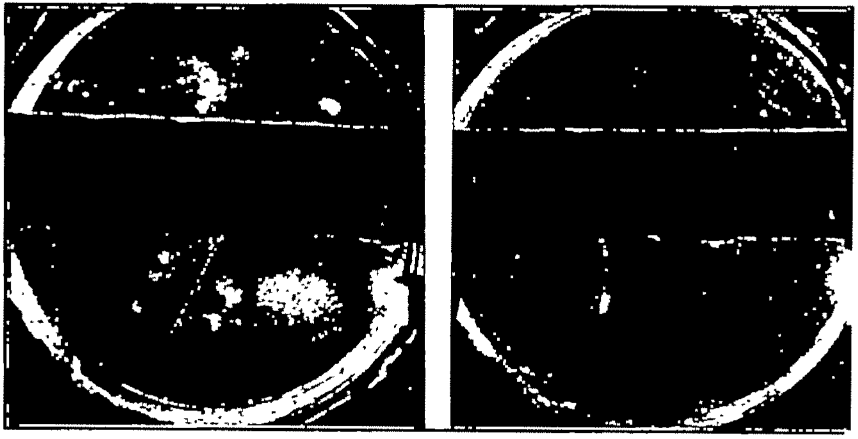
[1] Crowfoot, D., Riley, D., Bernal, J. D., Fankuchen, I., and Perutz, NATURE, 141, 521 (1938).

[2] Crowfoot, D., *Proc. Roy. Soc.*, A, 164, 580 (1938).

[3] Bernal, J. D., *Proc. Roy. Soc.*, B, 127, 36 (1939).

Evidence for the Occurrence of Meson Pairs

WE have taken a number of photographs with counter-controlled cloud chamber in a tunnel 30 under London clay. (1) 630 photographs were tak with a 1·4 cm. lead plate inside the chamber; (948 photographs were taken with a 2·5 cm. le plate inside the chamber; (3) 780 photographs we taken with a 2·5 cm. lead plate inside the chamb and 15 cm. of lead above the chamber.



a *b*

80 per cent of all the photographs show one sing ray penetrating the lead plate without appreciab deviation. We consider that most of these must mesons. 125 of the photographs show evidence electronic showers.

In five photographs, two apparently associate particles go through the lead plate without pe ceptible change in direction and without producir secondaries. Three of these photographs we obtained with arrangement (1), one with (2), an one with (3). In the accompanying reproduction, was obtained with arrangement (3), the ang between the tracks is 1·5° and they seem to diverg from a point 3 m. above the chamber. They hav therefore, both penetrated the 15 cm. of lead abov the chamber.

A possible explanation of these photographs that they show meson pairs.

Alternative explanations which must be considere are: (*a*) the random coincidence of independer mesons; (*b*) one or both of the particles are electron and happen not to produce secondaries; (*c*) one both of the particles is a proton.

It is estimated that two tracks which appear ntical must be formed within 1/50 sec. of one other. The chamber is set off by the counters, on average, once in 12 minutes, so that the probility of the random simultaneous appearance of o non-associated rays is of the order 3×10^{-5}.

An electron capable of passing through 2·5 cm. lead without sensible deviation by ordinary attering must have an initial energy greater than ^{9} e.v. The probability that only a single electron high energy would emerge from the 2·5 cm. plate ay be calculated from cascade theory as 0·007 for 10^9 e.v. particle and negligibly small for one of gher energy. The particles which penetrated cm. of lead could not be electronic.

J. G. Wilson[1] has calculated that the probability a meson producing a knock-on proton of high ergy is much too small to account for our photoaphs, and any process by which one proton knocks another would be expected to give rise to a umber of slow protons distinguishable as heavy acks. No such tracks have been observed.

We consider that our photographs are best regarded evidence for meson pairs.

H. J. J. Braddick.
G. S. Hensby.

Birkbeck College,
London, E.C.4.
Nov. 17.

---

[1] y private communication.

Occurrence of Greenockite in the Mendips

Although small amounts of greenockite (cadmium lphide) have been found in Scotland associated ith zinc blende, the mineral has rarely been found England. In July last one of us (A. W. G. K.) was amining blende from a small dump at some old orkings at a hamlet called Green Ore near Chewton endip. The area was at one time worked for lamine (zinc carbonate) and most of the material the dump consisted of this; but blende, galena and rytes were also present.

Thin layers of a yellow mineral, ranging up to out 1 mm. in thickness, were noticed in various all patches in the blende. These were afterwards amined spectroscopically and chemically and oved to be greenockite. There appears to be no cord of the mineral having been observed in the endips before this.

Arthur W. G. Kingsbury.

Cumberland Lodge,
Bathwick Hill,
Bath.

J. Newton Friend.

Central Technical College,
Birmingham.
Nov. 15.

A New British Locality for Fluorite in Somerset

Although small amounts of fluorite were recorded any years ago from the Avonian Limestone of the von Gorge at Clifton, it does not appear to have en found there again, or to have been previously corded from any part of the Carboniferous of the joining Mendip Hills.

In November last year, I found minute traces of a rk purple granular mineral in a disused quarry Shipham Gorge, near Axbridge on the south side the Mendips. Subsequent tests showed this to be orite, but the amount was too small for satisfactory amination.

This year, however, further search has resulted in the collection of a number of small but well-formed crystals. These crystals range in colour from colourless to almost black, purple and mauve shades being the only ones so far noticed: they are all small, the largest being about 3 mm. across the cube face. The simple cube, $a\ \{100\}$, and the low 4-faced cube, $f\ \{310\}$, are the most frequent forms, but combinations of these two also occur. Some crystals recently found are very complex; many crystals are well zoned and in some specimens the fluorite crystals are accompanied by beautiful little bright crystals of chalcopyrite and little velvety black hemispheres of hæmatite.

The fluorite appears to be confined more or less to one band in the quarry and occurs in granular calcite filling vesicles in the black limestone of the *C*-zone. These vesicles are numerous, but the majority appear to contain no trace of fluorite.

Careful search in this and other parts of the Mendips over a number of years has failed to produce any other specimens, and so far this appears to be the only locality in the district.

Arthur W. G. Kingsbury.

Cumberland Lodge,
Bathwick Hill,
Bath. Nov. 15.

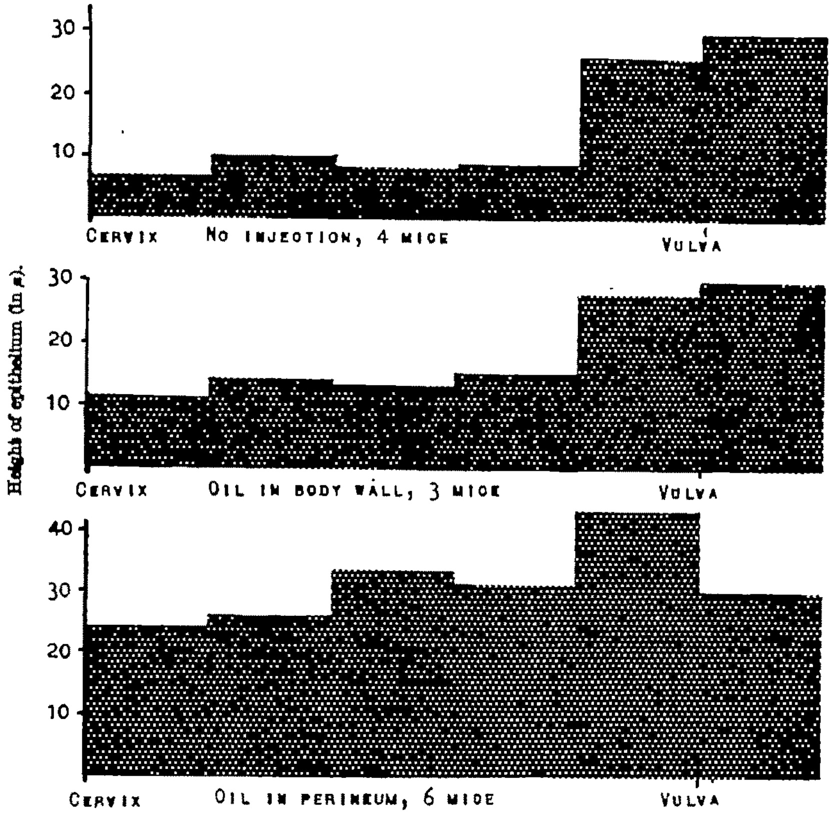
Œstrogen Depot Formation

In a recent communication, Zondek and Sulman[1] showed that, unlike œstrone, the hormone esters and stilbœstrol in oil, when injected into the rat, remain at the site of injection for a considerable time and from there are slowly absorbed.

Some time ago I undertook an investigation into the local effect upon the vaginal epithelium of the ovariectomized mouse of small doses of œstrone in arachis oil. The preliminary results showed little of interest, and the inquiry was put aside under pressure of other work. At the time I noticed, however, that a few control mice which received small doses of arachis oil alone, and showed little or no effect when the dose was injected into the body wall, did show proliferation of the vaginal epithelium, resembling that preceding œstrus, when the dose was injected into the perineum. The results are shown in the accompanying diagram. With doses of oil of from 0·0025 c.c. to 0·005 c.c. after times between 24 and 48 hours, the height of the epithelium is increased. This increase is a good deal more noticeable when the dose is administered in the perineum than when it is injected into the body wall.

From this it appears that (1) arachis oil, or some part of it, has the property of initiating some proliferation of the epithelium lining the vagina of the ovariectomized mouse; (2) this effect is rather localized.

The localization of the effect of the oil may in all probability be taken to indicate that the oil, or some fraction of it, forms a depot at the site of injection and is not distributed immediately all over the body. If this is so, then it may be that the depot-forming qualities of the solvent have some bearing upon the depot-forming qualities of the œstrogenic injection as a whole. The depot-forming qualities of arachis oil appear to have been made plain in these experiments through the accident of its effect upon this epithelium, which can be measured. It may be that some œstrogens, for example the esters mentioned and also stilbœstrol, simply tend to remain dissolved



The height of the epithalium was measured first at the cervix and then once on each side of a longitudinal vertical section every 100 μ until the vulva was reached. The two measurements, one on each side of the section, were then averaged. The length of the vagina was then divided into five equal parts. The average was then found of those previously found averages which fell within each of these five segments. The resulting quantities are the ordinates in the histogram. The first five 'cells', counting from the left, represent the five equal segments of the vagina. On the right is added an extra 'cell', 30 μ in height, which represents the height of the epithelium on the surface of the body.

in the solvent in which they were injected in preference to passing into the body fluids. This may be perfectly explicable in terms of chemistry and physics. It may be incorrect to assume that the œstrogen itself enters into any particularly close relationship with the tissue at the site of injection regardless of what that tissue may be.

I am about to publish in the *Proceedings of the Zoological Society* some observations which seem to show that a particular sub-system within an animal —for example, a feather-germ—which uses or is affected by œstrone, may really have in itself the power of stocking up with the hormone. It presumably accomplishes this in the time available between the giving of the dose and its removal or destruction. Zondek[2] has shown that for this substance, œstrone, this time may be very short—a matter of hours. The stock laid in may be changed (it has not been recovered to see whether its œstrogenic properties remain unaltered), but it lasts for days, or at least its very strictly localized effects do.

In view of the obvious importance of an understanding of depot-formation to the whole subject of hormonic physiology and the action of carcinogens and evocators, it seems that further information is required about (*a*) the possibly pseudo-œstrogenic qualities of arachis oil, in order that the experimenter
may be clear about all t
œstrogens actually present
the injection, and (*b*) the p
cise circumstances in which t
known œstrogens, and so p
haps other active substanc
do pile up at points in expe
mental material or in Natu
It is hoped to continue th
investigations in this Depa
ment.

PAUL G. 'ESPINASSE.

Department of Zoology,
University College,
Hull.
Nov. 7.

[1] Zondek and Sulman, NATURE, 1
596 (1939).

[2] Zondek, *Lancet*, 237, 356 (1938)

Connexion between Carbol drate and Potassium Metaboli in Normal and Adrenalecto ized Animals

OF the different metabo
disturbances caused by adr
alectomy, the increase of pot
sium in the blood plasma
believed by some authorities
be the most important, wh
others have emphasized m
especially the disturbances
carbohydrate metabolism.
now seems possible, howev
to connect these two sets
metabolic disturbance, as l
been suggested earlier[1] and c
now be proved.

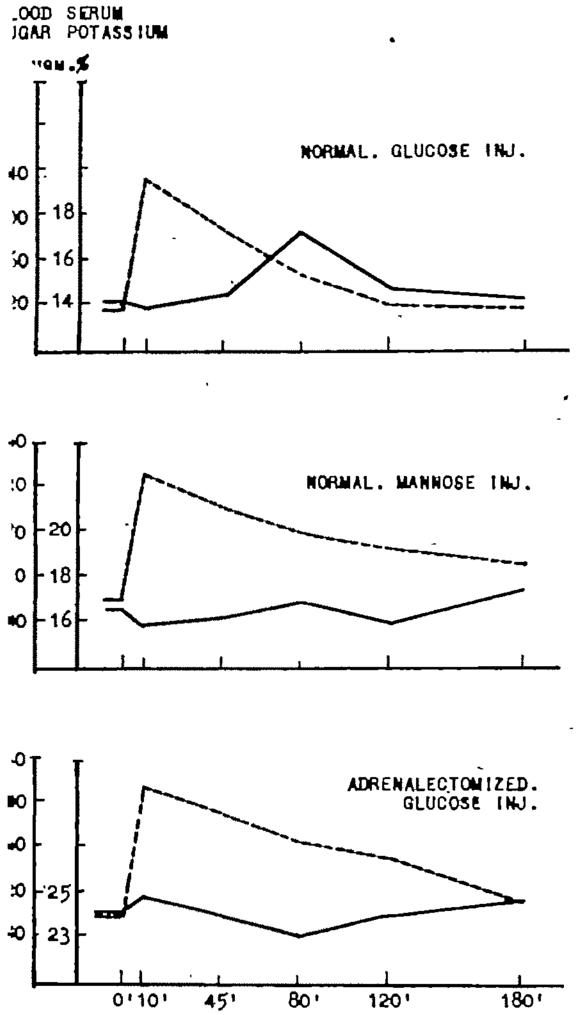
After intravenous injecti
of glucose (5 c.c. of 20 per c
solution in 1 minute to a cat
2–3 kgm.), the blood sugar ri
to about twice its normal le
and returns to normal after two hours. The same
true for galactose and fructose. Other hexoses, such
sorbose and mannose, and the pentose xylose, beha
quite differently: the sugar in these cases leaves t
blood much more slowly, and after two hours t
blood sugar is still 50 per cent higher than norm
Thus the different sugars behave in the same way
the transit between the blood and the tissues
between the lumen of the intestine and the epithel
cells during intestinal absorption. Those sug
which are selectively absorbed are also more rapic
taken up from the blood by the tissues than are t
non-selectively absorbed sugars.

After adrenalectomy, the changes in the behavio
of the different sugars in the blood are parallel
the changes in sugar absorption. Intravenou
injected glucose, galactose and fructose are n
taken up by the tissues just as slowly as the ot
sugars whose rate of leaving the blood has not be
changed by adrenalectomy. Just as the speci
process in the intestinal epithelium necessary for t
selective absorption of glucose, galactose and fruct
is lacking after adrenalectomy, so also is the speci
process by which these three sugars leave the blo
more rapidly than other sugars abolished.

It was then shown that injections of gluco
galactose or fructose caused a sudden increase

od potassium, while injections of other sugars used no increase. With the selectively absorbed gars, the peak of the potassium curve is reached ly when the sugar concentration in the plasma has eady begun markedly to decrease.

In adrenalectomized animals, however, there is no rease in plasma potassium after intravenous jection of the selectively absorbed sugars. These gars now react in the same way as the non- lectively absorbed sugars. The conclusion must be at there is a close connexion between the rapid take by the cells of the selectively absorbed sugars d the increase in plasma potassium. It seems st probable that the process which connects these o phenomena is a phosphorylation process leading the formation of glycogen or intermediary subnces. The possibility of such a mechanism has ently been stated by Conway and Boyle[2]. It uld then follow that it is this process which is king after adrenalectomy, thus causing the turbances both in carbohydrate and in tassium metabolism seen in adrenalectomized imals.



DOTTED LINE, BLOOD SUGAR; FULL LINE, SERUM POTASSIUM. AT 0′ 0·50 GM./KGM. SUGAR WAS INJECTED INTRAVENOUSLY.

The figures are examples of experiments which will be published in *Helvetica medica Acta*.

F. VERZÁR.
J. C. SOMOGYI.

Physiological Laboratory,
University, Basle.
Nov. 1.

[1] Verzár, F., Sixteenth Int. Physiol. Congr. 1938, and "Funktion der Nebennierenrinde", B. Schwabe (Basel, 1939).

[2] Conway, E. J., and Boyle, P. J., NATURE, 144, 709 (1939).

Anserine in Muscle: Possibility of Determination by Titration

SOME time ago[1], I showed that the buffering power of the non-protein constituents of rigor muscle between pH 6 and 7 could be largely accounted for by the sum of the buffering powers of the phosphate, carnosine, and lactic acid present. In the muscles of some animals, notably the horse, ox, and pig, these constituents accounted for more than 90 per cent of the non-protein buffering; in others, notably the rabbit, dog and fowl, a considerable residue of buffering—up to 26 per cent of the non-protein buffering of the muscle—remained unaccounted for. I suggested that this buffering might be largely due to anserine, which has a buffering range almost identical with that of carnosine, but reliable analytical data for anserine were not then available.

Zapp and Wilson[2] have, in the meantime, published a method of determining anserine, and give values for the anserine content of the muscles of various species which are of such a magnitude as to account completely for this unidentified buffering. Some instances are included in the accompanying table.

Species	Anserine equivalent of unidentified buffering (mgm./100 gm.)	Anserine reported by Zapp and Wilson (mgm./100 gm.)
Horse ..	50	17–48
Ox	110–240	38–144
Rabbit ..	325–495	223–502
Rat . ..	160–310	319
Dog .	270	212

The coincidence in the magnitude of anserine contents is extremely close, and although individual muscles vary widely the conclusion is justified that the unidentified buffering does represent buffering due almost exclusively to anserine.

The determination of residual buffering (that is, after deducting that due to phosphate, carnosine and lactic acid) may, therefore, serve as a rough guide to the amount of anserine present in muscle; it will certainly serve as a true guide to the upper limit of this substance present, for the actual titration of the muscle extract is accurate, the determination of phosphate is accurate, and the determinations of lactic acid and carnosine are reasonably so. The whole determination can be carried out on the extract from 10 gm. of muscle in a few hours (as compared with the several days needed for Zapp and Wilson's method) and many samples could be examined together.

It is proposed, when the opportunity offers, to evaluate the possibilities of the method by carrying out parallel analysis by Zapp and Wilson's method and by the titration method.

E. C. BATE SMITH.

Low Temperature Research Station,
Cambridge.
Nov. 15.

[1] *J. Physiol.*, 92, 336 (1938).

[2] Zapp and Wilson, *J. Biol. Chem.*, 126, 9, 19 (1938).

Isolation of a Catalytically Active Flavoprotein from Liver

WE have obtained from pig liver a flavoprotein in highly purified form which catalyses specifically the oxidation of aldehydes to their corresponding acids. The prosthetic group of this enzyme is flavinadenine dinucleotide. In the presence of acetaldehyde the enzyme is rapidly reduced to its leuco form, and the leuco form is autoxidizable in air. The mechanism of the catalysis, therefore, involves a cycle of reduction of the flavoprotein by the substrate followed by oxidation of the leuco form by molecular oxygen or any other suitable hydrogen acceptor. One molecule of the enzyme catalyses the oxidation of about 550 molecules of acetaldehyde per minute at 38°. Our best preparations of the enzyme transfer 2700 μl.H_2 per mgm. protein per hour ($Q_{\text{methylene blue}}$ 2700). The flavinphosphate content of the preparation as determined by direct estimation is 0·17 per cent. There appears to be some coloured grouping other than flavin which is associated with the enzyme molecule.

The above enzyme is not identical with xanthine-aldehyde oxidase either of milk or liver.

V. SUBRAHMANYAN.
D. E. GREEN.
A. H. GORDON.

Department of Biochemistry,
Cambridge.
Nov. 22.

Synthesis of Myristicin

ALTHOUGH it is now many years since myristicin was first isolated from the oils of nutmeg and mace, its synthesis has not previously been recorded. Its constitution was established by H. Thoms in 1903[1] as 3-methoxy-4 : 5-methylenedioxy-1-allylbenzene, a molecule suitably orientated for its use as the starting point in the successful syntheses of cotarnine by Salway[2] and by Becker and Decker[3].

Allylation of pyrogallol 1-methyl ether gave,
good yield, a mixture of two liquid monoallyl eth
(I and II) which were separated by fractional d
tillation and characterized by the preparation
their 3 : 5-dinitrobenzoates (m.p. 111/2° and 13
respectively). I (most probably 1-hydroxy-2-allylox
3-methoxy-benzene) readily rearranged on pyroly
to give 3-methoxy-4 : 5-dihydroxy-1-allylbenzene, a
this on methylenation with methylene iodide a
anhydrous potassium carbonate in acetone (Perk
and Trikojus[4]) gave a 30 per cent yield of pu
myristicin (b.p.$_{0\cdot1}$ = 95–7°). The synthetic produ
was characterized by the preparation of dibrom
myristicin dibromide (m.p. 127–8°), *iso*-myristic
(m.p. 43·5°) and dibromo-*iso*-myristicin dibromi
(m.p. 158·5°). The melting points of all three co
pounds were not depressed by admixture with t
corresponding derivatives prepared from a specim
of natural myristicin isolated from oil of nutmeg.

The other monoallyl ether (II) did not give t
expected 2 : 3-dihydroxy-4-methoxy-1-allylbenze
after pyrolysis, but a mixture which, on methyle
tion and subsequent bromination, yielded mai
dibromo-myristicin dibromide. This rearrangeme
is being further investigated.

Our thanks are due to Dr. T. G. H. Jones, of t
University of Queensland, who kindly supplied t
oil of nutmeg.

VICTOR M. TRIKOJUS.
D. E. WHITE.

Department of Medicine
and
St. Andrew's College Laboratory,
University of Sydney.
Nov. 10.

[1] Thoms, H., *Ber.*, 36, 3446 (1903).
[2] Salway, *J. Chem. Soc.*, 97, 1208 (1910).
[3] Decker and Becker, *Annalen*, 395, 328 (1913).
[4] Perkin and Trikojus, *J. Chem. Soc.*, 1663 (1927).

Points from Foregoing Letters

X-RAY photographs of zinc insulin crystals in several immersion media have been obtained by D. Crowfoot and D. Riley. The wet crystal unit cell is found to be a moderately expanded version of that previously found for the air-dried crystals. Preliminary calculations show that the striking differences in the X-ray intensities given by the different crystal structures is to be correlated mainly with a reorientation of the molecules relative to the crystal axes which takes place on drying.

A number of cloud chamber photographs of cosmic ray particles have been taken by H. J. J. Braddick and G. S. Hensby under 30 m. of London clay. Most of the photographs show mesons, some show electronic showers. In five photographs out of 2,300 there is evidence of the simultaneous passage of two penetrating particles, and these are interpretated as associated mesons.

A. W. G. Kingsbury and J. Newton Friend report that the rare mineral greenockite (cadmium sulphide), seldom found in England, has been discovered in small quantity as thin layers in blende near Chewton Mendip. A. W. G. Kingsbury also describes a new locality for small quantities of fluorite in a disused quarry near Axbridge.

Paul G. 'Espinasse reports a possibly pseu
oestrogenic effect, which appears to be localized,
arachis oil upon the vaginal epithelium of the mou
He suggests that the local action of some oestrog
may be due to their remaining in the oil at the site
injection in preference to going into the body flui

After adrenalectomy, rats show changes in
behaviour of the different sugars in the blood (para
to changes in sugar absorption) and also disturban
in potassium metabolism. F. Verzàr and J.
Somogyi present observations suggesting that
connexion between these two phenomena is due t
phosphorylation process leading to the formation
glycogen or intermediary substances.

E. C. Bate Smith describes a possible titrat
method for the determination of anserine in mus
The determination can be carried out in a few ho
as compared with the several days needed for Ze
and Wilson's method.

A new flavoprotein has been obtained from
liver by V. Subrahmanyan, D. E. Green and A.
Gordon, which has the property of catalysing
oxidation of aldehydes to their corresponding aci
It has been found to contain flavinadenine di
cleotide.

RESEARCH ITEMS

acteria of the Throat and Nose

AN account of the micro-organisms, the normal acterial flora, found in the nose and throat of persons ving in London and south-east England, some of hom were repeatedly examined over a period of ven years, is given in a report by Drs. Edith traker, Bradford Hill and R. Lovell, published by e Ministry of Health (Reps. on Pub. Health and ted. Subjects, No. 90. H.M. Stationery Office. s. net). The inquiry, which lasted from 1930 until 937, included repeated swabbings of volunteers from mong the staff of the London School of Hygiene nd Tropical Medicine, and of boarders in a boys' ublic school. Swabbings were also occasionally aken from inmates of the Royal Hospital School, reenwich, of an orphan home, and from members f the clerical staff of the Ministry. The work shows at of any large group of adults living in an urban mmunity between 20 and 40 per cent will usually t any one time be carrying a pneumococcus in the asopharynx, between 5 and 15 per cent a hæmolytic reptococcus, between 40 and 80 per cent the so-lled influenza bacillus, and between 5 and 20 per nt the meningococcus of cerebro-spinal fever. The eumococcus and the meningococcus were less equent in women than in men. The pneumococcus as found more frequently in cold damp weather an during hot dry periods, while the reverse sociation tends to occur with the hæmolytic reptococcus. The last-named organism shows a arp rise in prevalence in boys' boarding schools in sociation with outbreaks of tonsillitis. Neither the eumococcus nor the influenza bacillus shows any ose association with the fluctuations in mortality ttributed to influenza. Observations made on ersons suffering from colds tell strongly against the iew that the acute infectious cold is caused by any f the bacteria studied. Dr. Rosher contributes a ction on the frequency of the influenza bacillus in e trachea of unselected cases without respiratory isease coming to post-mortem examination; this rganism was found in 27 per cent of such cases.

arkings on Fossil Bones

ONE of the side-lines of investigation which variably leads to interesting and sometimes to portant indications of the make-up of a prehistoric una is the study of the markings upon bones. ones may be fractured or marked by contemporary uman beings, by animals and by various kinds of eathering and chemical action; and as a rule areful scrutiny reveals not only the agency, but in e case of animal markings perhaps even the species ncerned. Not much attempt has been made to stematize the distinctive characters of markings as guide to other workers, but in an excellent paper, piously illustrated, Pei Wen-Chung discusses s experience with bones from a series of sites in hina ranging from Pliocene to historic times ("Le le des animaux et des causes naturelles dans la sure des os", *Palæont. Sinica.* N.S., D., No. 7, 938). He describes the characteristic appearance of arkings caused by the gnawing of rodents of ifferent kinds and by carnivores, the striations due the scratchings of carnivore claws, vermiculations which are sometimes puzzling, and the indications of chemical action or the effect of water. Not the least useful section of his paper deals with examples of markings which, although due to other agents, might well be mistaken for human artefacts. Such errors of interpretation may easily be made by workers not familiar with the variety of markings which may be made by animal or physical agency.

Barnacle Communities

F. HIRO, in a survey on the barnacle communities at the Madarai Pier in Korôru Island, Palao (Palao Tropical Biol. Stat. Stud., No. 4), deals with the distribution and orientation of four species of Tetraclita and one of Chthamalus on vertical concrete piers. The various species show a clearly marked vertical zonation, Chthamalus occupying the highest zone, and extending to high-water mark. Where channels are cut under the pier, the Chthamalus show a marked tendency to avoid the parts where light and currents are strongest, while the Tetraclita species do not show this effect. Finally, in the centre of these cuts where light is weak, most barnacles are orientated at right angles to the current so that they can, by twisting the body through 90°, feed readily in a current coming from either direction, while those near the ends of the cuts tend to be orientated towards the light.

Bacterial Synthesis of an Eye Colour

THE diffusible substances *v*+ and *cn*+, which are essential for pigment formation in eyes of Drosophila individuals dominant for these genes, can be formed by recessive *vbw* insects cultured on starvation diet. E. L. Tatum (*Proc. Nat. Acad. Sci.*, 25, 486–497; 1939) now also finds that under suitable conditions certain bacteria synthesize a substance which has the activity of *v*+. All the present evidence indicates that the product from bacteria is identical with *v*+. An unidentified Bacillus species in the presence of tryptophane, can produce this substance, which is soluble in water and ethyl alcohol but insoluble in acetone and chloroform. Like *v*+, this substance is transformed into *Cn*+ when introduced into *vbw* flies.

Polyploidy in the Salamander

G. FANKHAUSER (*J. Hered.*, 30, 377–388; 1939) finds that the somatic chromosome number of ***Eurycea bislineata*** is 28. Of 134 larvæ examined, 13 were triploid with 42 chromosomes and 2 were tetraploid. The larger cells and pigment pattern allow the polyploid larvæ to be tentatively identified. The tetraploids were weaker and retarded in growth. Among 311 individuals of Triturus five were found to be triploid.

Fluorination of Phosphorus Halides

THE fluorination of phosphoryl trichloride and phosphorus tribromide has been studied by H. S. Booth, S. G. Frary, and F. B. Dutton (*J. Amer. Chem. Soc.*, 61, 2934, 2937; 1939). The phosphorus compounds were treated with antimony trifluoride, with bromine or antimony pentachloride as catalysts, or in the case of phosphorus tribromide with dry calcium fluoride. In this way the new compounds dibromomonofluorophosphine $PFBr_2$ and monobromodifluorophosphine PF_2Br were obtained from phosphorus tribromide. $PFBr_2$ is a colourless liquid (b.p. 78·4°, f.p. −115·0°), PF_2Br a gas (b.p. −16·1°, f.p. −135·8°), both hydrolysed by atmospheric moisture, decomposing slowly into PF_3 and PBr_3 at −78°, reacting with mercury with liberation of phosphorus, and combining with bromine to form, probably, $PFBr_4$ and PF_2Br_3. From the fluorination of phosphoryl trichloride by the same methods, gaseous PF_3 (b.p. −39·8°) and phosphoryl difluoromonochloride POF_2Cl (b.p. 3·1°, f.p. −96·4°), and liquid phosphoryl monofluorodichloride $PFCl_2$ (b.p. 52·9°, f.p. −80·1°) were obtained. All these substances are colourless and do not attack glass when dry.

Mercuric Halide Complex Ions

WHEN $HgCl_2$, $HgBr_2$ and HgI_2 are dissolved in solutions of the corresponding alkali metal halides, it is known that complex anions are formed. These have been represented as $HgCl_3'$, $HgBr_3'$, HgI_3', whilst evidence has been submitted for the existence of $HgBr_4''$ and HgI_4''. A. B. Garrett (*J. Amer. Chem. Soc.*, 61, 2744; 1939) has determined the solubilities of mercuric bromide and iodide in the corresponding potassium halide solutions. The solubility of mercuric bromide in pure water at 25° was found to be 0·0170 mol./1000 gm. water. The solubilities of mercuric bromide can be accounted for on the assumption that the only complex ion formed is $HgBr_3'$. In the case of mercuric iodide, however, an additional reaction is probably present, namely the formation of HgI_4'' in appreciable amount. The amount of $HgCl_4''$ is negligible; but the solubility of mercuric chloride in low concentrations of chloride solutions is anomalous. This is accounted for on the basis of polymerization of mercuric chloride to the order of 10 per cent. The free energies of formation of the complex ions from mercury halide and halide ions are given in gm. cal. at 25° as: $HgCl_3'$ −1700; $HgBr_3'$ −365; HgI_3' +430; HgI_4'' −2100.

Structure of Potassium Molybdocyanide Dihydrate

The substance potassium molybdocyanide dihydrate $K_4Mo(CN)_8, 2H_2O$, is one of the more familiar examples of compounds containing eight atoms or radicals bound to a central atom. The configuration of the MX_8 group has not previously been established with certainty in any single case, although the cube and the square Archimedean antiprism have been regarded as geometrically plausible. J. L. Hoard and H. H. Nordsieck (*J. Amer. Chem. Soc.*, 61, 2853; 1939) have shown by X-rays that the $Mo(CN)_8$ polyhedron is a duodecahedron with eight vertices and triangular faces. It can be described as the figure outlined by the vertices of two interpenetrating bisphenoids orientated in the same way as the positive and negative tetrahedra of a cube. Although required by the space group to possess only a plane of symmetry, the complex ion in the crystal approximates to the symmetry of one of the point groups.

Raman Spectrum of Gaseous Methylamine

THE literature on Raman effect contains very few researches on gases or vapours because of the difficulty of procuring good spectra at comparatively low pressures and with relatively short exposures. It is, therefore, extremely interesting to find that new technique has been developed by Kirby-Smi and Bonner (*J. Chem. Phys.*, 7, 880; 1939) whic by using a light source of high intensity, a lar scattering volume, and a spectrograph camera wi a large aperture, gives satisfactory spectra of ga at a pressure of approximately three atmosphe after an exposure of from three to six hours. De for gaseous methylamine are given and compar with those of Kohlrausch (*Monatsh. Chemie*, 349; 1936) for the liquid. The most noticea difference between the spectra is in the position the N-H valency vibrations near 3400 cm.$^{-1}$; in t liquid they are at 3312 and 3372 cm.$^{-1}$, whereas t gas shows them at 3360 and 3470 cm.$^{-1}$. These lar differences are attributed to the formation of hydrog bonds between neighbouring NH_2 groups in t liquid. For C-H vibrations, on the other hand, t largest difference between gas and liquid is 12 cm. Whereas all methyl compounds should possess on two vibrations characteristic of C-H bond stretchin methyl halides exhibit three, and gaseous meth amine is found to have four. Their origin is given a double Fermi resonance (*Z. Physik.*, 71, 250; 193 between a fundamental near 2840 cm.$^{-1}$ and t infra-red bands at 1460 and 1426 cm.$^{-1}$. The appe ance in gaseous methylamine of a hitherto unrecord displacement of 781 cm.$^{-1}$ is explained as due to N-H bending vibration, on the grounds that such vibration in the liquid would be sensitive to hydrog bonding and association.

Determination of Stellar Diameters by Interferometer

A PAPER was formerly published (*Mon. Not. Ro Astro. Soc.*, 99, 141) by Fürth, Sitte and App which proposed a modification of Michelson's stell interferometer that would enable it to be used ev when there were strong air perturbations. Tw independent papers have now appeared (*Mon. N Roy. Astro. Soc.*, 99, 9; October 1939) by P. Lacrou and J. A. Carroll, both of which criticize the efficien of the apparatus. Lacroute shows that in the modifi form suggested, even if fixed fringes are formed, th is, fringes insensible to movements of the Michels fringes, they would be utterly useless for the dete mination of stellar diameters. He shows, howeve that they are not insensible to movements of th Michelson fringes, and offers a tentative explanati of the reason why the authors of the original pap thought they observed stability, though he admi that the explanation may be conjecture, becau some of the experimental details could easily missed by anyone reading the description. Carr shows that they drew an incomplete analogy betwe a ruled grating illuminated by plane waves and th Michelson fringe system, because the displacement the Michelson fringes, in the focal plane of th observing telescope, does not correspond to a simp translatory motion of a grating, but to a translati and also a rotation, about an axis parallel to t rulings, of the incident light. For this reason th secondary system must move through the sa number of fringes as the primary Michelson syste He also tested the secondary fringes to see if th were less liable to disturbances than the Michels fringes, and found that the claim could not substantiated. It appears from the criticism Lacroute and Carroll that the apparatus for th elimination of strong air perturbation effects of no use for that purpose.

THE EVOLUTION OF THE STARS

By F. HOYLE AND R. A. LYTTLETON,

ST. JOHN'S COLLEGE, CAMBRIDGE

ROF. G. GAMOW has recently discussed in NATURE[1] the consequences of recent developents in nuclear theory on the problem of stellar olution. In the light of the exact knowledge that now available of a large number of nuclear retions, it is possible to decide which processes rise importance at the densities and temperatures evailing in the stars, and on this basis trustworthy timates have been given for the rate of liberation subatomic energy. These results, which are the tcome of laboratory investigations, furnish the athematical theory of internal constitution of the ars with a new equation that enables the luminosity a star to be calculated by direct methods. The formation so obtained has been utilized to attempt resolve the many paradoxes and discrepancies countered in discussing the general problem of llar evolution. All this recent work has been thoritatively summarized by Gamow with great arity and understanding in the article referred to ove. It is therefore with some surprise that we d that Prof. Gamow concludes his article with the pression that these new developments practically lve the problems of stellar evolution. This seems us to be so far from being the case that some rther discussion of the claims of nuclear theory as e main factor in stellar evolution would be desirable.

In the first place, it should be noticed that the plication of nuclear theory in its present state evitably leads to a result at least as embarrassing any of the questions that it might possibly resolve. r the theory maintains that no synthesis of atomic clei from hydrogen is possible within the stars cept for the very light elements. This would imply at the stars can no longer be regarded as the ilding place of the heavy elements, which must ve formed before they became part of the star—indeed they ever were formed. Now although such onclusion does not itself constitute a logical condiction, it seems to us to present such overwhelmg difficulty that it is much more reasonable to nclude that the basis of nuclear theory is in need revision rather than that the heavy elements were t formed by synthesis. On the other hand, many vestigators seem to have accepted the former sult as satisfactory, and in particular Gamow has oceeded to make it the basis of a theory of the red ant stars.

Secondly, Prof. Gamow apparently regards the nclusion that various classes of stars should be of ally different ages as a natural one. Thus the t that the present theory leads to a life-time for tain massive stars of order 10^{-3} the life-time of sun is not regarded as a difficulty at all; indeed is merely supposed that this is the case and the ory remains unquestioned. In point of fact, it is essential part of the theory as proposed by Gamow at all red giant stars are considered as of very ent formation, since the presence of lithium, etc., required to enable them to radiate with their posed low internal temperatures.

Now if all the stars could be regarded as single autonomous bodies, it would be difficult to dispute the validity of these views by direct means. But it so happens that the frequent occurrence of binary systems enables a simple test of the theory to be made, for in the case of binary stars both components must be of comparable age. It is immediately clear that the well-known difficulty concerning the relative emission per unit mass of the components of double-stars must remain in any theory that appeals only to the internal properties of the stars, although by making very artificial assumptions in Gamow's theory some of these discrepancies might be avoided. For example, it would require as a general result that the less massive components of binary systems form with a hydrogen content differing systematically from that of their companions. In certain cases this would lead to even more dubious initial conditions: thus, whilst Sirius must have formed with high hydrogen content, it would have to be assumed (according to the more generally accepted theory of degenerate matter) that the companion formed almost solely from heavy elements for it to have been practically exhausted during the whole of its existence. Such a solution of this difficulty could scarcely be regarded as satisfactory even if there were no other objection to the theory described by Gamow.

It should be particularly noticed that the foregoing suggestion assumes that the components have not evolved by fission, for this latter process (even if it were dynamically satisfactory) would clearly lead to two stars of closely similar compositions. We have been able to show, however, that to produce close binary systems, periods of order 5×10^{14} years are necessary[2]. Thus the existence of spectroscopic binary systems in which one component is a red giant or any highly luminous star presents an immediate contradiction of the theory given by Gamow. Moreover, there seems to be a general tendency for the mass of binary systems to increase with decreasing separation.

While on the subject of fission, it is perhaps only proper to point out here that although the mathematical investigations of the development of rotating fluid masses clearly demonstrate that binary stars cannot be generated by fission[3], many astronomers do not yet seem to have realized the physical significance of the mathematical results. As a consequence of this there are still many who 'believe' in the fission theory. But as will be seen, even an appeal to fission could not save Gamow's theory of the red giant stars, in addition to which it would raise afresh the difficulty of the relative emissions of the components in binary stars. Even if some process of break-up of a single star led to a binary system, it is evident that the components must have similar chemical compositions, while in close binary systems consisting of a red giant star and a class *B* star, Gamow's theory would require the red star to be the less massive component on account of the mass luminosity relation. But observation shows that in such pairs the giant star tends to be the more massive component. This is the case, for example, in the three stars υ Sagittarius, *VV* Cephei and ζ Aurigæ. Thus it seems that no matter from what angle we approach the questions raised by the observed properties of binary systems, the paradoxes already recognized by astronomers must remain in one form or another.

However, quite apart from the foregoing objections to the constructive portion of Gamow's article, it is very noticeable that no reference is made to the wide class of dynamical features that is associated with the stars. This, of course, is the direct result of attending only to the internal physical properties of the stars; but the dynamical features we have in mind are altogether too marked to remain unaccounted for in a satisfactory theory. Thus such questions as the formation of individual stars, and of binary and multiple systems, together with the general increase of mass with decreasing separation, and the observed approximation to equipartition of energy among the stars seem to present the real key to any theory of stellar evolution. An internal theory can give no explanation for the correlation between peculiar velocity and spectral class or the observed tendency for massive stars to lie in the galactic plane, features that must be related to the previous history of the stars.

It has been customary during recent years for investigators on stellar evolution to devote attention to internal constitution with little or no regard for the dynamical features. It appears that Prof. Gamow has followed essentially in this tradition and therefore confined his article to the modifications effected by the introduction of modern nuclear theory. Thus, in dealing with the properties of variable stars, no attempt is made to account for the three distinct periodicity groups comprised by stars of periods of order half a day, four days and 300 days. These variables also show a marked preference as rega spectral class, the first being largely of classes *B* a *A*, the second of *F* and *G* and the third of class Moreover, the two short-period groups exhibit most remarkable property in that none of them, o of more than two hundred available exampl possesses a close companion, whereas about one st in five of normal stars of similar spectral classes d possess a close companion. On the other hand, lon period variables appear to possess a normal co plement of companions. The first and third types a stars of moderate luminosity and show no pronounc galactic concentration, whereas the variables intermediate period, the Cepheids, are strongly co centrated to the galactic plane and are among t most luminous known stars. Thus it is clear th very remarkable dynamical properties are intimat connected with even the different types of variabili and therefore that purely internal considerations a most unlikely to prove capable of elucidating t nature of the connexion.

From these and many other dynamical qualiti associated with various types of stars, it appears us that Prof. Gamow has over-estimated the imp tance of nuclear theory in the problem of stel evolution. Indeed, in our opinion nuclear physi has very little to add to the results already co jectured by astrophysicists, and can merely serve confirm these conjectures, a typical instance bei the mass-luminosity relation itself. Finally, we wi to point out that although the present article consi largely of criticism, we have discussed elsewhere number of the questions raised[2], and it has be found that purely dynamical considerations may sufficient to provide a natural explanation of ma of the difficulties mentioned in this article.

[1] NATURE, 144, 575, 620 (Sept. 30 and Oct. 7, 1939).

[2] *Proc. Camb. Phil. Soc.*, (4), 35 (1939).

[3] *Mon. Not. Roy. Astr. Soc.*, 98, 646 (1938).

SCIENTIFIC AND INDUSTRIAL RESEARCH IN CANADA

THE twenty-first annual report of the National Research Council of Canada includes the report of the president, with reports of the various divisions and of co-operative investigations, together with the financial statement and appendixes listing the publications of the Council and papers published by members of the staff and holders of research grants during the year.

Under the Division of Biology and Agriculture a good deal of attention has been devoted to plant hormones, and a simple method of treating seeds with plant hormone chemicals has been developed in which a carrier is utilized, either an inert dust such as talc or a seed disinfectant such as an organic mercurial or copper carbonate. It has also been found that a very small amount of hormone when added to the treated solution greatly reduces or entirely prevents the injury of seed in treatment with formaldehyde for control of smut disease. A joint project with the Dominion Forest Service and the Department of Agriculture dealing with forest tree breeding is to some extent an outgrowth of these plant hormone investigations, since the discovery of a method of inducing wood cuttings to root more freely has opened up new possibilities in th direction, particularly in the propagation of rapi growing and disease-resistant trees. Further wo on plant hormones has been carried out under associate committee on this subject, and the Divisi of Chemistry has given a good deal of attention the synthesis of a series of homologues of α-naphth acetic acid, as well as developing an improved meth for the synthesis of α-naphthylacetic acid itself. Oth work under the Division of Biology and Agricultu has been concerned with grain research, including t standardization of an experimental baking test f wheat, experimental malting equipment and metho for barley, food storage and transport, including t effect of freezing treatment and rate of freezing the quality of frozen poultry, beef, pork and mutt and a survey of packing plants exporting Wiltshi bacon. The Division has also co-operated with t Dominions Department of Agriculture in the develo- ment of hybrids between wheat and the Agropyro or wheat grasses with the object of obtaining larg seeded drought-resistant grasses for western Canad and some work has been carried out on the effect phytohormones on bacteria and yeast.

The Division of Chemistry has examined the otors involved in the preparation of rennet casein itable for the manufacture of plastics, particularly ttons, and the highly efficient packings for fracnating columns and scrubbing towers designed the laboratories are now being developed in forms ecifically suited for larger scale operations. Active ntact has been maintained with the laundry and eaning industries of Canada, and the Division has so co-operated with the Sub-committee on Textile ecifications of the Canadian Government Purasing Standards Committee. An investigation of e laundry cleaning process with sodium hypolorite has been concluded, and work carried out the efficiency of wetting compounds and mixtures r use in the first or 'break' operation where orough wetting of the fabrics is of importance. he magnesian products laboratory of the Division as made available to the Canadian metal industry tter refractories and a wider range which can be tained from Canadian materials, notably the oduct of high-grade refractories from dolomite. Various barks have been investigated as a source tannin for the leather industry, and in the rubber boratory much work has been done on bonding bber to leather, particularly the application to e manufacture of automobile engine mountings a bonding material previously developed in the boratory. Numerous tests have been made of ch materials as paints and textiles on behalf of the anadian Government Purchasing Standards Comittee, while a process for the preparation of organic ercury derivatives, particularly alkyl mercuric alides and other salts used for seed disinfection, has een developed. Use of the disinfectants in the form a dust consisting of an inert carrier adapted to here to the seed has also been studied, and Canadian entonites or talc proved satisfactory as carriers, the ust being equal in disinfecting power to the best ported products. Work on synthetic resins has een extended to cover the formation of polymers om chloromethyl compounds.

The Division of Chemical Engineering has a wind tunnel for testing aeroplane models and streamlined locomotives and other equipment in which air resistance is important, and a model-testing basin in which similar problems in regard to water can be investigated. Safety tests are continually made of domestic oil, gas- and gasoline-burning appliances. Five ship models were tested during the year in the towing basin in connexion with the design of private and Government vessels. Numerous aircraft instruments, gasoline and lubricating oils have been tested for various branches of the Government service.

In the Division of Physics and Electrical Engineering an increasing amount of standardization and testing work of all types has been carried out. In addition to studies of the heat insulation properties of building materials, the development of a suitable thermostat for refrigerator cars has received much attention. Thousands of aircraft castings have been examined by X-ray methods; and the cathode ray compass and direction finder, detection of fire through haze, estimation of forest fire hazards, vibration in aircraft and ultrasonic generators for depth sounding are other problems under investigation.

Steps were taken during the year to reorganize the Division of Research Information and establish a Section of Research Plans and Publications, one function of which is to provide technical secretarial services for the president and some of the associate committees. Stress is laid in the report on the organization of an Associate Committee on Medical Research. The Associate Committee on Grain Research has outstanding achievements to its credit in the solution of problems relating to bread wheat. Studies of the drying of tough and damp wheat have established the conditions under which this can be done without injury to the milling and baking quality of the grain. Other investigations dealt with seed injury by fungicidal treatments, effect of formaldehyde treatment on the growth of wheat and prevention of heating of damp grain in storage.

R. H. THURSTON: ENGINEER

CENTENARY CELEBRATIONS

THE celebration of the centenary of the birth of the distinguished American engineer, Robert H. hurston, held at Cornell University on October 25, as the occasion for the delivery of several addresses in hich tribute was paid to the great influence Thurston ad on engineering education and progress, and also eference was made to the part the engineer should ake in the solving of social and economic problems. he addresses were given in the Bailey Hall before n audience of more than a thousand persons, which cluded many of Thurston's old students and elegates from no fewer than sixty universities and stitutions in the United States, Great Britain, anada, France and Germany.

When inaugurating the proceedings, Dr. E. E. ay, president of the University, said that in the nse and hurried living of this twentieth century of urs, it is difficult and at times well-nigh impossible keep in clear view the importance of the really urable values of life. No corrective for this difficulty so sure as the occasional review of the qualities of leadership in great men. War-racked and depression-ridden though this world may be, the force of individual character remains undiminished. As the years of Thurston's active service recede, his contributions to the upbuilding of Cornell lose none of their impressiveness, while the lives of the men who went out from his tutelage continue to attest the strength of his mind and spirit.

After speeches in which Thurston's training at Brown University, and his work as a naval engineer and as an instructor at the United States Naval Academy had been recalled, Dr. H. N. Davis, president of the Stevens Institute of Technology, Hoboken, dealt with "Pioneering in Engineering Education at Stevens". Thurston had joined President Henry Morton at Stevens in 1870, when thirty-one years of age, and he brought to bear upon the problem of an engineering curriculum an original mind, a wide outlook and great force of character. There were two aspects of his work at Stevens, said Dr. Davis, that seemed likely to be permanent parts of the Thurston tradition in engineering education. First he seems to have invented the idea that a mechanical laboratory is an appropriate part of an American Engineering School. It is, of course, difficult in 1939 to realize that in 1870 this idea had to be invented.

Thurston's conception of such a laboratory was a threefold one; first, it should be a place where a student could become practically acquainted with working machinery; secondly, it should be a place where staff and students, working together, might by research make important contributions to the progress of engineering; and thirdly, it should be a place to which industry could bring its problems, whether of testing, of design and development, or of a still more fundamental nature.

For his laboratory Thurston invented testing machines, and as a servant of industry the laboratory played an important part when few, if any, industries had their own plant for routine testing. From "a schedule of charges" dated 1877, and signed by Thurston, it appears that a test on the "autographic recording testing machine, of strength, ductility, resilience, and determination of elastic limit, elasticity, homogeneousness of structure and amount of internal strain, with strain-diagram and record" could be had for three dollars. A trial of a steam engine or boiler could be made for twenty-five dollars plus sixty cents an hour for field and office labour.

Thurston also had a conception of the fundamental position in mechanical engineering of the two great fields of the study of the properties of materials and of the problems of power. Further, he foresaw the position engineers were likely to occupy as industrial executives, and himself set an example to others by taking part in public affairs. He exemplified, concluded Dr. Davis, "a conception of the scope of the service of the engineer that may well be our inspira tion and ideal for many years to come".

The fourth address was by Dr. W. F. Durand, hi biographer, who dealt with Thurston's eighteen year 1885–1903, at Cornell, and the concluding addres was by Prof. S. C. Hollister, dean of the College o Engineering, Cornell, and was entitled "Looking t the Future". After referring to the great materia developments since 1868, when engineering was fir taught at Cornell, Prof. Hollister asked, "What ha all this development done to human living?" Ne problems have arisen of vast social import, and t every phase of the scene, as he saw it, the enginee has a direct relation. He must be prepared to cop successfully with changes wrought by scientific an technical advance; he is concerned with productio processes and organizations; he is involved i problems of management, finance, public relation and government. It seems clear that he is bound t be involved more and more in the social and economi problems that lie ahead.

There is but one way of preparing young men fo our expanding technical future, namely, to trai them broadly and deeply in the fundamental science Some feel that engineers are not trained in civi consciousness and usefulness. Prof. Hollister thinks i only fair to say that the whole educational field await with interest convincing testimony that any give curriculum accomplishes this very desirable en Civic consciousness is a matter of community attitud rather than the result of studying any system o subjects. The surest way to provide the right community attitude is to prepare men and wome thoroughly for the parts which they are to play i the community. Cornell for many years has, i varying degrees, been functioning in this direction.

MANUFACTURE OF RADIO SETS FOR EXPORT

ACCORDING to the *Electrical Times* of November 16, British manufacturers are often criticized for not studying the requirements of overseas markets. The reason for much of this criticism is easy to understand, as the conditions in the home markets of several of our international competitors are very similar to those in overseas countries which are large purchasers. To take a case in point, consider the export of radio sets.

It is common knowledge that, in the early days of foreign competition in the radio market, foreign competitors took the lead. In the United States, for example, where a widespread short-wave broadcasting system was employed, manufacturers found that little modification to the standard models was required to make them suitable for reception to distant parts of the world. British manufacturers had no similar home experience to rely on. Several of the leading firms in Great Britain have now built up an export market for models which have been specially designed for overseas use and have achieved success in winning back lost ground. The General Electric Co., Ltd., has an organization of a world-wide network of completely equipped and technically staffed branches which offer great facilities for before and after sales service. Its experts travel the world studying reception conditions and problems at first-hand. In one tour alone Nigeria and Siam, Canada, India, New Zealand and Hawaii were visited, th total distance traversed being 50,000 miles. As a resul of the valuable information obtained great improvements in design were facilitated and many specia tests, which every G.E.C. overseas radio receiver no undergoes as a matter of routine, were devised.

Illustrations are given in the *Electrical Times* o the apparatus used in the special laboratory an factory tests on the sets in the 'humidity cabinet'. I this cabinet any required temperature and relativ humidity can be obtained and also the cyclic variations representative of tropical climates. Syntheti resin insulation, used for wave change switches, an rubber insulation receive special treatment in respec of both electrical and mechanical properties. In th artificial ageing test, specimens are subjected to hig temperatures in an oxygen atmosphere and must remain unimpaired after 200 hours' treatment. One o the tests for the mechanism of switches is to perfor satisfactorily 50,000 operations. A motor-drive reciprocating mechanism operates the switch durin the test. An instrument is also used to check th moisture content of wooden components to ensur that seasoning has been thorough. During th manufacture of mica condensers all the operation are carried out in a filtered air-conditioned room an glass screens protect the condensers from th operator's breath.

FACTORIES AND THE BLACK-OUT

THE many problems which have been encountered by those responsible for blacking-out factories in the present emergency were discussed in some detail at a meeting of the Chemical Engineering Group of the Society of Chemical Industry which was held in the rooms of the Chemical Society, Burlington House, London, on December 8. Mr. H. W. Cremer presided and opened the discussion, during which it was manifested that the actual blacking-out in itself did not produce the only difficulty. It has been found hat there are psychological and physiological effects on the workers, to say nothing of difficulties which have been introduced in the matter of ventilation. As regards the latter, the need for blacking-out factories has rather revealed that there is yet a great deal to be learned concerning the ventilation of factories in normal times, and the suggestion that his problem should be gone into more thoroughly is likely to be taken up by the Committee of the Group.

Mr. Cremer directed special attention to the problem of ventilation and its effect upon night workers, plus the effect of reduced lighting, stressing hat factories should be designed normally—and reorganized in present circumstances—with an appreciation of the fact that they have to house human beings as well as machines.

Mr. L. W. Robson, of Messrs. Nobel's Chemical Finishes, Ltd., speaking of the actual physical problems of blacking-out, strongly advocated the extensive use of paint, which he said can be applied apidly, is cheap and permits of uniform lighting conditions being obtained in the factory by day and by night, so that the efficiency of workers is not affected by changes in degree of illumination prior o and after black-out times. He admitted that the objection to this is a considerable increase in the lighting bill, but claimed that the objection is not so great as is sometimes made out. For example, in the case of buildings camouflaged with paint or netting, the daylight illumination is often reduced to an extent which necessitates artificial lighting during the daytime. Again, in many engineering shops where fine work is done, bench lights are in constant use, irrespective of daylight or darkness.

Remarking that oil-bound distempers, oil paints and bituminous paints are all suitable for blacking-out purposes, Mr. Robson spoke also of the use of aluminium paint for vertical windows, which improves the general brightness of a room by its eflection, but it must not be used on roof lights, as it increases glint.

An alternative to the complete obliteration of windows is the use of complementary lighting, the colours chosen being usually orange and blue. This ystem is based on well-known optical principles and entails the conversion of the windows to blue filters which will not pass orange light, and the use of lamps which give orange light free from any blue ays. The lamps may be sodium vapour lamps or gas-filled lamps made of suitably coloured glass, or ordinary lamps suitably lacquered. It was emphasized that photographic workers find no difficulty in working in red or green light of much lower intensity than is afforded by this scheme. (Incidentally, there was some difference of opinion among the speakers on this matter, some referring to trouble with their workers owing to this form of lighting and others saying there had been none, after a short period of time.)

Mention was also made of fluorescent and phosphorescent paints. Fluorescent paints or pigments, of course, give off visible light when excited by invisible ultra-violet light but have no after-glow when the excitation is removed, whereas phosphorescent paints continue to glow after the exciting source is removed. The pigments used in these paints are based on zinc and cadmium sulphides. They must be incorporated in a special medium, and the paint, when applied, should be protected with a final coat of clear medium. These paints are obtainable in a variety of colours and glow brilliantly when used with a 'black' lamp.

There are, of course, numerous applications for such paints under black-out conditions, and it is recommended that where a paint is required for direction indicators in a building which will be suddenly blacked out when a warning is received, it should be of the zinc sulphide type, because of initial brightness. On the other hand, outside signs, or doorways which must be found after many hours of darkness, should be painted with an alkaline earth paint.

Dr. G. E. Foxwell said he had found that vertical retort tar, when heated under certain conditions with lime, had been found excellent for blacking out roof lights and was very resistant to moisture, showing no signs of peeling off. Mr. F. A. Greene remarked that he had discovered this many years ago, and added that with good quality tar there was no need for treatment with lime.

A number of other points were raised during the course of the discussion, in which some twenty speakers took part, and many of them concerned the extreme difficulty of complying with the regulations and maintaining manufacturing efficiency. For example, there are the numerous cases of large furnaces and the problem of blacking out the glow from them. In one case, where a complete black-out was effected, the men could not continue their work for more than two hours at a time. Some relief was obtained with a system of louvred ventilation combined with a degree of light restriction, but it was extremely costly.

One speaker remarked that where a complete black-out had been 100 per cent effective, it was practically 100 per cent defective as regards the workers, who objected to the orange lights and blue windows. The lighting of goods sidings at night has also entailed much difficulty and restriction of operations, but permission has been given by the authorities for a modified form of lighting and an arrangement of switches by which all lights can be instantly extinguished should a warning be received.

Another difficulty referred to was that of the increase of temperature in buildings under black-out conditions, due to reduced ventilation in consequence of windows having to be kept closed to prevent emission of light.

SCIENCE NEWS A CENTURY AGO

The Birmingham Mechanics' Institution

On December 17, 1839, an exhibition was held at the Mechanics' Institution in Birmingham and a correspondent wrote to the *Athenæum*, "It contains more than one hundred thousand articles arranged very tastefully in the rooms belonging to the Institution. Ornithology is the richest department in Natural History: there is a very perfect collection of British birds belonging to Dr. Lloyd; and a beautiful collection of the varieties of humming bird, prepared by Mr. Heywood, a mechanic of Coventry, who devotes his leisure hours to the cultivation of Natural History. . . . The departments of Geology, Mineralogy, and Crystallography are rich, but not extensive. . . . The models of engines, machinery, etc., are not so numerous as they were in the Grammar School during the visit of the British Association, but among them are some articles which were not then displayed, especially some lathes of admirable construction and great power."

Fossils from the London Clay

On December 18, 1839, Richard Owen read to the Geological Society a paper "On the Fossil Remains of a Mammal, a Bird and a Serpent, from the London Clay". Until a few months previously the highest organized animal remains known to exist in the London clay were those of reptiles and fishes. In collections at Ipswich and Woodbridge, however, had been discovered teeth of a quadrumanous animal, of Cheiroptera, plantigrade and digitigrade carnivora, and of a species probably belonging to the marsupial order. These had been found in the London clay of Suffolk. To these Mr. Owen had been enabled to add remains of a new and extinct genus of pachydermatous mammals, of a bird and a serpent. The first of these had been discovered in the cliffs of Studd Hill, near Herne Bay, by Mr. W. Richardson and consisted of a small mutilated cranium, about the size of that of a hare, containing the molar teeth of the upper jaw nearly perfect, and the sockets of the canine. The remains of birds consisted of a sternum with other bones, and a sacrum, both found at Sheppey. The sternum forms part of the collection of fossils formed by John Hunter. One of the specimens of extinct species of serpent was likewise in the Hunterian collection and consisted of about thirty vertebræ. This also was found at Sheppey.

Light from Plants

At a meeting of the Botanical Society on December 20, 1839, reported in the *Athenæum* of December 28, Dr. Willshire communicated all that was then known with respect to the evolution of light from plants, a subject which had recently attracted some attention on the Continent, but which was first observed in *Tropaloium majus*. The subject was divided into two portions, namely, light evolved from dead and living vegetable structures, and it appeared that wood rotted in the air never shines, it being requisite to be buried in the earth, when the sap is contained within it. It was observed that this effect takes place only in the months of July and August, in warm dry weather, never in damp. Several plants were mentioned as evolving light during the putrefactive stage, among others, mushrooms, potatoes, etc.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on before the dates mentioned:

TEACHER OF ENGINEERING SUBJECTS—The Principal, Luto Technical College, Park Square, Luton (December 20).

TEMPORARY DISTRICT OFFICER to the Essex War Agricultur Executive Committee—Executive Officer, East Anglian Institute Agriculture, Chelmsford (December 22).

TWO UNIVERSITY-GRADUATES (male and female) to teach Engli in a Lycée in Ankara—The British Council, 3 Hanover Street, W. (envelopes marked 'Turkey') (December 27).

CIVIL ENGINEERING ASSISTANTS in connexion with the Haweswate Scheme—The Secretary, Waterworks Offices, Town Hall, Manchester (December 28).

CHIEF EDUCATION OFFICER to the County Borough of Doncaster—The Town Clerk, 1 Priory Place, Doncaster (December 31).

SUB-LIBRARIAN at the University of Cape Town—The Secretar Office of the High Commissioner for the Union of South Africa, Trafa gar Square, W.C.2 (December 31).

SCHOOLMASTER OFFICERS in the Royal Navy—The Directo Education Department, Admiralty, S.W.1 (January 2).

TEMPORARY MASTERS to teach Mathematics, Physics and Applie Physics—The Headmaster, Oundle School, Oundle.

RESIDENT ENGINEER to the Witham and Steeping Rivers Catchmen Board—The Engineer to the Board, 50 Wide Bargate, Boston, Linc

LECTURER IN MECHANICAL ENGINEERING in the Witwatersran Technical College, Johannesburg—Messrs. Frank Ross and Co 9 Fenchurch Avenue, E.C.3.

UNESTABLISHED EXAMINERS in the W/T, Instrument, and Gener Engineering Branches of the Aeronautical Inspection Directorate the Air Ministry—Inspector in Charge, A.I.D. Training Schoo Brandon Street, Bristol 1.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scottish Marine Biological Association. Annual Report 1938-3 Pp. 48. (Glasgow: Scottish Marine Biological Association.) [221

Rothamsted Experimental Station, Harpenden: Lawes Agricultur Trust. Report for 1938. Pp. 213. (Harpenden: Rothamsted Exper mental Station.) 5s. [231

Ministry of Health. Memorandum on Typhoid Fever. Pp. 1 (London: H.M. Stationery Office.) 2d. net. [231

Other Countries

Smithsonian Institution: United States National Museum. Bullet 174: Life Histories of North American Woodpeckers, Order Pic formes. By Arthur Cleveland Bent. Pp. viii+334. (Washingto D.C.: Government Printing Office.) 50 cents. [221

U.S. Department of the Interior: Geological Survey. Bulleti 898-F: Spirit Leveling in Missouri. Part 6: Northeastern Missour 1896-1938. By J. G. Stack. Pp. x+797-869+xi-xiv. Bulletin 909-B Geophysical Abstracts 93, April-June 1938. Compiled by W. Ayvazo glou. Pp. ii+51-104. 10 cents. Bulletin 910-A: The Mineral In dustry of Alaska in 1937. By Philip S. Smith. (Mineral Resources o Alaska, 1937.) Pp. ii+114+1 plate. 35 cents. (Washington, D.C. Government Printing Office.) [221

U.S. Department of the Interior: Geological Survey. Professiona Paper 189-F: The *Venericardia planicosta* Group in the Gulf Provinc By Julia Gardner and Edgar Bowles. (Shorter Contributions t General Geology, 1937.) Pp. ii+143-216+plates 29-46. 40 cents Professional Paper 189-H: Pleistocene Diatoms from Long Island New York. By K. E. Lohman. (Shorter Contributions to Genera Geology, 1937.) Pp. ii+229-238. 10 cents. (Washington, D.C. Government Printing Office.) [221

U.S. Department of the Interior: Geological Survey. Water Supply Paper 822: Surface Water Supply of the United States, 1937 Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp vi+266+1 plate. 35 cents Water-Supply Paper 825: Surface Wate Supply of the United States, 1937 Part 5. Hudson Bay and Uppe Mississippi River Basins. Pp. viii+334+1 plate. 45 cents. Water Supply Paper 836-B.. Ground-Water Resources of the Holbroo Region, Alaska. By Marshall A. Harrell and Edin B. Eckel. (Contributions to the Hydrology of the United States, 1938.) Pp. iv+ 19-106+plates 2-11. 40 cents. Water-Supply Paper 838: Floods o Ohio and Mississippi Rivers, January-February 1937 Pp xii+ 746+25 plates. 1.25 dollars. (Washington, D.C.: Governmen Printing Office.) [221

Publications of the Lick Observatory. Vol. 14, Part 3: The Spec trum of Nova Aquilae (1918). By Arthur B. Wyse. Pp. ii+93-216+ plates 7-10. (Mt. Hamilton, Calif.: Lick Observatory.) [221

Ministry of Agriculture, Egypt: Technical and Scientific Service Bulletin No. 210: Manurial Requirements of Sugar-Cane in Egypt 4: Further Phosphate Experiments. By Arthur H. Rosenfeld. Pp ii+23+2 plates. P.T. 4. Bulletin No. 213: Manurial Requirement of Sugar-Cane in Egypt. 5: Time and Number of Nitrogenous Fer tilizer Applications. By Arthur H. Rosenfeld. Pp. vi+16+1 plate P.T. 2. Bulletin No. 220: Systematic and Automatic Warm Wate Steeping to Control Loose Smut of Wheat. By G. Howard Jones. Pp vi+12+10 plates. P.T. 3. Bulletin No. 223: Studies on the Contro of Kernel Smut of Sorghum. By A. F. El-Helaly. Pp. ii+22. P.T. 3 (Cairo: Government Press.) [231

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, DECEMBER 23, 1939 No. 3660

SOCIAL PROBLEMS OF WAR-TIME EVACUATION

AN admirable review of the problems arising out of the sudden redistribution of popula- n involved in the evacuation of the priority asses at the outbreak of war is given in a broad- eet on the "Home Front" recently issued by litical and Economic Planning (P E P). So far, wever, there has been little evidence of any g-term thinking on these problems. Moreover, hough a number of individual business firms pear to have acted on Mr. Harold Macmillan's a for a considered review of the whole policy evacuation, and returned part at least of their ntral offices from the country into London or her larger cities, there are no signs that the portunity of revising and improving evacuation rangements is being utilized by the Government. On the contrary, so far from evidence of funda- ental thinking about the essential problems, ich have such a close bearing on the efficiency our war effort and morale, everything indicates at evacuation questions are being dealt with as y-to-day exigencies, with little attempt at the ng-range thinking which would avoid many of e dilemmas at present involved. Until recently, serious effort has been made to consider the oblems of visitation between parents and ildren, whether of parents to the evacuation eas or of children to their homes.

The acute problems which evacuation has raised the sphere of education are indeed realized, and belated attempt is being made to deal with the fficulties of education of the children remaining the evacuated areas—difficulties which a firmer d more definite policy at an earlier date might ve very considerably reduced. Even in the ception areas, the essential social welfare work s been left to voluntary social service organiza- ns, and local welfare committees, and no organized effort made to meet the needs of the children or adolescents out of school hours, away from home influence and with the long nights of winter already here.

The absence of such national direction and co-ordination not only places heavy burdens on local authorities, but also is apt to engender a feeling of injustice in the reception areas, making for further attrition of the whole evacuation scheme. Its absence leads to grossly unfair burdens falling upon the teachers themselves, who are often bearing much heavier financial charges as a result of the disruption of their home life, apart altogether from the heavier responsibilities and the inroads on their private life. The effect of such factors on the efficiency and morale of the teaching staff is very far from receiving the attention it deserves.

The basis for any long-range policy which is to grapple effectively with the difficulties must be an impartial scientific examination of the facts. It is accordingly encouraging to find that an attempt at a scientific survey of evacuation problems has been made in at least one district. A preliminary report on this investigation, which has been made possible by a grant from the Liverpool Council of Social Service, and carried out by the University of Liverpool Department of Social Science in co-operation with the Liverpool University Settlement under the direction of Dr. Gertrud Wagner, has been published by the University Press of Liverpool.

The report is based on 356 interviews in the neighbourhood of the settlement, and is preliminary to a fuller investigation; but nevertheless it indicates clearly that the difficulties in working the evacuation scheme are due to four sociological and psychological facts. The family—

the basic unit of society—is broken up in the evacuation area or may be gravely disturbed in the reception area, with serious economic and psychological difficulties. For most working-class mothers, the main or even sole purpose in life—bringing up and working for their children—disappears when they are evacuated. Each social group in society has its own standards of living and behaviour, but under the evacuation scheme different groups are forced to live together.

The main difficulties discovered are listed under six heads. There is that of the mother in adapting herself to the new environment, and of the host in accepting the intrusion of someone with a different standard of living. Separation of the parents from the children frequently leads to a serious emotional problem. The provision of additional or better clothing for the children and the cost of fares to visit them present urgent economic problems, while lack of selection in placing the children and sometimes poor organization are a fourth set of difficulties. Removal of children from the reception areas by parents without due consideration or consultation, and the departure of the mother from the home leaving behind members of the family unused to managing on their own, apart from the economic difficulty of keeping two homes going, are further causes of trouble.

These difficulties are not to be dismissed lightly, and the report makes a number of suggestions for meeting them. The appointment of trained social workers in each reception area to visit the homes regularly and give informal advice to the hosts on the care of the children and their education, and to straighten out difficulties the hosts may have had with the children, would solve many problems. Propaganda by wireless talks or in the press advising mothers against visiting their children too soon after their removal from home or against being unduly influenced by letters written in a moment of depression would be of service, while social workers could also assist in diverting heavy demands on the mothers for clothes to organizations dealing with such matters.

Accurate knowledge in advance of the available accommodation in a reception area is essential, and also arrangements for medical examination of evacuees to secure diversion to camps or hostels of those unsuitable for private houses. Requisitioning of empty houses in the reception areas to deal with emergency cases is also recommended, as well as some regulation to prevent the removal by parents of their children without the consent of the appropriate educational author

It would be unfair to expect of a prelimin report more than recommendations to mitig the difficulties, and this investigation, wh incidentally, by illustrating the admirable con bution which the universities can make in so research, underlines the recent appeal of National Union of Students for liberal support the Government even in war-time, only indica the wide field open for both private and offi investigation if an adequate and resolute pol is to be evolved. Urgent as is the need for s investigations, there are matters in which im diate action is called for. The question of holid has to be faced boldly and frankly, whether fr the point of view of the children, the teachers the hosts. The construction of school camps ne expediting, and a large expansion of that p gramme would alleviate many difficulties. T school medical services must be reorganized time to cope with any of the usual spring epidemi and strenuous efforts made to safeguard, in rec tion as well as in evacuation areas, not mer teaching and discipline but also the whole syst of milk, medical, nursing and dental servic which largely came to an end when the scho were closed.

One recommendation of the Liverpool rep would appear to be fundamental. Unless it known what numbers of children are to stay the country, reorganization of education in t reception areas, the opening of temporary scho and hostels, the building of camps, and the relea of the local schools from the shift system can proceed. Parents should at least be requested authority to make a definite choice and compell to abide by it.

Education is, however, only one aspect of ci life which has been disturbed by evacuation, a even here the problems are far from being confined those of school-children. In technical and universi education, problems have been raised which a equally acute even if less in magnitude. Profou disruption has been experienced in professional li and the recent acceptance by the Ministry Health of the proposals of the special Adviso Emergency Hospital Medical Service Committ for reorganization of the emergency medical s vice covering the hospitals, the medical staffing first-aid posts and the position of specialis indicates that in one important sphere at lea the opportunity of readjustment and reconside tion has been utilized.

Much more, however, might be done to correct fects in our emergency plans, given the willing- ss of authority to recognize such defects and cept constructive criticism. Measures to facilitate e resumption by adults of family life might well sist in guaranteeing the maintenance of our onomic strength and the expansion of industry cessary both for the output of munitions d the buoyancy of the national finances. As r. Macmillan suggested, even now large industries d Government departments could consider return to normal, or at least locate their units accordance with long-range plans in which all e risks and disturbances are weighed. The rrender by Government departments of schools d hotels so hastily commandeered should not ly diminish some of the evacuation difficulties the educational field but also remove a potent use of public discontent.

The importance of this factor must not be overlooked. In the absence of any attempt to redress the mistakes made in this matter of commandeering—to repair the disturbance of education and destruction of equipment which occurred although alternative office accommodation was available, or to do justice to those who have suffered from the commandeering of hotels and other buildings—a lack of confidence is engendered alike in the impartiality and the integrity of the central administration. There can be no mistake as to the firm determination of the nation to see war through to victory, or as to the equally firm determination to have the utmost competence in its conduct. Refusal to acknowledge and rectify mistakes, or to accept constructive criticism, only undermines the good will and morale upon which the struggle and, above all, the unprecedented redistribution of population and activity make such tremendous demands.

THE LIFE-WORK OF MY FRIEND F. W. H. MYERS

Iuman Personality and its Survival after odily Death

y Frederic W. H. Myers. Vol. 1. Pp. xlvi+ 00. Vol. 2. Pp. xx + 660. (London, New York nd Toronto: Longmans, Green and Co., Ltd., 939.) 36s. net.

FREDERIC W. H. MYERS died in Rome in 1901, just as this century opened; but he ft behind him a mass of writing which was fterwards edited and published as two volumes n "Human Personality", reviewed by me in NATURE of June 18, 1903 (68, 145). These books epresent for all time his real life-work, that for hich he was willing to live laborious days; they epresent what he genuinely conceived to be a essage of moment to humanity; they are his gacy to posterity; and in the light of the facts ontained in them he was willing and even eager o die.

Death Myers did not dread. That is true; and is clear and happy faith was the outcome entirely f his scientific researches. The years of struggle nd effort and systematic thought had begotten in im a confidence as absolute and supreme as is to e found in the holiest martyr or saint. By this I ean that it was not possible for anyone to have more absolute and childlike confidence that eath was a mere physical event. To him it was n adversity which must happen to the body, but t was not one of those evil things which may ssault and hurt the soul.

Myers would have described himself as one who walked by sight and knowledge rather than by faith, and his eager life-long struggle for knowledge was in order that he might by no chance be mistaken. To some, conviction of this kind would be impossible—they are the many who know not what science is; to others, conviction of this kind seems unnecessary—they are the favoured few who feel that they have grasped all needed truth by revelation or by intuition. But by a few here and there, even now, this avenue of knowledge concerning the unseen is felt to be open. Myers believed that hereafter it would become open to all.

The doctrine which Myers arrived at after years of study is that each individual as we perceive him is but a small fraction of a larger whole, is as it were the foliage of a tree which has its main trunk in another order of existence. The metaphor constantly breaks down, as all metaphors must sooner or later; for some purposes it would seem better that the tree should be inverted; and the adjective "subliminal" contains no reference to what is beneath, except in the sense of foundation and support; in every other aspect the subliminal is probably the more real and more noble, more comprehensive, more intelligent self, of which the supraliminal development is but a natural and healthy and partial manifestation.

The products of the subliminal are to be regarded as "higher" in a definite sense than those of the supraliminal. The supraliminal is that which is the outcome of terrestrial evolution, and so is able to manifest itself in a planetary manner; the subliminal has a cosmic existence, which may play a part in terrestrial evolution hereafter, but at present only shows signs of doing so, as, for example, in the supernormal uprushes which are known as the inspirations of genius; signs which may be taken as anticipatory of the course of evolution in the future.

In this way sleep, death, genius, insanity, hysteria, hypnotism, automatism, clairvoyance, and all other disintegrations, abnormalities, and supernormalities of personality, fall into a consistent comprehensive scheme; and it is the object of the work to elaborate this hypothesis and to unify all these strange features of human personality, features which have so long afforded an exercise alternately to resolute credulity and to blatant scepticism, and have so perennially perplexed mankind.

The central feature of the book is the "Scheme of Vital Faculty", an elaborate and comprehensive scheme, which will be found in the second volume between pages 505 and 555, a scheme on which Myers bestowed a great deal of thought and which I saw emerging from his pen at the time he was writing it. It constitutes a synthesis or conspectus of the whole, wherein each vital faculty is displayed under the aspect appropriate to the three heads, somatic, psychic, and pneumatic; or, as he styled them, supraliminal, subliminal, and spiritual.

How far such a scheme as this soars above the range of the orthodox science of to-day is apparent from the fact that few of the faculties catalogued and classified in it, beyond those in the first category, are as yet generally recognized as existing at all. A few from the second or middle category are coming into recognition—such suggestion, hyperæsthesia, psycho-therapeuti and telepathy—but the greater part even of t second list is still only on the outskirts of recogniz knowledge; while in Myers's view it is the thi and at present wholly ultra-scientific catego which lies in the path of future knowledge a development, and constitutes the most pregna portion of his message to mankind.

It is not to be claimed that these volumes w convince a reader of the survival of personali beyond bodily death if he was previously hosti to or otherwise fortified against such an ide Perhaps they will convince nobody. The ma object of the work is not edification and finalit but stimulation to inquiry; and convictions any value are seldom attained by mere readin they can only be formed by soaking one's mind a subject for years, by "continually thinking un it", as Newton said. As the outcome of such process, it became Myers's undoubted belief th intelligence and human personality persist beyo bodily death; and that, between the two stat or conditions of being, intercommunication thou difficult was not altogether impossible. But th conclusion of his has been popularly seized an over-emphasized until to many of his conten poraries it seemed that an easy credulity on th point was his characteristic attitude. Nothi could be further from the truth. Easy credulit does not lead to a life-long labour and evolution a comprehensive scheme such as this.

It would have been an appalling blunder have allowed such a book as this to fade out remembrance and become impossible of attainme by the younger generation, especially at a ti like the present. OLIVER J. LODGE.

OLD AND NEW ASTRONOMY

One Day Telleth Another

By Stephen A. Ionides and Margaret L. Ionides. Pp. xii+324+31 plates. (London: Edward Arnold and Co., 1939.) 10s. 6d. net.

MANY books have been published on descriptive astronomy for general readers, ranging from simple stories intended to interest children in the starry heavens to surveys of celestial fact and theory requiring the intelligent attention of mature minds to comprehend them. All such works tend to remove the heavens farther and farther from the earth, though to early peoples these were complementary parts of a living universe. The quaint figures which, in ancient times, marked t positions and forms of the zodiacal and oth constellations have disappeared from celesti globes and maps, and the goddess Urania has lo her place among the other muses.

Mr. Ionides and his daughter have revived t human spirit in ancient astronomy and have th given new life to its presiding genius. In so aspects, their book is reminiscent of "Astronomic Myths", by J. F. Blake, which was based up Camille Flammarion's "History of the Heavens' and describes early observations and conceptio relating to the earth and the universe associate with the affairs of life and with religion. Th work, and R. A. Proctor's "Myths and Marvels of stronomy", were published more than sixty years go, and are unknown to most of the present-neration of observers and readers of astronomy. The volume before us, written in the light of dditional archæological knowledge and astron-mical discovery, should appeal to a wide circle f readers more interested in humanistic aspects f science than in simplified accounts of new ientific knowledge—factual or speculative.

The subjects of the chapters are time, days, easons, the sun, the moon, eclipses, planets, omets, calendar, precession, constellations, naviga-on, geography, astrology, and cosmology; and n each of them old and new ideas are lucidly ombined and interpreted. The field of inquiry and thought is vastly more extensive now than n the times of the astronomers of Babylonia, gypt and Greece, but the intelligence of man has ot undergone similar expansion; and if philosophers of those ancient days could be reincarnated ow, they would see clearly, in Mr. and Miss onides' book, how present knowledge has developed out of their own contributions in a natural equence.

What would be strange to such philosophers is he great extension of the field of observation endered possible by the use of optical and other ientific instruments. But though we now measure ime and angle in seconds, the division of the odiac into twelve signs of 30° each was the origin f the division of the circumference of a circle nto 360°. As to the use of the number twelve, he late Dr. J. K. Fotheringham, the great authority n ancient astronomy and chronology, showed that t was used by the Sumerians to divide the day, and that the Babylonians afterwards divided day and night each into twelve hours. It was natural or the Chaldeans, with whom sixty was an mportant number in their system of numeration, o use it in subdividing the hour into sixty minutes, nd, later, into sixty seconds. The construction of accurate instruments to measure seconds of time nd angle came long after these units had their origin.

It is of interest to trace in a single chapter of this volume how the old and new astronomy are combined; and that on the sun may be appro-riately used as an example. The sun as the source nd benefactor of all life on the earth was the essential idea of the religions of many ancient peoples, and its worship was particularly dominant n Egypt. The first truly monotheistic religion was that founded by Ikhnaton, whose followers worshipped the sun as a symbol of the one and nly God—"Thou disc of the sun, Thou living God: there is none other beside Thee". In his Moses and Monotheism", Freud, shortly before his death, traced the transition of Ikhnaton's teaching from Egypt into Palestine with the Exodus of the Hebrews. Long afterwards, Ezekiel was lamenting that the women of Israel were weeping for the departure of Tammuz—the sun-god of the Sumerians, Babylonians and Assyrians. Out of these ideas came the Greek gods of the sun—Phœbus and others—but these deities then became objects of inquiry, and Aristarchus used geometry to estimate the distance of the sun from the earth. About 1000 B.C., Zoroaster identified the "God of Light" with goodness, and evil with darkness, and called his god Mazda, the name given to-day to a well-known type of electric lamp. Because the study of light belonged to theology, it was encouraged when other branches of physical science were snares of the devil. So we are led up to modern times, with the discovery of helium in the sun by Sir Norman Lockyer (whose name, however, is not mentioned), and its isolation twenty-six (not twenty as stated) years later by Sir William Ramsay from the mineral cleveite.

Continuing their romantic story, the authors proceed to some modern aspects of solar physics. Referring to terrestrial influences of sunspot activity, they state that wet and dry seasons are associated with the sunspot cycle, but this simple relationship has never been established. Prof. A. E. Douglass's studies of the rings in sections of tree-trunks, though of scientific importance, cannot in any way be accepted as proof of such a connexion; while the statement that there were no spots on the sun during the seventy years from 1645 to 1715 requires more confirmation than that given in "a letter from a London astronomer". From sun-spots the authors pass to the chromosphere, prominences and the corona, and they point out that the form of the corona at minimum epochs of solar activity is roughly represented in the "ring with wings" found throughout Babylonia, Assyria and Egypt. Many motor-cars to-day carry upon their bonnets a form of the Egyptian ring with wings. The chapter ends with a reference to Dr. B. Lyot's photographs of the solar corona and prominences without an eclipse and to the construction and use of Hale's spectroheliograph.

The other fourteen chapters of the book similarly combine the archæology of astronomy with modern knowledge of the heavens. The pattern presented to the human mind to-day is made up of the warp and woof of time and thought from many stages of civilization; and, though the ultimate design be still unknown, the loom will continue to weave the threads of knowledge into a fabric which worthily represents man's endeavours to understand Nature and his place in it.

R. A. Gregory.

STRATIGRAPHICAL STUDIES OF CALIFORNIA

Miocene Stratigraphy of California
By Robert M. Kleinpell. Pp. ix+450+22 plates. (Tulsa, Okla.: American Association of Petroleum Technologists; London: Thomas Murby and Co., 1938). 22*s*. 6*d*.

THE geological pioneer in any newly explored area distinguishes certain broad stratigraphical units, based primarily on lithic characters, and secondarily on the contained fossils. He correlates these units roughly with those on the familiar time-scale. As subsequent research, in the course of years, is extended in area and intensified in each locality, palæontological evidence becomes increasingly important, and problems of interpretation and correlation arise. Does a well-marked lithic change, say, from shale to sandstone or limestone, correspond to a definite moment of time, or did it take place earlier here than there? What faunal aggregates may be trusted as exact age-indexes (zone-fossils), and which give ecological evidence (facies-fossils)? How can time-divisions based on Foraminifera be correlated with those based on Mollusca, echinoids or vertebrates? All these problems are faced by Mr. Kleinpell in his revision of the Miocene of California.

The Neogene of California is disposed in tectonic basins, about a dozen in number, from Humboldt in the north to Los Angeles in the south. About half-way along is the Paso Robles basin, and in this lies the Reliz Canyon, which provides the author with his type section. The aerial photograph serving as frontispiece shows the area to sufficiently arid to give a practically continuo exposure; but one must admire the painstaki determination with which so many successi associations of Foraminifera were collected, iden fied and tabulated. Such labour would scarce have been thought of without the stimulus whi the search for oil has given to the detailed stu of Foraminifera.

The first half of the text consists of discussio on matters of correlation, which are not only great importance to all who are concerned wi the Tertiary geology of the Pacific slope of Nor America, but also to all geologists interested the problems outlined in the first paragraph of th notice. The author introduces a new series divisions (with new names) which he believes have a precise age-value, replacing such we known terms as Monterey Shale, which will alwa keep their broad stratigraphical and physiograp ical usefulness, but are misleading when taken corresponding to the same duration of tin wherever they occur. This first part is illustrat by maps, sections and tables, the largest of whi occupy a pocket in the cover. Bibliographic references are very full. The second half is systematic catalogue of Foraminifera, illustrat by twenty-two plates. There do not appear be any new species.

This should be the standard work on the Mioce of California for years to come. A. M. D.

IN PRINCIPIO ERAT VERBUM

An Ecological Glossary
Compiled by J. Richard Carpenter. Pp. ix+318. (London: Kegan Paul and Co., Ltd., 1938.) 15*s*. net.

THERE are two ways of compiling a glossary: the critical and exclusive, and the complete and impartial. Dr. Carpenter adopts the second method. Its advantage is that it brings all the varying terms and expressions together and reveals in a striking way the inconsistencies and unresolved conflicts found in a comparatively new science such as ecology. Its disadvantage is that it conceals the dead words and meanings among the living. A compromise, relegating obsolete words and meanings to smaller print or brackets seems desirable and might be suggested for future editions.

Ecology, like genetics and other recent disciplines in biology, applies to both plants and animals. It is interesting to examine its termin logy from this point of view. Evidently botan was the predominant partner at the time th special terminology was in process of formatio as all the basic terms for associations appear t rest on plant criteria. Only in such ancillar matters as bird-watching do we find an infiltratio of terms based on zoology. This may, of cours be due in part to the fact that the plant con stituents of a society are more fixed than th animal ones and less liable to wander out of th picture; but it seems probable that zoologica terms will bulk more largely in future edition The glossary shows certain inconsistencies in term which ecology shares with genetics, for example 'variation'; and Dzierzon's 'theory' or 'concept is just a fact.

The sight of more than three thousand technica xpressions brought together moves one to reflect their quality as language. The great majority ecological terms are from the Græco-Roman, which biology seems undivorceably if unhappily edded. They vary in sound from the not unleasing 'kalloplankton' and 'quaquaversal' to the pellent 'autephaptomenon' and 'necrocoleopterphilous'. It is at times a shock to meet a native ord, like 'plot', which appears sandwiched etween 'ploadostadion' and 'plotophytes'. Prof. lements, the noblest Græco-Roman of them all, credited with more than four hundred terms. he non-classical words are broadly international; ost abundant are German (translated), Spanish nd Portuguese; but French, Italian, Danish, orwegian, Afrikaans, Serbian, Russian, Magyar, rabic and Swahili words occur, together with me unidentified by the reviewer. One wonders it is wholly wise to use outlandish languages; hough they sound as a rule better than the Greek examples, they are difficult to check and thus lead to confusion; witness the entries under 'igapu', 'ygapo' (not cross-referenced), 'igaqu' (p. 228) and 'caagapu', all apparently equivalent to the 'rebalsa', or in plain English, flood-forest, of the Amazon.

The book, though not free from misprints, is well produced. In addition to 287 pages of glossary there are a useful introduction and a bibliography, while appendixes give tabular comparisons of the plant-sociological terms of opposing schools, and reprint important plant and animal regional maps Dr. Carpenter cites, wherever possible, the author from whom he takes his definition, with the date—a practice to be commended to all compilers of scientific glossaries. He has carried out his task in a painstaking and exhaustive way, going so far as to define 'foreshore', 'reprint' and 'peck-order'. The book will be popular in university departments and will prove a valuable basis for any later critical survey of ecological terms.

B. S.

THE WORLD AFFAIRS SERIES

xford Pamphlets on World Affairs

o. 1: The Prospects of Civilization. By Sir lfred Zimmern. Pp. 32. No. 2: The British mpire. By H. V. Hodson. Pp. 32. No. 3: Herr itler's Self-Disclosure in "Mein Kampf". By C. K. Ensor. Pp. 29. No. 4: Economic Selfufficiency. By Prof. A. G. B. Fisher. Pp. 32. o. 5: "Race" in Europe. By Prof. Julian uxley. Pp. 32. No. 6: The Fourteen Points nd the Treaty of Versailles. By G. M. Gathorneardy. Pp. 40. No. 7: Colonies and Raw aterials. By H. D. Henderson. Pp. 32. No. 8: Living-Space" and Population Problems. By R. Kuczynski. Pp. 32. No. 9: Turkey, reece and the Eastern Mediterranean. By G. F. udson. Pp. 32. No. 10: The Danubian Basin. y C. A. Macartney. Pp. 32. No. 11: The Dual olicy. By Sir Arthur Salter. Pp. 32. No. 12: ncirclement. By J. L. Brierly. Pp. 32. No. 13: he Refugee Question. By Sir John Hope Simpson. p. 32. (Oxford: Clarendon Press; London: xford University Press, 1939.) 3*d*. net each.

THE admirable series of Oxford Pamphlets on World Affairs, of which the first thirteen itles given above were published before the utbreak of war, have lost nothing of their alue on that score. The brief accounts they ive of current international topics will serve to ssist in the clear understanding of the events which orced Great Britain into war, and to strengthen he determination to bend all our efforts to uccess.

In the first pamphlet of the series, Sir Alfred Zimmern discusses the factors which have destroyed internationalism in the modern period, the necessity for applying moral standards to political relations, and the problem of adjusting the social and political habits and traditions of mankind to the conditions of the modern world. The optimism of 1919 failed to recognize the dimensions of the problem that lay before the civilized world. Sir Alfred insists that the problem which baffles and discourages us in 1939 has political, economic and moral elements. The last he considers is the most important; for, if least urgent, it is a permanent problem in all political life. The difficulties which have always attended this problem, for example, from the fact that politics is concerned with power, have been intensified by the enlargement of the rule of political life through the multiplication of international contacts, and also through the weakening of moral standards. While Sir Alfred does not believe it is possible to eliminate the tension between moral ideals and political realities, it is quite possible to lay down general principles of political conduct which afford sure guidance in particular circumstances as they arise.

In regard to the economic element, which is a long-distance problem of adjusting the social and political habits and traditions of mankind to the conditions brought about by the Industrial Revolution, Sir Alfred suggests that we should begin by finding the smallest change in our established social and political habits and arrangements which will enable mankind to reap the benefits of the age of power, abundance and interdependence. Determination of the least possible change, not the greatest possible change, would, by easing the strain on the ordinary citizen, make it possible to reap the benefits which science has placed within our power. In regard to formation of a new habit of mind to meet the requirements of our problems, it is sufficient that most of the citizens of the responsibly governed countries should be world-minded.

On the political side, Sir Alfred considers the political problem of Europe to-day is that of the political immaturity of the German people. Until that chronic condition has yielded to treatment, Europe will remain a politically backward continent, and the statesmanship of the democracies, which otherwise might be fully employed in breaking down prejudices surviving from outworn conditions and leading the European peoples into the larger world opened out to them by science, must be expended in counteracting or overthrowing a senseless militarism.

This pamphlet is followed by one on the British Empire by H. V. Hodson, in which the status of the different members of the British Commonwealth of Nations, the position of the Crown in Imperial relations, the question of Dominion neutrality in time of war, the co-ordination of defence, trade relations within and without the British Commonwealth, problems of migration and race are concisely and lucidly explained and discussed. This is followed by Mr. R. C. K. Ensor's account of Herr Hitler's disclosures of policy in "Mein Kampf" and of the extent to which this policy has so far been carried out. In addition to assessing future possibilities, Mr. Ensor briefly describes Hitler's theory of 'race', the doctrine of *Lebensraum* or 'habitat', and the scale of annexation prescribed for Greater Germany. In the fourth pamphlet, "Economic Self-Sufficiency", Prof. A. G. B. Fisher discusses the fallacies which underlie the policies of 'autarky' or economic self-sufficiency, the pursuit of which in certain countries has aggravated the economic problems of the world in recent years. In the fifth pamphlet, based on sections of the book "We Europeans", under the title " 'Race' in Europe", Prof. Julian Huxley demolishes the myth of racialism and shows that the theory of an 'Aryan race' is a myth. The violent racialism in Europe to-day is a sympton of Europe's exaggerated nationalism ; it is an attempt to justify nationalism on a non-nationalist basis, and to find a basis in science for ideas and policies which are generated internally by a particular economic and political system, are relevant only to that system, and have nothing to do with science. The cure for the racial mythology with its accompanying self-exaltation and persecution, is a re-orientation of the nationalist ideal and an abandonment of claims by the nations to absolute sovereign right Science is bound to point out the biologica realities of the ethnic situation and to refuse t lend sanction to the racial absurdities and th racial horrors perpetrated in the name of scienc Prof. Huxley states that all the facts are agains the existence in modern Europe of anything i the nature of separate human races. He also dea with national types, the Jewish question and th advantages of race mixture.

A seventh pamphlet, "Colonies and Raw Materials", by H. D. Henderson, discusses the value of colonial possessions to a metropolitan country especially as sources of 'raw materials'. Mr Henderson concludes that the industrial people of Europe, whether they possess colonies or not have no reason to apprehend any difficulty i obtaining tropical raw materials, or raw materials of any kind, in a peaceful world. One of th problems of world-economics to-day is the exces of supply of primary products over demand. While the supply of raw materials of most types is tending to increase more rapidly than before, the populations of the industrial countries are increasing more slowly and will soon probably decrease

The next pamphlet in the series (No. 8), by R. R. Kuczynski, examines in detail the so-called problem of *Lebensraum* or living space. Dr Kuczynski's survey of this problem of population leads to the conclusion that from an economic point of view Germany's living-space is more valuable now without colonies than it was before the War of 1914–18 with colonies. She does no require colonies to relieve population pressure in the mother-country. Her former colonies would not be in a position to provide her with foodstuffs they could only supply her with a negligible fraction of her requirements of raw materials unless forced labour were introduced on a gigantic scale. The return of her former protectorates overseas is demanded for military reasons and to exploit them at the cost of the 'natives'.

Other aspects of this question are discussed by Prof. J. L. Brierly in Pamphlet No. 12 ("Encirclement"), in which the political significance of the problem of *Lebensraum* is indicated. Prof. Brierly. pointing out the reality of encirclement, shows how nearly all European countries are in fact encircled, but the encirclement of which Germany complains is a defensive measure provoked by Germany's own aggressive measures and broken faith. A pamphlet by Sir Arthur Salter (No. 11 "The Dual Policy") largely summarizing his book "Security : Can We Retrieve It ?", outlines the policy pursued by the British Government since March 15, 1939, resting on the twin foundations resistance to force, and the constructive work of building peace.

MAGIC IN MEXICO

IT has been remarked by more than one observer of the population of Mexico that whether account be taken only of the indigenous inhabitants of purely Indian descent, who subscribe to the observances of the Catholic Church, or those of mixed blood be brought into the picture, it includes a large number who habitually, and as a matter of course, take part in ceremonies and ites which are either completely pagan or have been adopted into the local ecclesiastical calendar with no more than a veneer of Christianity, which barely covers and does not disguise their true character. In remarking on such observances, no reference is intended to the beliefs and customs of hose Indian peoples of Mexico who are as yet but little affected by European civilization, and of whom there is still a considerable number.

A record of some remarkable ceremonies of a magico-religious nature has been made recently by Dr. Robert Gessain in the course of an expedition to the Hidalgo State or Province of Mexico, on behalf of the École française de Mexico, to which reference is made in another column of this issue (see p. 1039). Although compelled by ill-health to return to Europe before his work was completed, Dr. Gessain was able so far to win the confidence of a suspicious people as to be allowed o witness the performance of a number of these ceremonies, and also to secure descriptive accounts of others which had not been performed for very many years. The observances, it is believed, or known in certain instances, have a wide currency, with local variation, among neighbouring Indians belonging to groups other than that with which he was concerned; but it was impossible, owing to the circumstance mentioned, for him to enter upon the comparative study, which is obviously an essential for fuller understanding.

The Indians among whom Dr. Gessain's researches were carried on are the Tepehua, a group numbering approximately six thousand, who live in the village of Huehuetla of approximately a thousand inhabitants, and the surrounding district, which falls within the respective borders of three States, or provinces, Puebla, Hidalgo, and Veracruz, and lies on the Atlantic slope of the high central plateau. The Tepehua are surrounded by villages of Otomi and Totonac; and although on lingustic grounds they have been assigned to the Totonac group, it is permissible to doubt whether their affinities with their neighbours have been defined with complete certainty. They have been visited by European observers on two previous occasions only—Frederick Starr in 1900, and Helga Larsen in 1934.

While participation in similar ceremonies, or rather their local variants, appears to be virtually universal among the Otomi, the number of Tepehua who take part regularly is about two thirds of the total, the strict Roman Catholics standing aloof. There is, however, a considerable marginal body which is prepared to take part in pagan ceremonial or Christian ritual indifferently. The mixed breeds, numbering about a hundred, being resident with a view to commercial interests only, take no part.

Owing to a variety of influences, the cult has tended to become something in the nature of a survival within the last twenty or thirty years. The sorceror-priests (*brujos*) are less numerous, and the performance of the ceremonies is now of a less extended character. Nevertheless, the cult is still full of vitality, as is shown by the amounts the votaries are prepared to pay the *brujos* for the performance of a ceremony, such as that of the opening of a new house, or in connexion with the birth of a child. The cult is said to flourish with most vigour in San Francisco (Veracruz), where Tepehua emigrants are numerous.

The ritual ceremonies are many in number. Of these, some, connected with the routine of cultivation, or the climatic cycle, are periodic; others are occasional and indeed, it was stated, had not been performed for twenty-five or thirty years. Again, the ceremonies may either be associated with an individual misfortune, such as an illness, or a collective disaster, such as a river-flood.

Dr. Gessain describes in detail a number of ceremonies, or magical practices, in which the services of the *brujos* are sought: the opening of a new house or sugar cane mill; the ceremony of the maize harvest or general harvest festival, in which the whole community takes part, and at which all *brujos* are present, but receive no fee; a ceremony in the dry season for the protection of the maize and the other crops from both drought and the depredations of birds and vermin; for the bees, this a fertility ceremony when an insufficiency of wax is being produced, wax being of more importance than the honey on account of its use for ritual purposes; the installation of a sorceror-priest; when the river floods, again a ceremony at which several *brujos* are present, and most or all the members of the community; for curing disease and ill-health; against epidemics; for curing sterility in women; at and after child-birth; to secure the fertility of young girls; for the dead and after death; and numerous enchantments to procure or retain love; to ensure fidelity in the married; to avert jealousy, and the like.

Without entering into an analysis of the details of the ceremonies, which Dr. Gessain describes, attention may be directed to certain characteristics which afford a general idea of the nature of the ceremonies. They usually include offerings and a sacrifice, normally a fowl or a turkey, which is decapitated by the *brujo*, either with his *machete*, or with his hands. Sometimes, especially when the ceremony is intended to secure a personal benefit, such as the cure of sterility in a woman, or at the installation of a *brujo*, the blood of the victim is drained into a vessel, and used to make the mark of the cross on certain parts of the body of the individual in question. The head of the victim, sometimes also the dismembered body, may be buried, but more often among the Tepehua, the victim is cooked for the sacrificial feast; or with the other offerings it may be thrown away in the river or buried. Among the Otami, of the village of San Gregorio, the offerings of food placed on the altar raised to the dead are thrown away at a customary place at the end of the village, instead of being eaten as among the Tepehua. It is essential that the meat for the sacrificial meal should be cooked and served by women who are not members of the household in which the ceremonies are being held, and this rule applies also to the women who perform the office of laying out the dead. The ceremonies are led by the *brujo*, or sorcerer-priest, who performs the sacrifice, supervises the laying out of the feast, censing the food and table with copal, and leads the dances and chants which make up the greater part of each ceremony, apart from the offerings, the sacrifice, and the sacrificial meal. Should a procession form part of the ceremony, as in that for rain, it is headed by the *brujo*.

The ceremonies take place at night, often lasting the whole night through. They usually take place in the house of the individual concerned, for example, when an illness is being treated, or in the death ceremonial; but ceremonies in which the whole community takes a part may take place in the house of one of the *brujos*, as, for example, happens at the celebration of the harvest festival. This is interpreted by Dr. Gessain as evidence for the survival of a hierarchy among the priests. Among the Tepehua of San Pedro a special house is set aside for the celebration of ceremonies in which the whole community is interested or concerned.

A fee is paid to the *brujo* for the performance of all ceremonies, except the communal harvest feast. The installation of a sorcerer-priest costs the candidate a fee of several hundred pesos, which is paid to his sponsor, under whose instru tion he has been for the preceding twelve month He also provides his sponsor's clothes, whic includes two scarves which have been woven b the women, strangers to the household, who a responsible for the preparation and serving of th sacrificial meat. These scarves must be woven an completely finished in the two days before th ceremony takes place.

It is interesting to note the relation of thes ceremonies to Christian ritual and concepts. Th harvest festival, for example, is held on Septembe 16, which is the feast day of St. Michael, as we as the national day of Mexico; and the ceremon for the protection of vegetation in the dry seaso takes place on Palm Sunday. Among the Otom of San Gregorio, at the time of the sowing of th seed, *munecos* (paper figures) are cut out in differen colours according to the nature of the crops. Thes with sacred flowers, a species of Dianthu which plays a prominent part in all ritual perform ances, are placed in the church. There is n Catholic priest here.

It is perhaps worth noting, though Dr. Gessai offers no comment, that at the sacrificial meal a the installation of a *brujo* thirteen places are lai on the table, of which the thirteenth place i smaller than the rest, and receives a half-portio at each service, of which there are four. Afte each service, the meat is taken from the plate and placed in two *ollas* or jars standing ready fo the purpose, prior to its consumption by th company.

Enough has already been said to indicate th function of the *brujo* or sorcerer-priest. It is remunerative office. Should such a ceremony a for example, the opening of a new house not b performed, any serious illness of an inmate whic may follow, or any misfortune, will be attribute to that fact. Such stress, indeed, is laid upon it that a *brujo* will often exhort the owner to borro the money (six pesos) rather than omit it.

The *brujos* of Huehuetla are five in number The initiate whose installation is described was man of about fifty years of age. In the ceremon three altars were erected in the house of th initiate, in which the ceremony took place. Th altars differ in size, and the largest is left standin after the ceremony to be the *brujo's* special alta for the remainder of his life. The head of th turkey which was offered at the ceremony, an with the blood of which he was marked with th cross, was buried in this altar. The altar is destroyed at a ceremony fifteen days after the *brujo'* death. During his lifetime it is always adorne with sacred flowers, paper figures and clay saucers Burning tapers appear on the altar only while ceremony is taking place. The crystal which h es for magical and divinatory purposes rests it in a clay saucer. This crystal occupied the allest of the altars at his initiation. Another operty of the *brujo* is his *idolo*. This is an tique statuette or figurine, which has been dug by the *brujo*, often at a great distance away. equently it may consist of no more than a head, which event it is completed in wood and is essed either as man or woman. This also rests the *brujo's* altar and is the object of a cult. me *brujos* may have several of these.

The *brujo* enters into relation with the spirit rld on several occasions and by various methods. the fertility ceremony of the bees he addresses he advocate of the bees", and at the very close the harvest festival on September 16 he sets his *idolo* and addresses a chant of invocation it. In the rain ceremony a procession is made a certain marsh and the *brujo* addresses the goddess of the marsh (*sirena della una*) a list of the offerings which are to be rown into the water; and she is implored to peal to "the Lord of the Sea" should she not ntrol water enough in the marsh to cause fficient rain to fall. Among the *munecos*, which e thrown with other offerings into the lake, is e in two colours in the form of a young boy nich is said to symbolize the *brujo* himself. One the most interesting examples of the relation the *brujo* to the spirit world is seen in the open-g of the ceremony for the harvest, when the rcerer-priest retires under the table, which is aped with a fibre mat, thus forming a species of lge. A cup of chocolate and a cake are handed him, and here he remains in communion with e spirits for the space of one hour. At the remony of the installation of a *brujo*, when offer-gs of food are being served, twelve times he fills vessel with cane spirit, and tenders it in the sture of offering, first above, then below, the ble before pouring it away into a bottle. When yone who is seriously ill has been cured by the nistrations of the *brujo*, he offers apologies to e dead of the family.

The star cult, which is a prominent feature of omi belief, has also influenced the religious ideas the Tepehua, while the cult of the moon appears the ceremony for curing sterility in women. is ceremony is addressed to the moon, as it is lieved that sterility is caused by the moon's anger.

The remarkable element in all these ceremonies, wever, is the liberal use of paper 'figurines', the *necos*, either decorative patterns cut in rect-gular sheets of coloured paper, or in silhouette, latter being most frequently employed for the man form. The decorative forms are conven-nalized, as is the human form; but usually it possible to recognize what it is intended to represent, especially in the flower and corn forms, while the symbol for agricultural operations is readily to be identified, when it is realized that it represents the furrow made by the plough. The representation of the stars is more formal, but starlight in the sky is clearly intended. The human form, both male and female, though conventional in attitude and characteristics, which conform to certain standardized patterns, is otherwise sufficiently realistic. Many of the more decorative *munecos*, especially those in which crops and flowers are represented, recall the European cut-paper ornaments of the Victorian age, which perhaps may have influenced their development. European influence, even in the representation of the human form, seems to be clearly indicated. This, however, is not a question which has been discussed by Dr. Gessain.

Starr records the use of bark paper, but this apparently is now used only by the Otomi. The Tepehua always use paper which they purchase from the half-breed traders, and use for no other purpose. The *munecos* are not used singly. Not only are several different patterns used in each ceremony, each with its special function, but also a large number of each are cut out and used in various ways.

The magical function of the *muneco* is varied. In certain instances it is little more than an amulet with apotropaic power, as for example, when it hangs across a road to bar the approach of an epidemic to a village. The idea that the *muneco* may act as a detergent agent seems to be present in the ceremony of healing the sick, when *munecos*, sacred flowers and a live fowl are rubbed over the body of the patient. When the fowl has been killed, it is wrapped in the *muneco* and the whole, including the flowers, is thrown in the river. That they may symbolize a spirit, human or other, is indicated by the *muneco* used in the ceremony for the dead, which takes place on the bank of the river a week after death. It represents the *brujo* trampling on the corpse to prevent the spirit of the dead man from returning, while in another, used in the ceremony to ward off epidemics, the *brujo* is represented dancing on a devil, presumably the spirit of the disease. In its magical use the employment of a representation of the human form recalls the power given the European witch and others by the use of a waxen image. When a woman seeks the help of the sorcerer-priest to gain influence over her husband, or to prevent him beating her, in the former instance *munecos* are given her to place secretly in his pillow. These represent him at her feet, or in prefiguration beneath her feet; and the images are sometimes duplicated to enhance the influence she will have over him.

Further, spirits which are not human may be conceived as actually embodied in the *muneco*. When in the ceremony for rain the participants return from invoking the Sirena, two *munecos*, one male and one female, accompany the procession and are carried as standards. Before they start, water is dipped from the marsh and scattered over and around them, and this is kept up at intervals as long as is possible along the road. They are the helpers, or ministers, of the Sirena, who have been charged to carry water for the fields, which will fall as rain. They are left hanging over t road at the entrance to the village, while othe have been left along the road.

Comparative study of this body of ceremoni which Dr. Gessain was unable to undertak but it is to be hoped is only postponed f a future occasion, would be of the great interest. The magical use of the human figu recalls, for example, the appliqué need work, showing European influence, of San B (Panama).

RECENT WORK ON EXPERIMENTAL PARTHENOGENESIS

BY PROF. A. D. PEACOCK,

UNIVERSITY COLLEGE, DUNDEE

IT is proposed here to outline some recent biological and cytological studies in experimental parthenogenesis. The rearing of reproductive parthenogones and parthenogenetic strains after experimental treatment has been achieved only once. The Russian worker, Astaurov[1], after subjecting unfertilized ovarian or newly laid eggs of the silk-moth, *Bombyx mori*, to increased temperature, obtained adults from which descended three successive parthenogonic generations. Out of 25,770 caterpillars only 11 were males. His work developed from Sato's[2] in Japan, adults of both sexes, males predominating, being obtained after the use of hydrochloric acid or other chemicals. As the female in Lepidoptera is the sex-determining sex, these different results are possibly due to the different agents affecting differently the sex-determining mechanism in the eggs, or to physiological conditions, for example, degree of maturity, in the different eggs.

The next most successful results are limited to frog parthenogones advanced enough to be sexed, only two cases being known. Twenty years ago Jacques Loeb, after needle-pricking of eggs, reared certain specimens which Parmenter[3] later sexed: 21 metamorphosed tadpoles—18 male and 3 female; 34 tadpoles—12 male (one metamorphosed), 2 apparently changing into males, 18 female and 2 of doubtful sex.

Cases of adult, or of metamorphosed, but unsexed parthenogones are also few. So early as 1907 Delage[4] reared metamorphosed sea-urchins and starfish, while, recently, Parmenter[5] obtained five metamorphosed tadpoles after needle-pricking, and Kasansky[6] reports his curious experiment by which healthy adult carp were reared from eg stirred in male human saliva.

Artificial parthenogones of worms Mollus echinoderms and amphibians attaining stages advanced as the larval are more numerous b still comparatively few (Delage[4]). Recent ad tions comprise the echiurids *Urechis cau* activated with dilute sea-water by Tyler[7], a *U. unicinctus*, for which Hiraiwa and Kawamu used ammoniacal sea-water (which gave the be results), shaking, or warm, hyper- or hypoto sea-water, or sea-water containing potassiu cyanide. The eggs of freshwater fishes a promising material, for those of pope, perc roach, bream and pike developed when Trifonov used water at 28°–30° C., or distilled, while ea embryos of pike developed after Kasansky's[10] u of diphtheritic serum, sugar, salt, warm wat onion juice and mustard, etc.

Recent mammalian work presents remarkal features. In 1927 Champy (see Pincus[11]) d covered an 8-celled stage in a virgin rabbit's ova cultured in rabbit plasma plus fowl embryon extract. In 1930 Pincus achieved astonishi success by taking unfertilized rabbit eggs from t Fallopian tube and culturing them *in vitro* plasma clot, or in serum, plus embryonic extract of 213 eggs 63·8 per cent developed, ranging fro the 4- to the 40-celled stage and even to t morula, the stages to all appearance resembli *in vivo* specimens. Results approaching the appeared also in Garufi and Oliva's cultures[12] rabbit eggs from ovarian follicles. Further, Pincu even obtained blastulæ by transplanting into t Fallopian tubes of pseudo-pregnant rabbits eg artificially activated by agents commonly used f invertebrate eggs—hypertonic solutions, heat a

---

* From a paper read before Section D (Zoology) of the British Association at Dundee on August 31.

ak acids. Previously, by such agents, Pincus
d Enzmann had induced second polar body
rmation and also that of two polar bodies
incus[11]).

Also of remarkable interest is Harvey's[13] success
parthenogenetic merogony. Centrifuged sea-
chin eggs (*Arbacia punctulata*) divided into
herical halves and quarters, and those without
clei, activated with hypertonic sea-water, de-
loped into blastulæ (one with 500 cells), one
nbryo without gut, anus or skeleton actually
ing obtained. Later successes relate to other
a-urchin species and to activation by mono-
romatic ultra-violet radiation.

Traumatic parthenogenesis has been further
ploited by Kling[14], who has made steel needles
ith points as fine as 1 μ, the diameter of a sperm
ad, and much finer than those hitherto used.
ith these and less fine needles he has activated
og eggs. But he has also induced activation
lely by applying pressure with a blunt instru-
ent, without membrane rupture. The activatory
motion of the sperm he regards as chemical, a
urely mechanical function being excluded because
much weaker developmental effect is produced
y a needle point of the same diameter as a
erm's despite the needle wound being of greater
ze. Further, pressure alone sufficing for activa-
on, he attributes the initiation of activation to
rocesses set in action by traumatization of the
g cortex, membrane rupture being unnecessary.

Regarding the chromosome constitution of
perimental parthenogones, Parmenter[8] has dis-
vered an interesting range of conditions in 26
og tadpoles; haploids numbered 10; diploids
(5 metamorphosed); haploid-diploid forms 4;
iploid-triploid forms 1; diploid-triploid-tetra-
loid forms 1; and triploids 1.

Maturation and autoregulation show a diversity
f conditions. No autoregulation can have occurred
Parmenter's haploid tadpoles and normal
duction must have occurred; there is cytological
vidence for this in the lamprey's egg (Montalenti[15])
nd in certain eggs of the echiurid *Urechis uni-
nctus* (Hiraiwa and Kawamura[6]). These new
ases can, therefore, be grouped with the few
thers known in echinoderms and molluscs, and
re comparable to those few cases in Nature
emplifying 'rudimentary parthenogenesis'. The
iability, partial at least, of haploid animals is
lso illustrated by Parmenter's haploid tadpoles
nd by other previously known parthenogonic
rvæ.

Autoregulation in natural parthenogenesis may
e designated "post-maturational", in which
iploidy is *regained* during ontogeny, and "matura-
onal", in which diploidy is *retained* consequent
pon chromosome behaviour that prevents the egg from becoming haploid. Now in the great majority of cases of natural obligatory parthenogenesis, diploidy is retained because the reduction division is suppressed, the single division occurring being equational, and it is a curious fact that, as yet, no like case is known in experimental parthenogenesis. On the other hand, Parmenter's experimental haploid-diploid tadpoles provide the unique example of autoregulation being delayed until the larval stage. All the other methods of natural autoregulation now find their parallel in the cases of experimental parthenogenesis, thanks in part to recent research. For example, the silk-moth egg in Russia provides the sole case in experimental parthenogenesis in which autoregulation occurs late in segmentation—in the blastoderm (Frolowa[16]); the silk-moth egg in Japan (Sato[5]), as well as a minority of Russian eggs (Frolowa[16]) and some of Parmenter's frog eggs, provide new cases of autoregulation occurring at about the time of the first segmentation division; others of Parmenter's frog eggs probably add another case illustrating autoregulation due to fusion of polar body and egg pronucleus; some eggs of *Urechis unicinctus* probably illustrate autoregulation by non-release of the haploid set of chromosomes normally extruded in the second polar body (Hiraiwa and Kawamura[6]); in *U. caupo* certain eggs possibly omit both maturation divisions (Tyler[7]), lending supporting evidence to Doncaster's[17] old interpretation regarding parthenogenetic gall-fly eggs. Some of these cases also illustrate the polymorphism of autoregulation in one and the same species even when the same experimental procedure is seemingly followed, for example, the eggs of frog, silk-moth and *Urechis unicinctus*, the last example manifesting types of autoregulatory behaviour additional to those cited above. Such polymorphism, however, may be due to undetected differences in the eggs. Of autoregulation in rabbit eggs cultured *in vitro* little is known, though Pincus[11] has observed fusion nuclei and indications that diploid cleavage nuclei occur.

The problems of segmentation and cell division receive fresh light from Harvey's parthenogenetic merogones of sea-urchin eggs. These develop asters and divide in a fairly orderly manner, and division is independent of such cell inclusions as yolk pigment and mitochondria and also of the presence of the nucleus—though not necessarily of nuclear secretions. Again, cleavage is independent of spindle and asters but dependent on the physical and chemical state of the protoplasm and its surface layer. Nor is the orderly succession of cleavage essential, for the cytoplasm may break up irregularly but still give a blastula. Cleavage, budding and fragmentation are therefore different expressions of the state of the cytoplasm or of the cell surface or of both. The maternal cytoplasm seemingly has potentialities for determining at least the early stages of development, a matter that lies at the root of the problem of genetical inheritance, for it raises questions regarding the functions and relations of cytoplasm and nucleus. To what may these potentialities be traced? Normally the cytoplasm receives nuclear material when the germinal vesicle breaks down, but the role of such material in maturation and segmentation is not known; nor is there certainty that the cytoplasm receives secretions from the intact germinal vesicle. Nevertheless it would be unwise to exclude the latter possibility occurring prior to the experimental removal of the vesicle from the egg fractions. Another possibility is that the chromatin of the previous generation influences the maternal cytoplasm. Of these matters Harvey is well aware.

Regarding experimental activation, the work of R. S. Lillie, Just, Runnström[18] and others with sea-urchin eggs indicates that its initiation is due to the release and interaction of substances originally separated in the egg cortex, with the consequent formation of an acid which may be a fundamental activator.

The physiological bases of experimental parthenogenesis have been discussed in masterly fashion by Dalcq[19] and he cites the serious limitations in our knowledge. The types studied hav been mostly aquatic and the facts gleaned fror them are of limited application to the majority c parthenogenetic animals, which are terrestria Cytological knowledge is really patchy and incomplete. No common activating principle ha been found in the many agents used, nor has th nature of experimental activation been elucidatec How far the mechanisms of experimental and c natural parthenogenesis and of fertilization ar identical is unknown, while as for the origin(s) c natural parthenogenesis, experimental method have not as yet revealed them.

[1] Astaurov, B., *C.R. (Doklady) Acad. Sci. URSS*, II (1936).
[2] Sato, H., *Biol. Zentr.*, 51 (1931).
[3] Parmenter, C. L., *J. Gen. Physiol.*, 8 (1925).
[4] Delage, Y., "La Parthénogenèse naturelle et expérimentale" (Pari 1913).
[5] Parmenter, C. L., *J. Exp. Zool.*, 65 (1933).
[6] Kasansky, W. J., *Zool. Anz.*, 110 (1935)
[7] Tyler, A., *Biol. Bull.*, 63 (1932).
[8] Hiraiwa, Y. K., and Kawamura, T., *Biol. Bull.*, 70 (1936).
[9] Trifonova, A., *Zool. Anz.*, 96 (1931).
[10] Kasansky, W. J., *Zool. Anz.*, 106 (1934).
[11] Pincus, G., "The Eggs of Mammals" (New York, 1936).
[12] Garufi, G., *Arc. Sci. Biol.*, 21 (1935).
[13] Harvey, Ethel B., *Biol. Bull.*, 71 (1936).
[14] Kling, K. G., "Experimentelle Untersuchungen uber die traumatische Parthenogenese bei Amphibieneiern" (Uppsala, 1936).
[15] Montalenti, G., *R. C. Accad. Lincei*, 20 (1934).
[16] Frolowa, S. L., *J. Biol.*, 4 (1935).
[17] Doncaster, L., *Proc. Roy. Soc.*, B, 82-83 (1910, 1911).
[18] Runnstrom, J., *Biol. Bull.*, 69 (1935).
[19] Dalcq, A., "Les bases physiologiques de la fécondation et de l parthénogenèse" (Paris, 1928).

OBITUARIES

Mr. C. J. Bond, C.M.G.

BY the death of Mr. C. J. Bond, Leicester has lost one of her most distinguished and also most beloved citizens. Few lives can have been more completely devoted to the service of mankind. He was a 'philanthropist' in the literal sense of the word.

Bond's skill as an operating surgeon, combined with his kindly and considerate manner towards his patients, had brought him one of the largest surgical practices in the Midlands, but he retired from private practice at a comparatively early age (in 1912) in order to have more time for purely scientific and social work. He was specially interested in biology and genetics, and he carried out numerous interesting experiments, extending over many years, in the breeding of poultry and pigeons. Another special interest was eugenics, and he delivered the Galton Memorial Lecture, under the auspices of the Eugenics Society, in 1928.

When the War broke out in 1914, Bond offered his services to the War Office and became consulting surgeon to the Northern Command with the rank of Hon. Colonel, A.M.S. As the representative of the Medical Research Council, of which body he was an active member for many years, he served on the Inter-Allied Commission on the Treatment of Wa Wounds, held in Paris during 1916–18. He wa twice mentioned in dispatches and was awarded th C.M.G. in 1917.

Possessed of exceptional ability and a seemingl tireless capacity for work, C. J. Bond readily gav his support to causes and movements which h believed would benefit his fellow-men. In this brie notice it is quite impossible to enumerate all hi many activities and interests, though reference shoul be made to his work for the Leicester Royal Infirmar of which he was consulting surgeon, member of th Board of Governors and vice-president; also to hi work for University College, Leicester, which h helped to start and of which he was a member of th Board of Governors; and for the Leicester Literar and Philosophical Society, of which he was twic president. Nationally, he served on the Departmental Commission on the Cause and Prevention o Blindness; on the Industrial Fatigue Researc Board (of which he was deputy chairman); Lor Trevethin's Committee on the Prevention of Venerea Disease; the Advisory Council of the Nationa Health Insurance Committee, etc. He was a lif member of the British Association.

Bond was a strong advocate of total abstinence and n active and generous supporter of the temperance movement, both locally and nationally.

He was the author of several books, for example, The Leucocyte in Health and Disease", which embodies the results of much painstaking original esearch work; "Essays and Addresses of a Surgeon", and Chapter v in "Health and Healing in the Great State", edited by H. G. Wells. He also made numerous ontributions to current medical and scientific iterature.

During the later years of his life, one of Bond's chief nterests was the movement for voluntary euthanasia. He helped to found the Voluntary Euthanasia egalisation Society, and he was chairman of the xecutive committee for the five years since the Society was started. Undoubtedly, the great prestige attaching to his name has greatly helped the movement, and he had the satisfaction before he died of eeing it steadily growing and apparently firmly established.

To those who knew C. J. Bond intimately—as it was my privilege to do for more than thirty years—e will be chiefly remembered, not so much on account of all the good work he accomplished during his long and active life, as on account of what he was. He was a man of absolute integrity, scrupulously concientious in everything he did or said, and modest of character, almost to a fault. It is impossible to think of him as ever being guilty of an unkind, elfish or unworthy action.

He leaves a widow, a son who is in the medical rofession, and a married daughter.

C. Killick Millard.

Prof. C. G. Santesson

Prof. Carl Gustaf Santesson, the eminent Swedish pharmacologist who died on July 26, was born in Stockholm on July 5, 1862, the son of the professor of surgery at the Karolinska Institutet. He received his medical education at Uppsala, Stockholm, and Lund, and qualified at Stockholm in 1890. During the next two years he studied pharmacology under Schmiedeberg at Strassburg and Boehm at Leipzig. On his return to Sweden he became lecturer in pharmacology at Uppsala, and in 1895 was appointed extraordinary professor in this subject at the Karolinska Institutet at Stockholm, becoming full professor in 1908. He retired in 1927.

In addition to numerous contributions to periodical literature on pharmacology and toxicology, Santesson was the author of a work on general pharmacology (1919). From 1901 until 1916 he was editor of the *Nordisk Medicinskt Arkiv* and from 1924 until his death of the *Skandinavisches Archiv für Physiologie*. The high reputation which he enjoyed at home and abroad is shown by his being a member of the Academies of Sciences of Uppsala, Stockholm, and Halle, the Finnish Medical Society and the German Pharmacological Society. An address on his life and work was delivered at a meeting of the Swedish Medical Society by Prof. G. Liljestrand, his successor in the chair of pharmacology, and published with his portrait in the *Nordisk Medicin* of October 14, and the issue of *Acta Medica Scandinavica* of October 17 contained the address delivered by Santesson two months before his death on the occasion of the publication of the hundredth volume of the journal.

J. D. Rolleston.

NEWS AND VIEWS

Anthropological Investigation in Mexico

On p. 1033 of this issue extracts are given from an account of some remarkable magico-religious observances recorded by Dr. Robert Gessain in the istrict surrounding Huehuetla, a village in the State f Hidalgo, Mexico, in which in certain respects the se of paper figurines, or *munecos*, recalls practices of Old World witches and the employment of waxen mages against their victims. The expedition, of which Dr. and Mme. Gessain were the personnel, was the fifth of a series sent out by an organization for which Dr. P. Rivet of Paris is mainly responsible. This organization, known as the "École française de Mexico", sends out each year a research worker to carry on investigations in that country. In view of Dr. Gessain's qualifications as medical man and anthropologist, in which capacity he had already worked in Greenland, the objective of the expedition was mainly to record observations in physical anthropology, including racial pathology, combined with nguistic and ethnographic inquiry as a subsidiary id in gaining the confidence of the people. Equipment for testing blood groups and making psychophysiological observations was also carried. Unfortunately much delay in reaching the base of operations was caused by difficulties in getting the scientific equipment into the country; and after a few weeks work only, both members of the expedition were taken seriously ill and had eventually to return to France. This happened at a peculiarly inopportune moment, as they had just made a beginning in breaking down the hostility and suspicion with which their early inquiries had been received. Notwithstanding this unfavourable attitude of the inhabitants, a number of interesting anthropographic and demographic observations have been made—the congenital or 'Mongolian' patch was found on all infants—and, in addition to the cultural evidence noted above, songs, technological films and a large number of anthropological and ethnographical photographs have been secured.

Oil and its Uses

The Petroleum Films Bureau (15, Hay Hill, Berkeley Street, London, W.1) now has a library of fifteen films about oil which may be borrowed free of charge by schools, technical colleges, scientific societies and other educational organizations. Both 35 mm. and 16 mm. sound and silent films are available. Synopses of these films giving an indication of the main themes dealt with are to be found in a catalogue recently issued by the Bureau. The films fall into three main sections, dealing with the varied aspects of oil production and drilling, some of the uses to which oil is put, and its particular adaptation to the requirements of the modern petrol engine, respectively. In the production and drilling section, there is one more or less general film giving an indication of how oilfields are discovered and wells drilled, which countries produce oil and how it is transported in tankers across the seas. This is followed by others having a more local bias. The work of James Young on the production of oil from shale and the subsequent establishment of the Scottish shale industry is only one of several themes which lend themselves admirably to pictorial development. Illustrations of the uses of oil are as diversified as they are manifold. They embrace fishing for swordfish, re-fuelling an Imperial Airways liner at Kisumu and spraying trees to destroy insects, to cite only a few examples. The films depicting first principles of internal combustion and compression ignition engines and the theory and practice of their lubrication are of necessity less spectacular in their conception. Nevertheless the diagrams and models will prove of great assistance to those seeking lucid explanations of technical details.

Antiquity

IN the December issue of *Antiquity*, the editor discusses in the frankest terms the future and the policy of that publication in relation to present conditions in international relations and world affairs. After the most careful survey of all possibilities and probabilities, it has been decided "to take courage, and at any rate plan for the year 1940". In arriving at this decision notwithstanding the difficulties which arise both from the almost complete cessation of all archæological activities on the outbreak of war, and from the absence on active service of many of its contributors and subscribers, the editor's decision has been determined largely by the view that the periodical for which he has been responsible both in and since its inception represents an essential contribution to learning and progress to which, so far as is humanly possible, there should be no interruption. In this opinion he is fortified by expressions of opinion from his supporters, of whom one writes that it is "of paramount importance that all *foci* of Culture and Learning should be kept alive" during the present troubles. While endorsing in the strongest terms this formula of one, at least, of the functions of publications of the class to which *Antiquity* belongs, we would also second the more readily the editor's appeal for continuance of that support from the public which has helped him to win for this publication the position which it holds in cultural studies to-day.

An Early Gas Mask

ATTENTION is directed in the *Journal of the Roy* *Society of Arts* (Nov. 3, p. 1239) to a description a mask which appeared in vol. 43 of the Society' *Transactions* (1825). It was designed by Joh Roberts, of St. Helens, Lancashire, "to enabl persons to breathe in thick smoke or in air loade with suffocating vapours", and was effective again smoke and also against a gas such as sulphurou acid. It consisted of a leather hood with two aperture filled with glass or mica to see through. The hoo descended to the bottom of the neck, was well wadde at the bottom, so as to be rendered airtight, or nearl so, when secured by the straps attached. From th nose a flexible leather pipe is attached, terminatin at the bottom in a trumpet-shaped piece of japanne tinplate, the open end of which is plugged with moist sponge kept in place by a piece of coarse clot Breathing is carried on through the tube, and an particles in the air or vapours or gases in any considerable degree absorbable by water are remove by the cloth filter and the moist sponge. An illustration shows a very workman-like piece of apparatu Details are given of various tests that were mad with it.

Alcoholism and Suicide

DR. MERRILL MOORE (*New England J. Med.*, 22 691; 1939) discusses the relation between alcoh and suicide in a paper based on the study of 14 alcoholic patients, admitted to the Boston Cit Hospital during the period 1915–38, who ha attempted suicide, out of a total of 1,195 admitte during the same period after attempting suicide 98 were men and 45 women. The great majorit were between the ages of thirty and forty. Condition of occupational, marital or economic maladjustmen were present in all. By far the greatest numbe were unemployed or of unknown employment, an few skilled workers were included. As regard motivation the reasons offered for the attempte suicide were occupational maladjustment, domesti friction, depression and anxiety. Poison by mout especially iodine, the ineffectiveness of which wa probably not realized, was the most popular metho of suicidal attempt. Inhalation of illuminating ga came next, while less frequent methods were slashing jumping from high places, hanging, immersion an firearms. 136 (95 per cent) were unsuccessful in thei attempt and only 7 (5 per cent) died after admissio to hospital, as compared with 11 per cent of th total number of suicidal patients admitted. Dr Moore attributes the large number of failures i suicidal attempts among the alcoholic patients partl to the ingestion of non-poisonous substances or sublethal doses, and partly to the tendency of th alcohol to render the method of suicidal attempt les efficient.

Social and Technical Aspects of Housing

THE methods employed in Belgium, the Unite Kingdom, Denmark, Finland, France, the Netherlands, Norway and Sweden for improving urban an rural housing conditions, and in the United States of America and Canada for urban housing, are reviewed n a study entitled "Urban and Rural Housing" conducted by M. B. Helger, of the Swedish Social Board, which has been published by the Economic Intelligence Service of the League of Nations (Geneva: League of Nations. London: George Allen and Unwin, Ltd. 3s. 6d.). The study has special reference to the cost involved and the results obtained, mainly n the housing problems raised after the War of 914–18, and the attempts at solving those problems up to the outbreak of hostilities in 1939. Separate hapters are devoted to each country, and figures are iven showing the need for additional accommodation, he lack of modern conveniences in existing dwellings, nd the number of existing dwellings which should be repaired, or demolished as unfit for further use. General aspects of the housing problem are discussed n an introductory chapter in which the two aspects—ocial and technical—of the problem are distinguished.

IN regard to the social aspects, the causes of fluctuation in building activity and their bearing on he periodic shortage of houses are examined. The echnical aspects are concerned with the quality of housing and are better treated separately because the ideas of public authorities as to minimum standards appear to make it impossible to solve the housing problem merely by the operation of supply and demand. This is partly because the income of many families is inadequate to enable them to obtain housing with the minimum conditions of health and comfort, and partly because many families fail to appreciate the importance of these conditions and make no effort to obtain suitable housing even when they can afford to pay the rent for it.

Economizing on House Fuel

According to *Science Abstracts* of November 4, E. S. Draper, director of the regional planning studies, reported at a meeting of the Committee on the Hygiene of Housing of the American Public Health Association, that by using adequate insulation against heat loss when building a small house, the cost of the fuel required can be reduced by nearly one half. A simple heater suitable for the central heating of small houses was developed after tests at the Gilbertsville Dam construction community and is now being placed in the open market. The insulation studies were carried out in two identical four-roomed houses in the Niwassee Dam construction community. The installation of electrical heaters made it possible to record with great accuracy the heat loss in the two houses. One of them was insulated throughout by wool bats in the walls and over the ceiling and an insulation board under the floor joists. Both houses had both doors weather-stripped. Both families obeyed the same schedule of window-opening in bedrooms at night, windows closed by day, and the heaters were turned on and off at the same times. The reduction in the total heat loss in the insulated house was 44·75 per cent. The cost of the insulation, including labour and materials, was about £40. The simple heater described by Mr. Draper was designed to effect a reduction in the capital cost of central warm air heating over that of installing the warm air furnaces available in the market. The object was to have a primary heat source (without provision for air filtering or humidification) placed in an exceptionally small first floor heating chamber centrally located, so that it might give service to all rooms of a small house without the usual extensive system and basement.

Accessibility of University Theses

"The Accessibility of British University Thesis Literature", a pamphlet prepared for the Nottingham meeting of librarians last September by Colonel Luxmoore Newcombe, principal executive officer of the National Central Library, is a full and careful survey. A thesis usually contains original matter which may be important for the advancement of the subject, and the range of special studies has been enlarged of late. It should be easily consulted, if only that the work may not be duplicated by some other specialist. This accessibility, the writer shows, is far from being satisfactorily arranged at present. He gives a list of all the theses for degrees at British universities, and the conditions under which they can be consulted. He includes also the collections of foreign theses available. Oxford received between 1885 and 1938 about 263,000 of these. Great Britain has no great guides to her published and unpublished theses such as exist in Germany, France and the United States.

THE French issue annually a volume containing on an average 2,150 entries, well indexed. The American catalogue of "Doctoral Dissertations" during 1937–38 includes 2,768 items, but here the degree sought is so common among teachers that good subjects are getting rare, and descriptive rather than original stuff finds a place. The library of the University of Aberdeen has no printed list after 1937. Edinburgh has published an annual list since 1931, but it cannot be purchased. In London an annual list of titles is published and a cumulative catalogue is to be made out of it every five years. Medieval studies and history are fortunate in special catalogues. Only six universities have both an author and a subject index. A national guide to all British theses should be made, and its natural place would be the Central Library. It should be possible for friends of research such as the Carnegie Corporation to back the scheme with adequate funds. Colonel Newcombe also suggests that the Library might have a copy of every foreign thesis on loan. The photostat seems a suitable means of increasing the supply of duplicates at the various universities.

Astronomy in Ancient Egypt

THE traditional view that the knowledge of astronomy of the Greece of classical times had been derived from Egypt, a view to which the writings of the Greeks themselves lent support, has lost favour with increased acquaintance with the achievement of the peoples of Mesopotamia in this branch of science, and of the indebtedness of Greek thought to Babylonian and Assyrian conceptions of the nature and movements of the heavenly bodies. At the same time, research on the astronomical knowledge of the ancient Egyptians has shown that its basis of exact and scientific observation has, if anything, been overrated. At the recent autumn meeting of the National Academy of Sciences, held at Brown University, Providence, R.I., on October 23–25, Dr. O. Neugebauer, in a communication on "The Egyptian Picture of the Sky" (*Science*, 90, 410; Nov. 3, 1939), pointed out that while Egyptian and Babylonian astronomy are usually quoted as equivalent foundations of Greek, and, therefore, medieval and modern astronomy, really very little is known about Egyptian astronomy. Investigation of Demotic texts, however, has now shown that Egyptian methods of treating the movements of the moon and planets were only very approximate, and without any consideration of details. This picture, Dr. Neugebauer stated, has now been completed by a Demotic text recently purchased by the Egyptological Institute in Copenhagen, which shows how the aspect of the sky and the setting and rising of the stars was connected with the religious myths. The close connexion of religion, especially so far as the underworld is concerned, with the changing aspect of the sky during the year indicates that the main interest of Egyptian astronomy was not a mathematically detailed description of very complex effects, but merely a rough scheme, just good enough to reflect the main traces of the observed facts.

Submarine Valleys

DURING the last nine years, the United States Coast and Geodetic Survey has made an intensive acoustic survey of the Atlantic continental shelf and slope of the United States. The surveys are now so far advanced that the surface topography can be studied in detail. Charts of most of the slope have been published by the Geological Society of America (Special Paper No. 7; 1939). The *Geographical Review* of October 1939 publishes "Atlantic Submarine Valleys" by Mr. R. A. Smith, with a chart on a scale of 1 : 1,000,000 of the shelf and slope, and adjacent land, between New England and Albemarle Sound. Even on this reduced scale many striking features are shown. The flatness of the shelf is so remarkable that only by the use of a five-fathom contour interval can any noticeable relief be shown. The slope, on the other hand, shows a topography so irregular and broken that a 100-fathom contour interval has to be employed for the sake of lucidity. While the shelf, for a distance of 60–125 miles seaward, shows beach forms, the outcome of marine erosion, or modified river forms, the continental slope is deeply dissected and shows forms characteristic of subaerial erosion. In many places the complexity of relief is much greater than that found in the Appalachian Mountains and is more comparable, according to Mr. Smith, with that of the western mountains of North America.

Lancashire and Cheshire Fauna

THE twenty-fifth annual report of the Lancashi and Cheshire Fauna Committee adds a large numbe of insects to the dual county lists and also to th British area and some species new to scienc Among Coleoptera, *Philonthus jurgans* Tott. was di covered new to science from a specimen obtained a Ashton-under-Lyme in 1935, since when it has bee found widespread throughout the British Isles, als occurring in Cheshire at Tarporley and Arden. *Aph davidsoniella* Theob., a species that has been separate from *A. rumicis* L., has been obtained on dock a Preston and Stalybridge. The fly *Bairamlia nidicol* Ferriere is described as new from material obtaine from flies breeding in birds' nests at Mobberley Cheshire. Six new moths are added to the dua counties' lists and one new to Lancashire. The bird mammal and Lepidoptera notes are largely of loca interest, but some of the more general items includ the breeding of the death's head moth from larvæ a Raby, Cheshire, a 1927 specimen of the rare migran Camberwell Beauty at Alderley Edge, Cheshire numerous foreign insects collected from importe fruit and other goods, the beetle *Cryptophagu acutangulus* Gyll feeding abundantly on the moul on damp plaster in almost all the new houses in th district, increasing numbers of red squirrels in th Ribble valley and in west Cheshire, detailed report of the surveys on reed-warblers, tufted duck an turtle-dove surveyed for the British Trust fo Ornithology, Lapland bunting at Ainsdale, where th little tern is nesting again, the spotted crake nestin in Cheshire, the bittern at Rostherne, the quail nea Nantwich and increasing numbers of reports abou many wading birds and duck formerly considered rar in the districts but which are obviously much mor frequently seen now. The committee, of which Prof J. H. Orton is chairman, has a membership of 28 and commences the year with a surplus of £146.

Merseyside Naturalists' President

THE annual meeting of the Merseyside Naturalists Association (the Merseyside Branch of the Britis Empire Naturalists' Association), held at Liverpoo Museum on December 3, elected Mr. R. K. Perry keeper of vertebrates at the Museum, president fo 1940, Dr. J. C. P. Miller, lecturer in applied mathematics in the University of Liverpool, as chairman, and Mr. Eric Hardy as honorary secretary. Formed last winter, the Society faces the War with a surplu in its ordinary and its sanctuary accounts, and wil shortly issue a portfolio of its faunal and floral work during the past year.

Horticulture of the Lily

THE eighth number of the Royal Horticultural Society's Lily Year-book (from the Society's Office, Vincent Square, Westminster, S.W.1, 5*s*. paper, 6*s*. cloth), makes a very effective attempt to keep pace with the multitudinous variations of these plants. Mr. A. Simmonds lists the names and origins of 114 hybrid lilies, and there are papers which arify the taxonomic positions of *Lilium bulbiferum* d its varieties, by Dr. Fred Stoker, *L. myriophyllum*, y Mr. A. D. Cotton, and *L. pardalinum* and its allies, y Dr. Vollmer. A happy personal note is struck by r. A. D. Cotton, in a biography of the late Dr. . H. Wilson, a vigorous botanical explorer who ntributed greatly to liliaceous garden beauty. apt. F. Kingdon Ward describes a new lily which e discovered in the Assam Himalayas, and Mr. . Ogilvie-Grant has collected several new fritillaries Greece. Other papers deal with the cultivation and orticultural grouping of the lilies which are now ell-tried favourites of our gardens. Scientific work pon lily matters does not appear to have been great amount. Dr. M. A. H. Tincker describes the rates f growth of roots in several species, and there is an ccount of a discussion on propagation. The net sult, however, is to show the need for more accurate ientific knowledge of all phases of lily horticulture—e relation of lilies to soil conditions, to nutrition in eneral, to pests and diseases. There are, indeed, fficient unanswered questions in the book to employ lily research station for a considerable period.

lant Growth-Substances

A RECENT report in the *Kew Bulletin* describes experiments conducted in co-operation with the garden aff but designed by Dr. C. R. Metcalfe and Dr. W. G. empleman to test the influence of synthetic growth-ubstances upon the rooting of cuttings of many lants ("Experiments with Plant Growth-Substances r the Rooting of Cuttings". By C. R. Metcalfe nd W. G. Templeman. *Bull. Misc. Information*, o. 8; 1939). Their results show that some 45 per ent of the species they selected have responded avourably to one or other of the treatments, which ncluded the use of solutions of indolylacetic acid, dolylbutyric acid, and α-naphthylacetic acid, at ifferent concentrations. The list of plants is a horoughly representative one including many well nown to practical propagators to be exceedingly ifficult to root from cuttings. Their successes include ome seventeen plants already listed by the Plant ormone Committee as difficult to propagate in this ay, but their results also show that other difficult lants have failed to respond to the treatments. The abular presentation of the data affords ready reference, and many nurserymen and gardeners generally ill consult their list, which, however, contains records f failures with a few species which have been successully propagated elsewhere at perhaps other seasons f the year. It is hoped that this work will be extended to include tests of these substances applied n powder form.

lant Disease Nomenclature

THE "List of Common Names of British Plant Diseases" compiled by a sub-committee of the British Mycological Society's plant pathology committee as been accepted by the principal societies and nstitutes in Great Britain which need to use such ames. A certain number of emendations to the econd edition are published in the Society's *Transactions* (23, Pt. 3; October 1939). No major correction appears to be necessary; the changes are such as give increased exactitude about the authorities for the names adopted, or which remove doubts previously felt about the nature of some diseases. Reasons and references are given for the more significant changes, and any mycologist interested further in this standard nomenclature may obtain additional information from Dr. G. C. Ainsworth, secretary of the Plant Pathology Committee, Imperial Mycological Institute, Kew, Surrey.

Demography of Dublin

IN the recently published report on the State of Public Health of Dublin for the year 1938 the Medical Officer of Health, Dr. Matthew Russell, states that the estimated population of the city was 477,000, the density of the population being 25·4 per acre, compared with 40·4 in 1929. The birth-rate, which was 24·4 per 1000 of the population, has shown a continuous decline since the beginning of the century, when the rate was 33 per 1000. The death-rate has shown a continuous but greater decline. In 1900 it was 30·5, whereas in 1938 it was 13·31, a drop of approximately 57 per cent. The infant mortality, while showing a considerable decline from that in the previous two years, was 98 per 1000 births, as compared with 106 in 1937 and 115 in 1936, is higher than the average—97—for the previous ten years. In 1934 the figure was as low as 74. The maternal mortality in childbirth showed a rate of 2·5 per 1000 births; the average rate for the previous ten years had been 3·07.

Earthquakes Registered at Kew

DURING November 1939 eleven earthquakes were registered on the seismograms at Kew Observatory, this number being probably fewer than the average. Nine of these are reported to have been small or confused by microseisms, and the other two both occurred on November 21. The first was received at 8h. 55m. 8s. G.M.T. with the *P* and *S* waves of small amplitude followed by large amplitude surface waves, and is stated to have been destructive in north-east Anatolia. The second was registered at 11h. 10m. 30s. G.M.T. and has been estimated to have occurred about 85 degrees distant in a direction north-east of Kew, with a deep focus, approximately 175–200 km. below the earth's surface.

Earthquake in New England

ON November 15 at about 3h. G.M.T. an earthquake was registered on the seismograms at the observatories of Weston, Georgetown, Ottawa, Pittsburgh, Fordham, Williamstown and Philadelphia. The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the probable epicentre of this shock to have been near latitude 39° 45′ N., longitude 75° 18′ W., and that it had an origin time 2h. 53m. 48s. G.M.T. with a depth of focus near 25 km. below the earth's surface. Large earthquakes are very rare in these regions, though small shocks and tremors have occurred very occasionally in the past. That the present shock released only a very small amount of energy, thus being no exception, is shown by the facts that no damage has been reported in this well-populated region, and that the earthquake was not registered on the seismograms obtained at Kew.

American Association: Columbus Meeting

THE one hundred and fifth meeting of the American Association for the Advancement of Science is being held during December 27–January 2 at Columbus, Ohio. General sessions will be held on December 27, when Dr. Wesley C. Mitchell, of Columbia University, will deliver an address as retiring president of the Association on "The Public Relations of Science"; on December 28, when Dr. Kirtley F. Mather, of Harvard University, will deliver the annual address arranged jointly by the Association and the Society of Sigma Xi, taking as his subject "The Future of Man as an Inhabitant of the Earth"; on December 29, when Dr. Julian S. Huxley will deliver the first address in the United States under the arrangement between the American and British Associations to provide lecturers in alternate years, speaking on "Science, War and Reconstruction"; and on December 29, when Dean Marjorie Nicolson of Smith College, will deliver the annual address under the auspices of the United Chapters of Phi Beta Kappa, and will speak on "Science and Literature". Symposia have been arranged on "Isotopes", "Photosynthesis", "Speciation", "The Relation of Ecology to Human Welfare", "Defence Mechanisms in Plants and Animals", "The Internal Environment and Behaviour", "Effects of Science upon Human Beings"and "Blood, Heart and Circulation", among other topics.

Awards of the Geological Society

THE following awards of the Geological Society of London have recently been announced: the Wollaston Medal to Mr. Henry Woods, formerly University lecturer in palæontology in the University of Cambridge, in recognition of the value of his researches into the mineral structure of the earth, especially his studies of fossil Mollusca and Crustacea from the Cretaceous formations of Great Britain, Africa and New Zealand; the Murchison Medal to Prof. Arthur Holmes, professor of geology in the University of Durham, in recognition of the value of his petrological researches and of his stimulating studies concerning the composition and physical state of the earth's interior; the Lyell Medal to Prof. H. L. Hawkins, professor of geology in the University of Reading, for his eminence in palæontology, particularly in his studies of the Echinoidea, and for his researches in Eocene stratigraphy; the Wollaston Fund to Miss Dorothea M. A. Bate for her investigations of Pleistocene mammalian faunas in Palestine and the Mediterranean; the Murchison Fund to Archibald Gordon Macgregor, for his petrological researches into Scottish rocks and his work on the geology of Monserrat; a moiety of the Lyell Fund to Miss Dorothy Hill, for her researches on Palæozoic corals; anothe moiety of the Lyell Fund to Mr. L. H. Tonks, fo his work on the Carboniferous rocks of Lancashir and Northumberland.

Announcements

PROF. F. G. DONNAN, emeritus professor c chemistry in the University of London, has ha conferred on him the honorary degree of D.Sc. o the National University of Ireland.

DR. MARY EVELYN LAING MCBAIN, formerly o the University of Bristol and now of Stanfor University, California, has been elected nationa president of the American Women's Chemical Hono Society, Iota Sigma Pi, for the new triennium. Th Society comprises 2,500 women chemists. The nev secretary is Dr. I. Macy Hoobler, director of th Research Laboratory for the Children's Fund o Michigan.

A UNIVERSITY OF POLAND ABROAD was institute at a meeting held in the Polish Library, Paris, o December 1.

IT is reported in *The Times* that many of the sta and students of the University of Poznan are bein held under arrest as hostages. It is believed tha the intention is to repress Polish culture and scienc in this overwhelmingly Polish province.

THE University of Bern has awarded the firs international prize for researches on encephalitis t the Italian neurologist, Dr. Beppino Disertori.

THE January meeting of the Pathological Societ of Great Britain and Ireland will be held on Januar 12 in the Department of Pathology at Cambridg and not at Guy's Hospital.

THE London Scientific Film Society proposes t open its 1939–40 season early in the New Year. Th Society would be glad to hear from readers of NATUR of films on scientific subjects, either completed or i the process of production, which could be considered fo inclusion in the Society's programmes. Applications fo membership should be sent to the Secretary, L.S.F.S. 30 Bedford Row, London, W.C.1. The subscription for the season is 10*s*. or 15*s*., the higher rate entitling the subscriber to the better seats at the shows o the Society.

ERRATUM.—Referring to his communication entitled "A Peculiar Phenomenon Observed in Larval Populations of the Flour Beetle *Tribolium confusun* Duv.", Prof. John Stanley writes that the appearances of the various larval instars as indicated in Fig. 1 were given incorrectly in his original communication. They should read as follows: first insta 6·04 days, second instar 8·47, third instar 12·10, fourth instar 15·13, fifth instar 18·40, sixth insta 21·74.

LETTERS TO THE EDITORS

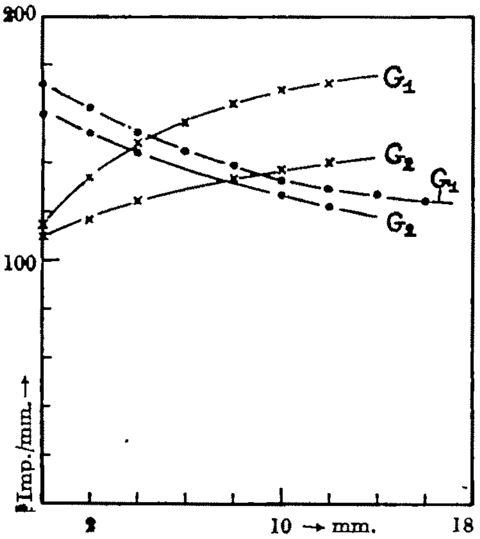
The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1051. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Radioactive Gases Evolved in Uranium Fission

In this letter, a brief account is given of the preliminary results of an investigation of the radioactive gases evolved in the fission of uranium nuclei. This investigation was commenced this summer but was interrupted by the outbreak of the War. Even if the results so far obtained are not more complete than those obtained in the meantime by other investigators[1], it may still be of interest to describe the method employed, which follows somewhat different lines.



×, increase; •, decay

The radioactive gases evolved in the fission process were carried by a circulating stream of an inactive gas through two Geiger-Müller counters placed in succession. The time lag of the arrival of the gas in the two counters could be varied within wide limits by means of a system of capillary glass tubes of various bores placed in parallel and fitted with stopcocks. The magnitude of the lag was ascertained by separate experiments in which actinon or thoron was circulated. As a carrier gas, acetone vapour at a pressure of 10 mm. mercury was used because of its favourable properties for the working of the counters. The circulation was kept up by means of a Vollmer glass pump.

The uranium vessel, containing about 30 gm. of uranium oxide (U_3O_8), was surrounded by paraffin and provided with a well to allow introduction or removal of the neutron source, which consisted of about 30 mgm. of radon + beryllium. In the experiments, the counting rate of both counters was recorded for a period of time immediately following the commencement or cessation of irradiation. Typical results, using a time lag between the counters of 15 sec., are shown in the accompanying figure, from which it may be seen that the curves obtained for increase and for decay are almost complementary, and indicate several periods, of which some are of the order of a minute, while others are evidently much longer, giving rise to a residual activity almost constant within the time of the experiment.

The shorter periods were estimated from a decay curve obtained in a separate experiment, in which the flow of gas was stopped at the same time that the source was removed, and the records of the two counters at any subsequent time simply added. This gave two periods of about 30 sec. and 4 min., the ratio between the rates of production of the corresponding gases being estimated as 1·82. (Glasoe and Steigman (*loc. cit.*) find two gaseous products of uranium fission of periods 30 sec. and 5 min., of which the first transforms into a product of 3 min. period. It is possible that the period of 4 min. found in our experiments results from a combination of the periods 3 min. and 5 min.)

A test of these estimates was further obtained by calculating from them the values of the ratio between the counting rates of the two counters for steady flow with the various circulating periods obtained by inserting different capillary tubes in the circuit, and comparing the calculated values with the values measured 12 min. after the beginning of the irradiation. This interval of time is not quite sufficient for complete equilibrium to be established, but, on the other hand, it is sufficiently short compared to the periods of the long-lived transformation products to ensure that the values obtained do not depend on the formation of these products to any appreciable extent.

Assuming that the radioactive gas consists only of the two short-period components of decay constants λ_1, λ_2 produced at the rate of n_1, n_2 atoms per sec., the counting rate in any of the counters can readily be shown to be given by

$$G = n_1 e^{-\lambda_1\tau} \frac{1-e^{-\lambda_1\theta}}{1-e^{-\lambda_1 T}} + n_2 e^{-\lambda_2\tau} \frac{1-e^{-\lambda_2\theta}}{1-e^{-\lambda_2 T}},$$

where τ is the time taken by the circulating gas to travel from the uranium container to the counter in question, θ the time taken by the gas to flow through the counter, and T the period of the whole circulation process.

In the table are recorded the counting rates, G_1, G_2,

$\tau_2 - \tau_1$	G_1	G_2	$G_1 : G_2$	$(G_1 : G_2)$ calc.
15 sec.	108	63	1·72	1·31
50 sec.	94	45	2·09	2·01
2 min.	52	24	2·15	2·10
3 min.	42	21	2·00	2·01

for the two counters measured 12 min. after the beginning of the irradiation for four capillary tubes corresponding to values of the time lag $\tau_2 - \tau_1$ between the counters stated in the first column.

The agreement between the experimental and calculated values for the ratio $G_1 : G_2$ is seen to be very good except for the fastest circulation, for which the calculated value depends mostly on the shorter period and on the short time-lag, the determinations of which are the least precise.

L. WERTENSTEIN.

Mirosław Kernbaum Radiological Laboratory,
Warsaw Society of Sciences,
At Turczynek, near Warsaw. Sept. 24.

---

[1] Hahn, O., and Strassmann, F., *Naturwiss.*, 27, 163 (1939). Heyn F., Aten, A., and Bakker, C., NATURE, 143, 516 and 679 (1939). Glasoe and Steigman, *Phys. Rev.*, 55, 982 (1939).

Baade and Zwicky's Theory of Cosmic Rays, and the Helium Content of Beryls

PANETH and co-workers[1,2] have discussed the possibility that cosmic radiation may have produced the helium found in beryls by disintegration of beryllium nuclei, and they give experimental evidence that to do this the intensity would need to be at least sixty times greater. However, to reject cosmic radiation as a possible cause, on the experimental evidence, requires the assumption that, during the life-time of the beryls, the cosmic radiation has had its present intensity, whereas if the theory of Baade and Zwicky is true this is not so. These authors[3] have suggested that cosmic rays are produced at the flare-up of super-novæ. These, of which ten or so have been observed during recent years, rapidly reach a peak of brightness some 20,000 times that of the sun, lasting two or three days. During twenty-five days of maximum brightness they each emit, on the average, as much visible radiation as the sun does in 10^7 years, and after a life of a year or so they become faint stars[4]. They suggest that Tycho Brahe's nova of 1572 was a super-nova occurring in our Milky Way system. Zwicky estimates their frequency of occurrence as one per stellar system per 600 years[5]. They estimate that during its brief life a typical super-nova emits from 10^{52} to 10^{54} ergs, almost all in cosmic rays, and by averaging throughout the heavens they calculate a cosmic ray flux at the earth's surface of the same order of magnitude as the observed, namely, 3×10^{-3} ergs/cm.^{2} sec. However, they point out[3] that a super-nova occurring in the Milky Way 30,000 light years away would, for a short time, produce a cosmic ray flux at the earth some 10,000 times greater.

Evidently, if this theory is true, when considering the production of helium in beryls by cosmic rays, we must take not only the present cosmic ray flux into account, but also the average value due to one super-nova in the galaxy each 600 years. Let us assume that, in the past, super-novæ have occurred throughout the galaxy in proportion to the present density of visible stars. Then from Kapteyn's star distribution, as given by Jeans[6], I calculate the mean value of $1/D^2$, D being the distance from the earth to each super-nova, to be 4×10^{-8} (light years)$^{-2}$. An emission of 10^{54} ergs at the corresponding distance gives an energy at the earth's surface of 2×10^9 ergs/cm.^{2}, account being taken of the fact that a point on the earth can see only half the heavens. This equals the energy received in about 2×10^4 years at the present rate, so that, average over 600 years, the average rate of cosmic ray recep tion is about 35 times the present rate.

In view of the uncertainties of this type of calcula tion, it seems possible that the theory of Baade an Zwicky and the *experimental* data regarding th helium content of beryls are compatible. However there is a theoretical difficulty which is pointed ou by Fay, Glückauf, and Paneth[2]. The cross-sectio of the beryllium nucleus for disintegration by cosmi ray particles and quanta would need to be far greate than that predicted by the quantum theory eithe for photons or fast electrons, but as the quantum mechanics is inadequate to describe other qualitie of cosmic radiation, perhaps this theoretical difficult is not conclusive.

The suggestion that cosmic radiation has playe any appreciable part in the production of biologica effects, such as mutations, has also been discarde because of the small intensity. If Baade and Zwicky' theory is true, this conclusion also will need recon sideration.

JOHN READ.

Mount Vernon Hospital,
Northwood, Middlesex.

---

[1] Glückauf and Paneth, *Proc. Roy. Soc.*, A, 165, 229 (1938).

[2] Fay, Gluckauf, and Paneth, *Proc. Roy. Soc.*, A, 165, 238 (1938).

[3] Baade and Zwicky, *Proc. Nat. Acad. Sci.*, 20, 259 (1934).

[4] Baade and Zwicky, *Astrophys. J.*, 88, 411 (1938).

[5] Zwicky, *Astrophys. J.*, 88, 529 (1938).

[6] Jeans, "Astronomy and Cosmogony", 15 (1928 edition).

"The Relativity of Time"

PROF. H. DINGLE has put forward[1] the view that, while it is correct to deduce the "Fitzgerald contraction" of moving bodies from the Restricted Principle of Relativity, it is incorrect to deduce the slowing down of moving clocks. His main ground is that the second statement is meaningless, because a clock is not a well-defined measuring instrument. If, for example, it takes the form of a stream of equal grains of sand falling regularly in an hour-glass, the time elapsed may be measured equally well by the *number* of fallen grains, N_1, or by their total *mass*, N_2, or by their total *volume*, N_3. Since mass and volume have different transformation laws for moving axes, Prof. Dingle infers that N_1, N_2, and N_3 also have different transformation laws, some showing the retardation and others not.

If this argument is intended to show a real difference between kinds of clocks, it must mean that if two hour-glass clocks are synchronized and moving together, and if one contains a counting apparatus and the other an apparatus for finding the mass of the fallen sand, then although at any instant they show the same reading for an observer relatively at rest, they show different readings for a moving observer. This is clearly not true, if the distance between the clocks is negligible: if the two dials look the same, at any given instant, to one observer, they look the same to all, no matter what mechanism is behind them. What appears to have been overlooked is that the sand and the measuring apparatus both form part of the clock, and therefore move together: the mass involved is the rest mass, and its effect on the transformation law is *nil*. To obtain Prof. Dingle's transformation law the mass of the moving sand would have to be measured by the stationary observer, an arrangement which can scarcely be called a "clock".

In any event, if it is equally legitimate to read a sand-clock by counting grains and by weighing them, must also be equally legitimate to read a measuring od by counting its divisions or weighing a piece of it, o that any difficulties on this score about clocks will e paralleled by difficulties about rods. The problems of a logical theory of measurement appear to be ymmetrical with respect to space and time.

M. H. A. NEWMAN.

St. John's College,
Cambridge. Nov. 27.

NATURE, 144, 888 (1939).

I CANNOT agree with Mr. Newman that an instrument which measures time in terms of the mass of allen sand is not a clock. If such an instrument is assed by a recognized observatory, I should be glad o know on what authority Mr. Newman would reject t. If it is accepted, then the mass must be measured, directly or indirectly, whenever it is used, whether moving or at rest. A consideration of what an observer would see on a dial is not sufficient to determine such a measurement, as perhaps the ollowing example will show most convincingly. Suppose we wish to find how mass varies with velocity. Insert a body in an apparatus which ndicates its mass by a pointer reading on a dial. Now recede from the apparatus with velocity, *v*. o long as the dial can be seen its reading will, learly, appear the same. Hence if Mr. Newman is right, mass is invariant. It is not "equally legitimate o read a measuring rod by counting its divisions or weighing a piece of it", because the standard of space measurement in physics is defined as the length, and not the weight, between two fixed marks.

I should add that I did not say that "it is correct to deduce the 'Fitzgerald contraction' of moving bodies from the Restricted Principle of Relativity". The Restricted Principle of Relativity is an expression of the Fitzgerald contraction.

HERBERT DINGLE.

mperial College of Science and Technology,
London, S.W.7.

Flame Method of Spectrochemical Analysis

UNDER the present troubled conditions there is no prospect of Dr. F. Majewsky's publishing in the near future his six months' work here ending August 1938. I therefore wish to place his main results on record.

His main work consisted in improving and adapting for routine use Ramage's flame method of spectrochemical analysis. Ramage[1,2] burnt a small quantity usually 50 mgm.) of powdered plant material rolled n filter paper in an oxy-coal-gas flame in front of a spectrograph. Reproducibility of results depended on the uniformity of feeding the roll into the flame. This was made difficult by the roll bursting into flame just outside the oxy-coal-gas flame.

The difficulty was overcome by raising the roll to a sufficiently high temperature to drive off inflammable gases and carbonize it before burning it in the oxy-coal-gas flame. This improvement alone resulted in increased reproducibility of results and increased sensitivity of the method.

We affected a further improvement by combining with the heat treatment immersion in ammonium chloride vapour to convert the minerals into their chlorides. This resulted in an increased sensitivity which varied from thirty-fold for calcium, the chloride of which is much more volatile than the carbonate, to nil for potassium, the chloride and carbonate of which are about equally volatile.

Dr. Majewsky was able to burn a roll treated in this way always in 75 seconds, whereas untreated ones were consumed in about 50 seconds, but the actual time varied by some seconds from roll to roll.

Quantitative results were obtained by comparing the unknown spectra with those given by rolls impregnated with known mixtures of salts. A statistical analysis of the results obtained with strawberry leaves showed that the means of two determinations each done in triplicate must differ by 12–18 per cent to have a twenty to one degree of significance. This degree of accuracy is sufficient for many horticultural purposes.

Differences between replicate determinations were much less for solutions than for leaf material, and the apparent amounts of most of the minerals showed parallel variation in the spectra of solutions but less so in those of leaf material. These results suggested that the comparatively small variation between replicates of determinations on solutions was due to faulty standardization of burning, and that the increased variation between replicate results on leaf material was due to lack of homogeneity of the leaf sample. These and other facts raise the hope of a further considerable increase in sensitivity and accuracy.

The comparatively simple and inexpensive method worked out by Majewsky was then used by S. G. Thompson for examining leaf samples sent to East Malling by me from South Africa, and proved adequate for a preliminary survey of the mineral status of fruit trees. The results obtained showed some remarkable agreements with horticultural performances and with diagnosis by plant injection.

As there is unfortunately no prospect of Majewsky's paper being published in the near future, it seems desirable to report briefly his contributions before their importance is masked by the superstructure which we hope to build on them.

W. A. ROACH.

East Malling Research Station,
Kent. Nov. 30.

[1] Ramage, H., NATURE, 123, 601 (1929).

[2] Ramage, H., NATURE, 125, 279 (1930).

Surnames and Blood-Groups

As is generally known, very large series of blood-groupings have been made in recent months in connexion with the emergency blood transfusion service. Among these depots, one has about 12,000 cases on record.

As the district is one of recent industrial development associated with immigration, it occurred to us to examine whether the blood-group frequencies are associated with surnames. A group of characteristically Welsh surnames was chosen centred on the eight types, Davis, Edwards, Harris, Jones, Lewis, Morgan, Phillips and Roberts, a selection for which we are indebted to Mr. B. S. Bramwell of the Society of Genealogists. This accounted for 5·2 per cent of our sample.

The percentages of the four blood-groups and the two sexes are shown in the accompanying table.

PERCENTAGES CONTRIBUTED BY THE SELECTED WELSH SURNAMES TO DIFFERENT GROUPS.

	O	*A*	*B*	*AB*
Women	5·4	4·3	5·7	3·8
Men	5 7	5·1	5·9	4·5

It may be observed that in each group the percentage of men is higher than that of women, as might be expected from recent immigration of a number of unmarried men. This difference is, however, not statistically significant. In both cases, however, the percentage is lower in group *A* than in *O*, and again lower in *AB* than in *B*. This difference is quite significant, and confirms the conjecture that recent population movements, even within Great Britain, can lead to significant association between surnames and blood-groups.

There are probably many other places in which empanelling for blood transfusion is now sufficiently active for local heterogeneity to be detected by the same method. Local surname frequencies may be obtained rapidly from telephone directories, and more thoroughly from marriage registrations, of which the Society of Genealogists has a large collection.

R. A. FISHER.

Galton Laboratory,
(at Rothamsted).

JANET VAUGHAN.

Emergency Transfusion Depot.

Human Origins and Taboo

IF we think of the evolution of man from some anthropoid stock as the evolution of mainly instinctive (innately conditioned) behaviour into mainly customary (socially conditioned) behaviour, we can both see the possibility of the formation of a larger group than the family one characteristic of extant anthropoids and can relate the said possibility to the facts of taboo—and totemism.

It is commonly and plausibly assumed that the reason why anthropoids do not form larger groups than family ones is the difficulty the larger group would have in finding sufficient food. This difficulty would not arise to the same degree in the case of anthropoids whose behaviour-habit was becoming less instinctive, more customary. The more variegated the dietary customs of family-groups of such a species became in course of ages, the more possible it would be for such groups to combine permanently together without undue strain on the food-resources of the larger group thus formed. It is a matter of pooling experience. When two heads began to be better than one, *Homo sapiens* was in sight.

Customary behaviour is initiated by individuals acting consciously in a novel manner, making a habit of novel and 'agreeable behaviour' and making a negative habit of novel and 'disagreeable behaviour'. In general, the agreeable behaviour *is* viable and the disagreeable *is* unviable. But accidents of conditioning occur in Nature as they occur, not as accidents, in the experimental psychologist's laboratory. A dog can be conditioned to regard anything whatever as 'taboo', so to speak; it is merely a matter of administering some unpleasantness concomitantly. Similarly, in a state of Nature negative customs *could* be formed by accidents of conditioning in regard to objects suitable for food, and it is almost a statistical necessity that our family-groups of anthropoids during the ages while, *as* family-groups, they were evolving their respective customary diets, should have formed one or more such negative customs. There would be nothing to distinguish these 'mistakenly' conditioned negative customs for their 'owners' from customs normally conditioned by di agreeable experience until *after* families were combined in larger groups. Even then we are still long way from the name and concept of 'taboo' an from totemistic theories of food-taboo practices an social organization, but all that follows easily enoug

This hypothesis is an application of my "Novu Organum" (Longmans, 1931), namely, the assumptio of 'nature as habit' in a sense of 'habit' quite th reverse, in relation to 'mind', of Hering's and Butler notion of 'habit'.

J. C. MCKERROW.

34 Cartwright Gardens,
London, W.C.1.
Dec. 4.

Metaplasia and Adenoma-like Changes in the Uter of Rats Injected with Sex Hormones

SQUAMOUS metaplasia in the uterine epithelium ca be considered as the first stage of pre-cancerou changes. In a previous publication[1], we have give the literature on the subject and have described ou own experiments, which showed that metaplasia i the uterine epithelium, produced by injections int the rats of œstrogenic hormones, can be decreased c prevented by the simultaneous administration (progesterone, the hormone of the corpus luteum.

In another paper[2], on the basis of a few exper ments only, we have suggested that male hormone when injected simultaneously with œstrogens, migh influence the metaplastic changes.

We have now completed a series of experiments o 105 normal or ovariectomized rats. The animals wer injected for 2–3½ months with œstradiol dipropionat or benzoate-butyrate (0·018–2 mgm. a week) alone or simultaneously with male hormones (androsteron 7·5 mgm., testosterone propionate 2·25–7·5 mgm and testosterone dipropionate 7·5 mgm. a week In one experiment progesterone (4·5 mgm. a week was given in addition to œstradiol dipropionate an testosterone propionate. The results obtained ca be summarized as follows:

(1) The percentage incidence of the metaplasti changes may be the same in the rats injected wit œstrogens as in those injected with both œstrogen and male hormones.

(2) With the doses used, however, adenoma-lik changes in the uterine glands and the most sever degree of squamous metaplasia of the uterin epithelium were found only in the latter group of rat

(3) The addition of progesterone considerabl decreased or in most cases prevented the metaplasti changes.

(4) The results obtained add weight to th suggestion that disturbances of the ratio of th male and female sex hormones, simultaneousl present in the organism of either sex, may be a important factor in the occurrence and developmen of some types of neoplastic growths.

V. KORENCHEVSKY.
K. HALL.

Lister Institute of Preventive Medicine,
London, S.W.1.
Dec. 1.

---

[1] Korenchevsky, V., and Hall, K., *J. Obst. and Gynaec.*, 45, 22 (1938

[2] Korenchevsky, V., Hall, K., and Burbank, R., *Biochem. J.*, 33, 37 (1939).

ffect of Œstrogens on the Pouch of the Marsupial *Trichosurus vulpecula*

Trichosurus vulpecula, the common Australian ossum, has a well-developed pouch which shows arked reactions towards the administration of strogens. After the injection of small doses of strogen (200–1,000 I.U.), development of the pouch d mammary glands becomes evident, particularly in xually immature animals. Furthermore, hyper-asia of the pouch muscles is noted as well as the cretion of a pigment which is deposited within the uch and which stains the hairs a deep orange ithin the pouch as well as those around it. After e administration of one or several moderately large ses of œstrogen (1,000–10,000 I.U.), hyperplasia and pertrophy of the muscles of the pouch occur, and e pouch decreases in size. After the administration of single large dose of œstrogen (50,000–1,000,000 I.U.), e hypertrophy and hyperplasia of the pouch muscle come marked and it goes into a state of contraction hich is accompanied by an almost complete dis-pearance of the pre-experimental pouch.

If the injections of large doses of œstrogen are aintained, the contraction of the pouch remains rmanent, but the animal dies from the action of e hormone on the internal reproductive organs. his end result is similar in animals which possess nall or large pouches pre-experimentally; but it cessarily becomes more obvious in animals which d large pouches before injecting the œstrogen. his reaction indicates that the muscle of the pouch, hich is voluntary muscle, is contracted by œstrogen.

A. Bolliger.
A. Carrodus.

ordon Craig Research Laboratory,
Department of Surgery,
University of Sydney.
Nov. 17.

evere Mortality of *Mactra corallina cinerea* (Montagu) off the Lancashire Coast

I was informed by Mr. J. H. Duggan that enormous umbers of molluscs had been thrown up on the coast etween Southport and Hightown on October 28. hey then formed a continuous belt averaging six et in width and ten inches in depth at the crest, tending nine miles from Southport towards High-wn. The majority were, at this time, alive.

I visited the area on November 1 and found that e tides since October 28 had scattered the molluscs ver a zone averaging twenty-five yards in width. hey were arranged in drifts parallel with the high ater mark and usually five in number, the heaviest posit being in the most shoreward drift. In many laces this drift was five inches deep and five feet ide.

Most of the molluscs, at this time, were dead, but the deeper drifts the ones underneath were still live, having been protected from the wind and sun y the upper ones. The fact that no deposits were und in which all or most were alive suggests that one had been cast up since October 28.

Only one species of mollusc was present, namely, *actra corallina cinerea* (Montagu), and all were nall specimens, averaging 0·9 in. in length, and bviously the same year's spat.

It was found that one cubic foot of the drifts con-ined approximately 3,600 specimens of Mactra, so hat Mr. Duggan's figures imply a belt nine miles long, six feet wide and, say, seven inches average depth, from which a conservative estimate of the mortality of the Mactra can be obtained. This figure is in the order of 600 millions and, as Orton has stated[1], represents a tremendous loss in fish food.

Two previous records of great numbers of molluscs being cast on to this beach have been made: Chaster[2] recording *Cardium echinatum* being washed up in great numbers in January 1891, and Orton[1] recording great mortality of *Abra alba* and *Donax vittatus* in November 1929.

Orton suggested that the mortality was due to a certain wave action set up by a combination of the action of spring tides and a strong inshore wind, which washed out the organisms in the surface layer of the sea bed. In the present case, however, the mortality occurred at the time of the spring tides, but an offshore wind was prevailing.

It is interesting to note that on each of these three occasions a different species was cast up. This might be due to one of two alternatives: either the population of the sea bed off the shore has changed in the time between each of these events, or a different area of the sea bed has been affected by the tides on each occasion.

G. E. Williams.

Department of Invertebrate Zoology,
Liverpool Free Public Museums.
Nov. 20.

---

[1] Orton, J. H., Nature, 124, 911 (December 14, 1929).

[2] Chaster, *Southport Soc. Nat. Hist.*, 1 (1892).

Chitin Content of the Mandible of the Snail (*Helix pomatia*)

The presence of chitin in the above-mentioned organ has been indicated so far by means of colour reactions only, probably owing to the lack of material. During the course of another investigation, we came into the possession of 650 mandibles (1 gm.), and an acetolytic breakdown experiment was carried out. After boiling with dilute alkali and hydrochloric acid, the remainder weighed 70 mgm., and yielded upon the application of Bergmann's method 8 mgm. of colourless needles which were identical with octa-acetyl chitobiose: m.p. 290°, nitrogen content 4·4 per cent. The experiment shows that the presence of chitin can be proved in even minute amounts of natural substances.

G. Tóth.
L. Zechmeister.

University,
Pécs,
Hungary.
Nov. 15.

Potential Hosts of Potato Viruses in Garden and Field

In the spring and summer of 1938 one of us (R. N. S.) was working on potato leaf roll with the object of producing an attenuated strain of the virus. To this end, attempts were made to convey leaf roll not only to members of the Solanaceae but also to a wide range of unrelated genera. Two successes were secured by means of grafts, one with Matthiola, the other with a garden Campanula, both of which behaved as carriers.

Encouraged by these results we have explored, during 1939, the possibility of such infections occurring in plants grown as field crops. In particular, we attempted to infect cruciferous weeds and cultivated

Brassicæ both by means of graft and by the agency of the aphid *Myzus persicæ*. We succeeded in conveying leaf roll twice, once through a turnip and thence to a President potato, in both instances by graft; and again through a Brussels sprout and on to a President potato, both by means of the aphis *Myzus persicæ*. Neither hosts showed any symptoms, but the virus which was recovered on the Presidents produced a typical leaf roll in the first case and a poorly developed and ambiguous syndrome in the second.

We were from the start, however, confronted with an unexpected complication: in a large number of cases the virus carried over to the potato and thence to tobacco or *S. glutinosa* plants from infected Brassicæ or other foreign host was the *Y* virus (Sol. Virus 2, K.M.S.), and not leaf roll. Careful checking of all controls and examination of our potato leaf roll sources showed that it was these latter which were harbouring the *Y* virus, notwithstanding that they had been exhibiting acute leaf roll for nearly twenty years without a sign of the usual *Y* virus symptoms.

Our researches have proved that the *Y* virus can be carried by turnips, cabbages, kale and Brussels sprouts without symptoms, and that from them it can be conveyed to potatoes by graft or by means of *Myzus persicæ*, and thence to tobacco or *S. glutinosa*. In addition, we have shown that red clover, the garden pea and bindweed may be infected with the *Y* virus by means of *Myzus persicæ* without producing symptoms. The Brassicæ are frequently the overwintering hosts of *Myzus persicæ*: may it be that they and the well-nigh ineradicable bindweed may also act as reservoirs for these destructive potato viruses during the winter months?

REDCLIFFE N. SALAMAN.
W. R. S. WORTLEY.

Potato Virus Research Station,
Cambridge.
Nov. 20.

A Bacterial Disease of Forsythia

A BACTERIAL disease has appeared in an East Anglian nursery on bushes of *Forsythia spectabilis* and *F. intermedia*. When, early in the year, the two-year-old branches are removed to the forcing house, the flower buds remain dormant or open imperfectly. Sometimes only a few twigs on a branch are affected; more often the branch as a whole remains dormant. Examination of the cut end of the shoot shows a stain in the wood, usually crescent-shaped, and varying in colour from scarlet to dark brown. At the time of cutting, the diseased branches cannot be distinguished superficially from healthy branches, but the stain in the wood betrays the presence of the disease. On any bush, healthy and diseased shoots arise from different stools. Excision of diseased branches (but not of the diseased stools) has been practised, but the bushes continue to die back, indicating that the disease can spread from the diseased to the healthy stools.

From stained wood a bacterium was readily isolated; this produced green fluorescence on beef-infusion agar and in Uschinsky's solution. Its reactions in culture media show it to be closely related to *Pseudomonas syringæ*. The Forsythia organism was inoculated into the wood of young Forsythia bushes growing in pots, and produced a dark stain in the wood; the following spring the flower buds opened normally. Inoculated int swelling flower buds, the organism caused a delay opening of about a week compared with wounde controls. When inoculated into young succulent lil and Forsythia shoots, blackened lesions appeared shortly afterwards the shoots died. *Ps. syringæ* w inoculated into the wood of Forsythia bushes b produced no stain in the wood and did not affe the opening of the flower buds. When *Ps. syring* was inoculated into young succulent shoots Forsythia, black lesions developed and shortly afte wards the shoots died and turned black.

It thus seems probable that the organism isolate from Forsythia belongs to the *Ps. syringæ* grou Wormald[1] records a disease of Forsythia, probabl caused by *Ps. syringæ*, the symptoms of which we elongated black lesions on the shoots and spots o the leaves.

G. METCALFE.

Botany School,
Cambridge.
Dec. 1.

---

[1] Wormald, Annual Report E. Malling Res. Sta., 1935 (Sect. II p. 145.

Excretion of Thiamin and Biotin by the Roots o Higher Plants

THE fact that soil in the immediate vicinity plant roots supports a much higher microbial population than that existing outside the plant's zone influence has been recognized for many year Although it has been suggested that 'root excretion account for this effect, these hypothetical exudate have never been identified, nor has their mode action been satisfactorily explained. In studying th relation of plants to soil-borne diseases, it was considered desirable, therefore, to examine the possibilit that excretion of minute amounts of bacterial growt factors by the growing plant might be a fundament factor in determining the character of the rhizosphe microflora.

One hundred representative bacteria were isolate from each of the rhizospheres of Bison and Novelt flax, after three weeks' growth in uniform soil unde greenhouse conditions, and from the rhizospheres o two varieties of tobacco grown in the field. A simila number of control organisms was isolated in eac case from soil outside the root's zone of influenc Each of the isolates was inoculated into two medi one containing glucose, potassium nitrate an inorganic salts, and the other containing, in additio cysteine 50 mgm., *m*-inositol 100 mgm., thiami 100 γ, β-alanine 100 γ, nicotinic acid 100 γ, an biotin 0·5 γ, per litre. All growth-substances wer used in pure form except biotin, a concentrate o which was prepared by the procedure of Kögl an Tonnis[1] and shown to be approximately 0·5 per cen pure[2].

Results in every case showed that those organism dependent for their development on a supply o previously synthesized growth-factors were markedl more abundant in the rhizosphere than in contr soils[3], suggesting that the plant may excrete th necessary factors for their nutrition. In testing th growth-factors separately on twenty-five organism selected from flax and tobacco rhizospheres, fo which the more complex medium was essential, a were found to require either thiamin or biotin o both, but in no case did inositol, β-alanine, or nicotinic acid show any growth-promoting properties.

Although these findings indicate that the plant possibly exerts at least a part of its 'rhizosphere effect', through ability to excrete thiamin and biotin, more direct evidence to support this tentative assumption was desired. Seeds of Novelty and Bison flax were sterilized, and germinated in petri plates. After four days at 28° C. the seed-coats were carefully removed from the cotyledons and the seedlings planted in 8-in. test tubes containing 15 ml. sterile utrient solution. A circular disk of cheese-cloth supported by short lengths of glass tubing held the plant at the surface. Following one, two and three weeks of growth, the nutrient solutions from five tubes, containing one plant per tube, after being checked for sterility, were combined and concentrated n volume to 10 ml.

The plant excretions were assayed for thiamin by the growth response of *Staphylococcus aureus* in a medium containing all essentials except the substance to be determined[4]. The presence of thiamin was readily detectable by this method; the excretion from five Bison flax seedlings was 0·23 and 0·64 gammas, nd from five Novelty flax 0·24 and 0·64 gammas after one and two weeks of growth respectively. The appearance of inhibitory material in the plant excreions after two weeks interfered with this assay on older seedlings.

Biotin was assayed by the response of *Rhizobium rifolii* (Wisconsin Strain 205) according to the technique described by West and Wilson[2]. The amounts of this factor excreted in one, two and three weeks were in the neighbourhood of 0·06, 0·25 and 0·21 gammas, and 0·08, 0·20 and 0·20 gammas for five Bison and Novelty flax seedlings respectively. While it is recognized that the accuracy of these results depends on the validity of the assay methods concerned, it is believed that the specificity of these microbiological tests has been satisfactorily established for the strains employed[2,4,5,6,7].

From these observations it appears that the excretion of significant amounts of thiamin and biotin from young roots of higher plants occurs normally, even under sterile conditions, and accounts, at least in part, for certain quantitative and qualitative differences characteristic of the bacterial flora of the rhizosphere.

P. M. West.

Division of Bacteriology and Dairy Research,
Science Service,
Department of Agriculture,
Ottawa, Canada.

Nov. 1.

---

[1] Kögl, F., and Tönnis, B., *Z. physiol. Chem.*, 242, 43 (1936).
[2] West, P. M., and Wilson, P. W., *Enzymologia*. In the press.
[3] West, P. M., and Lochhead, A. G., *Can. J. Res.* In the press.
[4] West, P. M., and Wilson, P. W., *Science*, 88, 334 (1938).
[5] Knight, B. C. J. G., *Brit. J. Exp. Path.*, 16, 315 (1935).
[6] Knight, B. C. J. G., *Biochem. J.*, 31, 731 (1937).
[7] Nilsson, R., Bjälfve, G., and Burström, D., *Ann. landw. hochschule Schwedens*, 7, 301 (1939).

Points from Foregoing Letters

L. Wertenstein was investigating the radioactive gases evolved in the fission of uranium at the Mirosław Kernbaum Radiological Laboratory of the Warsaw Society of Sciences when Poland was invaded. Writing from Turczynek, near Warsaw, he describes some of the results he had obtained. The radioactive gases were carried through two Geiger-Müller counters placed in series and the time lag of arrival of the gases in the counters could be varied by a system of capillary tubes. Typical curves indicate bodies of period of the order of a minute, and others of much longer period, giving almost constant residual activity within the time of experiment.

J. Read points out that if Baade and Zwicky's theory of cosmic radiation is true, the experimental vidence regarding the helium content of beryls is ot incompatible with the assumption that this helium was produced by cosmic rays. The possibility f biological effects due to cosmic rays would also eed reconsideration.

M. H. A. Newman questions Prof. H. Dingle's view hat the current doctrine of the slowing down of moving clocks in relativity is incorrect. Prof. Dingle, n reply, maintains that the clocks described by him are legitimate, and that the uncorrected dial readings referred to by Mr. Newman are not relevant to the problem.

F. Majewsky and W. A. Roach have rendered Ramage's flame method of spectrochemical analysis more sensitive and the results more reproducible. The roll containing the sample is introduced into mmonium chloride vapour to drive off volatile gases nd convert the minerals into their chlorides before the roll is burnt in the oxy-coal-gas flame.

J. C. McKerrow suggests that some anthropoid became man as behaviour became more and more conditioned by custom. Confirmation of this hypothesis, itself based on the view of Nature which he has propounded in "Novius Organum", is found in the facts of taboo and totemism.

Since adenoma-like changes and the most severe degree of metaplasia appear in the uterus of rats only when male hormones are administered in addition to oestrogens, V. Korenchevsky and K. Hall conclude that disturbance of the ratio of the male and female sex hormones may be an important factor in the occurrence and development of some types of tumours.

Heavy mortality of *Mactra corallina cinerea* (Montagu) on the Lancashire coast is reported by G. E. Williams. Comparisons are made with two previously recorded mollusc mortalities on this part of the coast.

R. N. Salaman and W. R. S. Wortley have shown that the cultivated Brassicæ, as well as the garden pea, red clover and common bindweed, may be induced to behave as symptomless hosts of two destructive viruses which affect the potato crop. It is suggested that certain of these plants may serve as virus reservoirs as well as overwintering hosts for the aphid vector.

G. Metcalfe describes a disease of Forsythia, apparently caused by *Ps. syringæ*.

The excretion of thiamin and biotin from young roots of higher plants has been found by P. M. West to be of significance in explaining the occurrence of high numbers of bacteria requiring those growth substances, in the soil adjacent to the root surface.

RESEARCH ITEMS

Rock Art in North Africa

M. **Raymond Vaufrey** has now added to his previous reports on the results of his researches on the rock art sites of southern Oran and their bearing on the origin, affinities and chronology of the north African neolithic, further details of the sites, comparative studies, and full illustration (*Arch. de l'Instit. de Pal. Humaine*, Mém. 20; 1939). On four groups of sites, in the mountains of Figuig, Ksour, Géryville and Jebel Amour, the association of a stone industry with these rock-engravings of animal and human figures, an association previously undetected, made it possible to assign this art to a neolithic with Capsian traditions, which is shown to extend to northern Oran and beyond, linking up with the neolithic of the Sahara and a neolithic pluvial period, to which a date is assigned ranging from the middle of the sixth to the middle of the second millennium before our era. In order to test the application of this dating to the North African neolithic with Capsian tradition and the associated rock art of Oran, the comparison, obvious on both geographical and cultural grounds, is made with proto-historic and pre-dynastic Egypt. Here it is found that certain cultural elements in the North African neolithic are to be assigned to the various cultural stages or 'civilizations' now distinguished—Tasian, Badarian, Amratian, Gerzean—dating from at most 6000 B.C. to about 2000 B.C. But whereas these cultural elements or traits appear at various stages in Egypt according to the 'civilization' to which they belong, in North Africa they appear together—a fact which is explicable only on the ground that the North African is 'colonial' in character in relation to Egypt. A possible affinity of certain rock engravings showing a chariot with galloping horses fixes the latest dating at the opening of the Eighteenth Dynasty, 1580 B.C. As regards its racial character, the culture in Oran is linked with the race of Mechta el-Arbi, which has been shown to have Cro-Magnon affinities.

Tardenois Site in Western Scotland

Microlithic sites in Scotland have been discovered chiefly towards the east coast, while the well-known exception of Shewalton Moor, near Irvine, is probably to be assigned to well into the Bronze Age. A newly discovered site at Ballantrae, Ayrshire, described by the Rev. W. Edgar (*Trans. Glasgow Archæol. Soc.*, N.S., 9, 3; 1939) has so far yielded only the earlier types of microliths and may, therefore, be assigned to the Middle Tardenoisian. The site is situated on the 50-ft. beach extending from Laggan Burn to Downan Point over a distance of about a mile and a half, with an average breadth of about one quarter of a mile. Two streams intersect the area, which with the Laggan Burn supply an abundance of water. The area is fertile and mostly under the plough. Up to the present, only surface finds have been made, nor has the area been examined where not turned by the plough. So far no evidence of pit-dwellings or occupation floors, or traces of charcoal have been found, though concentrations of implements suggest the activities of craftsmen at localized centres, in two or three instances supporte by an abundance of cores. The implements collecte include blades in comparatively large number generally of the small battered-back type. Th triangular is not frequent, but some crescent-lik forms have been found; also micro-burins in number the majority of the usual type; scrapers in larg numbers and in different varieties; notched flak not uncommon; gravers, though rarely, two bein 'accommodation pieces'; and cores in abundanc mostly pyramidal.

Origin of the Grasping Movement in Man

Prof. Davenport Hooker, reporting on researc work towards which financial support has been give from the Penrose Fund of the American Philosophic Society (Year-Book, Amer. Phil. Soc., Philadelphi 1938), states that observations on the developmen of the grasping reflex in human fœtuses prove th independence of its two phases, finger closure an gripping, as they develop sequentially. Finge closure appears at about 11 weeks of menstrual ag as a quick, though only partial, flexion of the finger in which the thumb is not involved. Though th thumb may become feebly mobile so early as 12 week in response to tactile stimulation of the palm it play no part in the grasp by 25 weeks—the terminal ag of the present observations. Finger closure become progressively more complete. At and after 16 week tactile stimulation of the palm usually evokes com plete closure. Gripping has first been observed at abou the eighteenth week. It continues feeble for th remainder of the age-span studied. Further stud may modify the age-levels at which these charac teristic responses appear. Up to the present 4 individuals have been studied in a period of six years the age-span covering from 7 to 25 weeks. It is th second largest series ever studied and the only on documented by objective records, the fourteenth wee being exceptionally well covered. An atlas coverin fœtal activity from its initiation, about the eight week, through the 14 weeks stage has been prepared

Robin Redbreast Pigment in Fowls

Mary E. Rawles (*J. Gen.*, 38, 517–431; 1939 grafted small pieces of skin from the head of a 90–96 hour-old embryo robin on to the right wing bud of 73-hour-old White Leghorn. On hatching, the host showed areas of down coloured cinnamon brown o part or all of the right wing. In one case this wa later replaced by juvenile contour feathers of colour typical of the robin. After moulting, th feathers were host coloured. The barbules were o the structure of the White Leghorn. Hence th robin-coloured feathers arose from the host's feathe germs and were coloured by melanophores whic migrated from the grafted tissue into the epiderma 'collar' of the host's feather germs.

Hybridization and Tumour Formation in Mice

C. C. **Little** (*Proc. Nat. Acad. Sci.*, 25, 452–455 1939) has shown that the first generation hybri between females of the *C57* race of *Mus musculu* d males of ***M. bactrianus*** showed a larger incidence 5·5 per cent) of tumours as compared with that the parents 14·4 per cent and 3·8 per cent respec- vely. The parental strains are different in the mount and type of tumour present, but the hybrids ave an incidence much greater than the addition of e tumour-tendencies of the parents. Also, multiple mours in one individual occur in 11·57 per cent of e F_1 and in not more than 1·14 per cent in one arental strain. Internal physiological 'unbalance' creased by hybridization is given as the most asonable cause for the results.

scular Anatomy of the Apple

THE developmental anatomy of two different arieties of apple has been studied by Mary Mac- rthur and R. H. Wetmore (*J. Pom. and Hort. Sci.*, 7, 218; 1939). The varieties McIntosh and Wagener ere chosen, as having the same chromosome number 4), a similar growth period, and distinct shape ifferences. The McIntosh apple is uniform in shape ith very faint angulation and with the stamens asal to medium in the distal depression. The agener is unequal-sided, definitely angulated, and ith stamens attached higher up. The outline of the rimary vascular bundles in the former case is rcular, and in the latter lobed, corresponding with e respective shapes of the two fruits. In McIntosh, e ventral lobes of the carpels never unite. The cules are thus never completely separated from the ntral cavity, leaving the core 'open'. In Wagener, e ventral lobes of a carpel are joined, no opening nnects the locule with the central cavity, and the re is thus 'closed'. The ovules of Wagener are ranged longitudinally with one ovule in each half f a locule. In McIntosh they are horizontal and retch across both halves of the locule or occupy the ntral cavity. This irregularity in McIntosh is sociated with irregularity in the separation and irection of the ovular traces. The authors have xamined in detail the anatomy and development of e floral parts, and in particular their ontogeny in lation to the nature of the fleshy part of the fruit. hey conclude that this is essentially a fleshy calyx ube or 'floral cup', that is, the consolidated ases of the calyx, corolla and stamens.

ontrol of Club-root

CLUB-ROOT (*Plasmodiophora Brassicae*) is normally ontrolled by correction of soil acidity and adequate rop rotation. Where applications of lime are ndesirable or ineffective, as may occur with some orticultural crops, mercuric chloride has been suc- essfully used on a small scale. Chlorinated nitro- enzenes have been tried by Margaret J. Smieton *J. Pom. and Hort. Sci.*, 17, 195; 1939) as an alterna- ive lacking the objectionable properties of mercury ompounds. Seed box experiments on white mustard ith mercuric chloride, pentachlornitrobenzene and richlordinitrobenzene showed that the latter com- ared favourably with mercuric chloride. The same ubstance applied at 1·5–3 oz. per sq. yard gave ariable control of the disease on cabbages, sprouts nd broccoli in outdoor seed beds. Mercuric chloride as, however, most effective. The trichlordinitro- enzene reduced the stand of seedlings when applied greater amount than 1¼ oz. per sq. yard. Sub- tantial control of the disease, though not always qual to that given by mercuric chloride, was obtained by the addition of a small quantity of trichlordinitrobenzene to the dibble hole at the time of transplanting. Pentachlornitrobenzene was less effective except in cases of mild attack, but was less phytocidal than the other substances. All the substances tested were liable to check the growth of the plants. With trichlordinitrobenzene the check was greater when lime was used as a diluent than when chalk or talc was used.

Exchange between Nitrogen Isotopes on Metal Surfaces

FOUR years ago Taylor and Jungers (*J. Amer. Chem. Soc.*, 57, 660; 1935) concluded that both in the synthesis and decomposition of ammonia on an iron surface the rate-determining step was $N_{2(gas)} \rightleftarrows 2N_{adsorbed}$. The correctness of this view has now been investigated by observing the velocity with which the isotopic exchange reaction $^{28}N_2 + {}^{30}N_2 = 2{}^{29}N_2$ occurs on iron and on tungsten surfaces from room temperature to 725° and 900° respectively. The exchange reaction is immeasurably slow below 450°, and even above this temperature is very slow in comparison with the exchange reaction of molecular hydrogen isotopes at the surfaces of hydrogenation catalysts. Reaction is, however, accelerated by the presence of hydrogen. To explain the slowness of the reaction two alternative mechanisms are put forward involving either (*a*) the rupture of valency bonds of adsorbed molecular nitrogen, or (*b*) if the nitrogen is adsorbed as atoms, migration of these atoms over the surface. On either hypothesis the acceleration by hydrogen is readily understood due to formation of imido or amido groups which, in (*a*), would lessen residual valency forces of adsorbed molecular nitrogen and, in (*b*), would diminish the Fe-N forces inhibiting migration. The high activation energy of approximately 50 kgm.-cal. indicates that the adsorption of nitrogen on synthetic ammonia catalysts is true activated adsorption.

Activity Coefficients of Strong Electrolytes

IT is well known that the formula of Debye and Hückel for the activity coefficient of an electrolyte holds only at high dilutions, and for moderate concentrations an empirical term involving the first power of the concentration must be added to obtain satisfactory results. P. van Rysselberghe and S. Eisenberg (*J. Amer. Chem. Soc.*, 61, 3030; 1939) have investigated the consequence of assuming a van der Waals' force of repulsion between ions, and as this is related to the mean distance of closest approach between a positive and a negative ion, which is already contained in the Debye and Hückel equation, the result is a one-parameter formula. A term proportional to the volume concentration and to the cube of the distance of closest approach, and another term proportional to the square of the volume concentration and to the sixth power of the distance of closest approach, are added to the Debye and Hückel expression for the logarithm of the activity coefficient. It is shown that precise determinations of the distance of closest approach can be made only at high concentrations, when the activity coefficients become sufficiently sensitive functions of this parameter. Activity coefficients in 0·001 and 0·01 molar solutions are calculated for several electrolytes, and in eight cases out of fifteen comparison with experimental values is possible and shows very promising agreement. The mean ionic diameters are calculated by the method of least squares.

RECENT RESEARCHES ON EARLY MAN IN CHINA. I

Late Cenozoic History of North China

P. TEILHARD DE CHARDIN opens a review[1] of the geological and palæontological evidence bearing on the late Tertiary and early Quaternary epochs in northern China by pointing out that, in the course of the past ten years, a continuous outpouring of new facts has necessitated a constant readjustment of number and relative importance of the successive physiographic stages recognizable in that part of the world, which has to be explained periodically.

Thus, the original conception of the Late Cenozoic of China as a massive and continuous formation, in which the lower and uppermost terms only (Pontian Hipparion red clays and the Pleistocene loess) were explicitly distinguished as two separate horizons, was modified through a succession of discoveries by the conception of the "Sanmenian", an intervening polymorphous complex rather vaguely referred either to the Late Pliocene or to the Lower Pleistocene. It soon became more and more clear, however, that several marked differences in species and genera were separating in the so-called Sanmenian the faunas of Nihowan and of Choukoutien, representing a definite faunal and physiographic break, the former being left in the final Pliocene and the latter representing the true Lower Pleistocene of China. The evidence has now become overwhelming that fundamental changes separate the upper (Choukoutien) and lower (Nihowan) parts of the former "Sanmenian".

Although views are still far from definite, they may be expressed provisionally as follows. Notwithstanding physiographic changes, the Equus-Camelus beds of Nihowan and the underlying pre-Nihowan (Middle Pliocene) have lithological and faunistic affinities. Both are lacustrine in facies and both are characterized by the same 'sub-tropical Asiatic' fauna. By this term it is intended to indicate that in the Middle Pliocene two different faunistic blocks were mixing in the forested steppes of north China—one of south-eastern affinities, including an abundance of Cervulids, and another, a peculiar Central Asiatic block, characterized by a harvest of beautiful, mostly strepticere, antelopes, apparently a special antelope province, parallelizing the modern African province, but separate from it since the base of the Pliocene.

The bearing on the present point is that these two blocks were still thriving in North China after the appearance of such forms (horse, bison, camel) as characterize the Villafranchian of Europe. In spite of many important differences in their respective faunas, the Middle Pliocene and Villafranchian (Nihowan) of North China are marked by the same general topography, the same climate, and the same fundamental types of deer and antelope.

These conditions being realized, it is difficult to escape the conviction that a change of the first magnitude occurred between the end of the Sanmenian (Nihowan) stage of deposition and the beginning of the following 'Choukoutien sedimentation', and that this change corresponds to a positive epeirogenic movement rejuvenating the entire Pli
cene topography. Supposing that at the end of t
Pliocene the whole of the Asiatic plateau has bee
moving upward, while a few compartments only-
Ordos (?), Fenhotrough, Peking plain—sink betwee
the rising blocks of Mongolia, Shansi, Tsinling, etc
then an increasing number of facts, so far overlooke
or unexplained, find a natural connexion and ea
explanation, among those mentioned being th
dislocation of the Pliocene lakes drained by new-c
gorges, the replacement of the lacustrine tilted
faulted sediments by thick loamy fans sloping dow
in the basins from rejuvenated ranges, the enormo
accumulations of Pleistocene sands and silts (Tientsi
800 metres; Taiyuan, 300 metres), the first appea
ance of the modern Hwang-ho, and probably the fin
separation of Japan from the continent.

As a natural consequence the antelopes die, th
Malayan deer and Stegodon retreat southward,
western or northern wave brings new types of de
(Œuryceroids, Pseudaxis, etc.), and probably fro
the south with the water-buffalo, man (Sinanthropu
appears.

Still somewhat African-looking up to the end
Nihowan times, Asia was essentially our present As
at the dawn of the Choukoutien cycle. This prov
the positive reality and gives the measure of th
post-Villafranchian break in North China.

Among conclusions which follow, it would appe
that in North China, as in France and North Indi
the first appearance of horse (more and more general
accepted by palæontologists as indicating the base
the Pleistocene in the Old World) antecedes clear
the major diastrophisms which would be the best lim
between the Tertiary and Quaternary from a ge
logical point of view; and, therefore, the advanta
of keeping the Villafranchian in the Pliocene instea
of the Pleistocene should be reconsidered. So far a
North China is concerned, the most natural bas
of the Quaternary is given by the appearance
man on a modernized topography after the Vill
franchian.

Origin of Mankind[2]

As a result of his researches on the skeletal remain
of fossil man found in the cave of Choukoutien, Pro
Franz Weidenreich maintains that the importan
body of knowledge gained from the numerous spec
mens of Sinanthropus (structure of the teeth, crani
capacity, variability of type, etc.) call for a radic
transformation of our conceptions of the problem o
the origin of mankind. The true Anthropoidea o
one hand, and the Hominidæ and Australo-Pithe
coidea on the other hand, have been derived fron
a common primitive anthropoid stock. Sinanthropu
and Pithecanthropus, representing a pre-human stag
of development, belong to the second group. Th
different specimens of the Neanderthal group repre
sent a higher, and recent man yet a third stage.

Development has been decidedly orthogenetic, an
has come about as a combination of primitive an
progressive characters. The diversion of mankin
into geographic varieties (races) is an old phenomeno

and is traceable so far back as the early stages of development of the Hominidæ. It would be wrong to suppose a polygenetic development of the Hominidæ, as the development of the common group took place only once. But the development has been polycentric, and four centres of the genesis of the Hominidæ can be distinguished—European – Western Asiatic, Middle East African, North Chinese, South-East Asiatic – Sundaic. As the development in these centres took place not at the same time and at different speeds, young and old races are to be found in every stage.

The developmental factors of Lamarckian and Darwinian conception are considered to be of no importance, the essence of evolution being an independent progressive differentiation of the type itself. The phylogenetic development is the result of internal causes, and is, like the ontogeny, an evolution of innate character.

Forerunner of *Sinanthropus Pekinensis*[3]

Certain deductions as to the character of a hypothetical forerunner of *Sinanthropus Pekinensis* are drawn by Prof. Franz Weidenreich from the skeletal material from Choukoutien. The line of argument followed is that Sinanthropus, representing the most primitive hominid known hitherto, and it being possible to connect it with recent man by a continuous line of characteristic types such as Javanthropus, Neanderthal man and the man of Mount Carmel, we may trace a picture, imaginary, but based on ascertained fact, of the forerunner of Sinanthropus in a complete and uninterrupted line of evolution, by attributing to it those specialities which, as we know, have gradually disappeared in the course of human evolution.

Thus, taking the evidence of the brain-case, its main peculiarities in Sinanthropus are the extraordinary lowness, the greatest breadth coinciding with the bi-auricular breadth, thick and far projecting supraorbital tori separated from the receding forehead by a broad and relatively deep furrow, a strong and rounded occipital torus combined with a low inion angle, and finally the location of the foramen magnum in a rather posterior level. The persistence of this bulkiness of superstructure, which in all great apes is a direct and indirect result of the misproportion of the size of the brain-case affording insufficient space for attachment of powerful nuchal and masticatory muscles, but is reduced in extent and bulkiness as the brain-case is enlarged in the course of the evolution of more advanced human types, indicates that in regard to this feature the forerunner of Sinanthropus could not have been very different from the great apes of to-day.

As to the general configuration of the brain-case, neither the relation between length and breadth, nor that between length and height, could have been considerably different from that of Sinanthropus, in whom these ratios are about the same as in the great apes.

The character of the forerunner is also suggested by the teeth, in which Sinanthropus has several features in common with the apes, but differs completely from recent man. As human evolution proceeds, the teeth undergo a reduction in size, height, length proportions and a simplification of their patterns. It is probable, therefore, that the characteristics of the teeth were still more developed in the forerunner. The canines, however, require special consideration, and there are indications that the crowns of both upper and lower canines may have been much higher in the forerunner, as is characteristic of the anthropoids of to-day. Further, the dental arcade of Sinanthropus suggests that in the forerunner the jaws were more salient.

All these facts thus outlined lead to the conclusion that the immediate forerunner of Sinanthropus was an anthropoid primate the general appearance of which with regard to skull, jaws and teeth did not differ in principle from that of female anthropoids of to-day. To know the special relations of this anthropoid-like hominid to the ancestor of recent anthropoids, we must compare Dryopithecus or Sivapithecus with Sinanthropus; but in actual fact the closest resemblance is found in neither of these, but in Australopithecus, which, therefore, must be regarded as representing an anthropoid with some relation to the anthropoid forerunner of Sinanthropus.

Such other parts of the skeletal structure of Sinanthropus as are known—or rather the collar-bone and the humerus fragment specifically—indicate that his immediate forerunner probably had abandoned the arboreal mode of living; and judging from the size of brain-case, jaws and teeth, could not have been a pygmy.

The question as to which of the anthropoids of to-day Sinanthropus bears the closest resemblance is not so easily answered as may be imagined. In some peculiarities of the teeth he approaches the gorilla (cingulum), in others (for example, wrinkles) the chimpanzee, and then again the female orang in 'taurodontism'. But when reviewed in general among all anthropoids, recent and fossil, known hitherto, Australopithecus seems to be the closest relative of Sinanthropus and his assumed forerunner.

Duration of Life in Fossil Man in China[4]

Investigation of the evidence of individual age in the remains of fossil man discovered at Choukoutien corroborates the conclusion at which Prof. H. Vallois arrived in his study of similar evidence relating to Neanderthal man, that only rarely, if ever, was death due to natural causes, and that in consequence the duration of life was not prolonged. In the Sinanthropus population, now numbering approximately thirty-eight individuals, fifteen, or 39·5 per cent, were children up to the age of fourteen years old, three skulls may have belonged to individuals aged less than thirty years old, three may range between forty and fifty years, and only one skull, that of a woman, unfortunately in a fragmentary condition, may have been that of a really old individual of more than fifty years, or even sixty years of age.

It is interesting to note that in the Pithecanthropus group, the nearest relatives to Sinanthropus, complete fusion of the sutures of the skull cap points to an age of more than fifty years, while the recently discovered third skull (1938) belongs to a juvenile.

It must be remembered that these conclusions as to age are subject to the reservation that it is assumed that the eruption of the teeth and the fusion of the sutures correspond in time to the respective processes in modern man, though it is known that in the anthropoids they take place at a much earlier age than in man. This, however, would only serve to confirm the conviction that the actual duration of life in Sinanthropus was shorter than in modern man.

With regard to late palæolithic man of the Upper Cave, of the seven individuals there were three juveniles, a fœtus or new-born infant, a child of about five years, and one of an age of fifteen to twenty years. Of the four adults, two, probably women, may have been slightly more than twenty years of age; the third is indeterminate, but probably not advanced in years, and the fourth was an old man of at least sixty years. Thus in the late palæolithic population also old age was seldom reached.

In both groups, Sinanthropus and late palæolithic man, the brevity of duration is to be attributed to the conditions of primitive life. In both groups, also, the cause of death is clear. It was due to violence—wounds inflicted by club and axe or spear as the case may be—whereas the members of the Pithecanthropus group died by accident as the consequence of a volcanic eruption.

Neither bones nor teeth show evidence of disease, while the repair of fractures and the ready formation of secondary dentine points to greater powers of recuperation than in modern man. Further, th absence of decay in the teeth suggests a resistance t bacterial infection which may account for the absenc of disease, with the doubtful exception of an arthriti affection in the vertebræ of the old man of the Uppe Cave. In undomesticated animals a natural power o resistance to disease and influences of a detrimenta character destroying the efficiency of the organ apparently compensates for the dangers of attack and extermination by their enemies, and the same may hold good of primitive man.

---

[1] Teilhard de Chardin, P., "The Post-Villafranchian Interval in North China", *Bull. Geol. Survey, China*, 17, 1 (1937).

[2] Weidenreich, Franz, "Tatsachen und Probleme der Menschheitsentwicklung", *Bio-Morphosis*, 1, 1 (1938).

[3] Weidenreich, Franz, "The Forerunner of Sinanthropus Pekinensis", *Bull. Geol. Soc. China*, 17, 2 (1937).

[4] Weidenreich, Franz, "The Duration of Life of Fossil Man in China and the Pathological Lesions found in his Skeleton", *Chinese Medical J.*, 55 (1939).

EIGHTH AMERICAN SCIENTIFIC CONGRESS

THE Eighth American Scientific Congress will be held in Washington, D.C., during May 10–18, 1940, under the auspices of the Government of the United States of America. Invitations on behalf of the President have been extended to the Governments of the American republics members of the Pan American Union to participate in the meeting, and scientific institutions and organizations are being invited to send representatives.

On April 14, 1940, the Pan American Union will celebrate its fiftieth anniversary. Although the Eighth American Scientific Congress will meet a few weeks after the anniversary date, the Congress will be one of the important phases of that celebration. It is hoped that the presence in Washington of many distinguished scientific workers of all of the American republics as participants in this Congress will serve as one of the many tributes to the Pan American Union for its work in the fostering of goodwill and better understanding among the republics of the western hemisphere.

This series of inter-American meetings, serving as a medium for the exchange of scientific information of particular interest and importance to the Governments and peoples of the Americas, dates from the first Latin American Scientific Congress held at Buenos Aires in April 1898 in commemoration of the silver jubilee of the Argentine Scientific Congress. The Second Latin American Scientific Congress was held at Montevideo in 1901 and the Third at Rio de Janeiro in 1905.

In 1908 the Government of Chile, which had offered to act as host to the Fourth Latin American Scientific Congress, enlarged the scope of the meeting and invited the Government of the United States of America to participate. At the same time, the name of the meeting was changed to the First Pan American Scientific Congress.

The Second Pan American Scientific Congress was in session in Washington, D.C., during December 27, 1915–January 8, 1916, and inspired a wide interest on the part of the Governments and scientific workers of the other American republics. A total of 2,566 participated in the sessions, including ninety official delegates of twenty Governments and a hundred and thirty representatives of scientific organizations and institutions in the other American republics.

The Third Pan American Scientific Congress was held at Lima, Peru, in December 1924 and January 1925. The fourth meeting in this second series of scientific congresses was held in Mexico City in September 1935, and in recognition of the continuity of the preceding conferences was designated as the Seventh American Scientific Congress. A resolution adopted at the Seventh Congress reposed in the governing board of the Pan American Union the responsibility for the selection of the date and place of the next meeting. In due course it was decided that the necessary steps would be taken to arrange for the convening of the Eighth Congress in Washington in connexion with the celebration of the fiftieth anniversary of the founding of the Union.

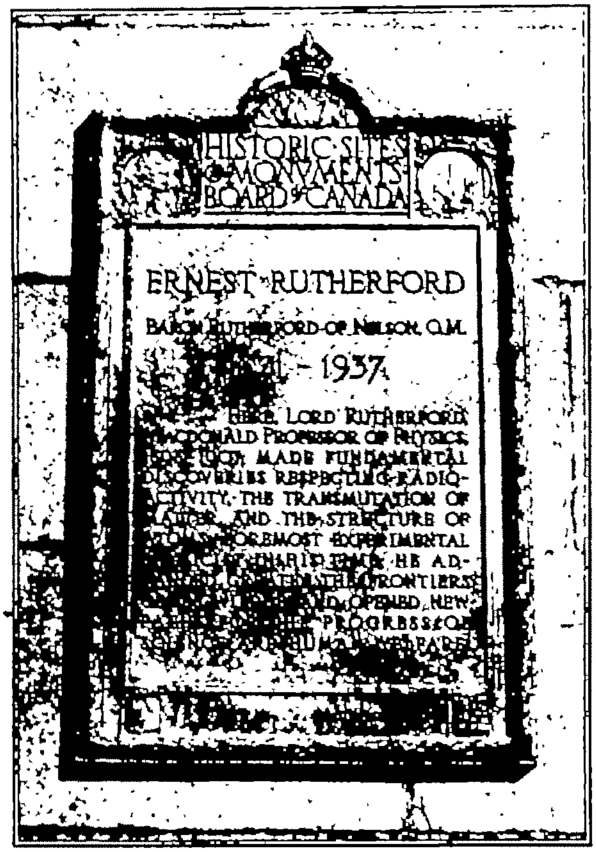
An organizing committee has been set up including the Hon. Sumner Welles, Under Secretary of State (*chairman*), Dr. Warren Kelchner, acting chief, Division of International Conferences, Department of State (*vice-chairman*), and Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution (*secretary*), to collaborate with the Department of State in formulating definite plans for the Congress. Dr. Wetmore has been appointed also as Secretary General of the Congress.

It has been decided that the Congress will be divided into the following sections, each to be in charge of a chairman, assisted by a vice-chairman, secretary and section committee: I, Anthropological Sciences; II, Biological Sciences; III, Geological Sciences; IV, Agriculture and Conservation; V, Public Health and Medicine; VI, Physical and Chemical Sciences; VII, Statistics; VIII, History and Geography; IX, International Law. Public Law and Jurisprudence; X, Economics and Sociology; XI, Education.

In accordance with established precedent at inter-American conferences, the official languages of the Congress will be English, Spanish, Portuguese and French. Papers may be submitted in any one of the official languages and appropriate arrangements will be made for the presentation of these papers, or résumés thereof, in the other official languages of the Congress.

MEMORIAL TABLET TO LORD RUTHERFORD AT McGILL UNIVERSITY

THE Historic Sites and Monuments Board of Canada recently presented to McGill University a memorial tablet in honour of Lord Rutherford and the work he did while in Montreal. This tablet is now placed on the outside wall of the Macdonald Physics Laboratory, McGill University. As many of the plaques and tablets prepared by the Monuments Board commemorate historic events such as battles, it is gratifying that there should be national recognition of scientific activities which, although they transcend in importance historical incidents of conflict, are so often neglected in the public recognition of important persons and events.


HISTORIC SITES & MONUMENTS BOARD OF CANADA
ERNEST RUTHERFORD
BARON RUTHERFORD OF NELSON, O.M.
1937
LORD RUTHERFORD
MACDONALD PROFESSOR OF PHYSICS
MADE FUNDAMENTAL
DISCOVERIES RESPECTING RADIO-
ACTIVITY, THE TRANSMUTATION OF
MATTER AND THE STRUCTURE OF
FOREMOST EXPERIMENTAL
HE AD-
FRONTIERS
OPENED NEW
PROGRESS

Tablet in commemoration of Lord Rutherford, recently presented to McGill University by the Historic Sites and Monuments Board of Canada.

A short unveiling ceremony was held in the Physics Laboratory at McGill on October 6, immediately preceding the Autumn Convocation for the granting of degrees. About a hundred persons attended the ceremony, including many old pupils and colleagues of Lord Rutherford. Sir Edward Beatty, chancellor of McGill University, presided, and a number of visitors from other universities and institutions were present. For the unveiling ceremony, the tablet was placed in the large lecture theatre of the laboratory, and surrounded by an exhibition of the apparatus used by Lord Rutherford during his nine years at McGill University, when he elucidated the phenomenon of radioactivity, and laid the foundations of much of his subsequent work. This apparatus has been admirably catalogued and described by Dr. F. R. Terroux (*Transactions of the Royal Society of Canada*, 32, Sec. III 9-16; 1938), who acts as custodian of the collection.

The ceremony was opened by Sir Edward Beatty with a tribute to Lord Rutherford, and a statement about the tablet and its formal acceptance with the gratitude of the University for this recognition. Prof. A. Norman Shaw, director of the Laboratory, referred to "the depth of feeling and the warm affection with which Rutherford is regarded in this Laboratory . . . our scientific ideals, our long and continued output of research, and the irrepressible urge to better our own limited efforts, are derived in large measure—and will continue to be derived—from the undying influence of Rutherford within these walls. It was in this very room he first announced some of the greatest of his discoveries and revealed his uncanny instinct for the next best step. Here are some of his famous pieces of apparatus which reveal the ingenuity and simple directness of much of his early work".

The Honourable Justice E. Fabre Surveyer, who is professor of civil law in McGill University, performed the unveiling ceremony, acting on behalf of the Historic Sites and Monuments Board of Canada. He said: "The Historic Sites and Monuments Board of Canada received with enthusiasm the suggestion made to it by a citizen of Montreal, Mr. Arthur J. Livinson, to commemorate by a tablet the important services rendered to science by the late Lord Rutherford. The members of the Board only divided on two questions: the site of the tablet and the date of its inauguration. Some were of opinion that the most suitable place was the house Lord Rutherford lived in while in Montreal, which, by the way, is for sale, and should, in my opinion, be secured by a friend of the University and turned into rooms for students or bachelor professors. Some also thought it advisable to postpone the inauguration so as not to affect too seriously our budget for 1939–40. Neither of these suggestions appealed to me." Eventually it was decided to place the tablet in the wall of the laboratory where Rutherford worked.

At the conclusion of the ceremony the guests remained for an informal inspection of Rutherford's apparatus, some of the essential features of which were explained by Dr. F. R. Terroux to the audience.

SCIENCE NEWS A CENTURY AGO

Davies Gilbert, F.R.S., 1769–1839

ON December 24, 1839, Davies Gilbert, president of the Royal Society from November 6, 1827 to November 30, 1830, died at Eastbourne at the age of seventy-two. Gilbert was born on March 6, 1769, at Tredrea, in the parish of St. Erth, Cornwall, his father being the Rev. Edward Giddy, curate of that place, who had married an heiress of considerable property. Educated at first by his father, he afterwards attended schools at Penzance and Bristol and in 1785 became a gentleman-commoner of Pembroke College, Oxford. He had already devoted much study to the physical sciences, and he became known as "the Cornish philosopher". In 1791, at the early age of twenty-four, he was elected F.R.S. Being free to follow his own inclinations, he left Oxford in 1793 and returned to Cornwall, acting as sheriff, dividing his time between his magisterial duties and the cultivation of science and literature, and was the friend and correspondent of Beddoes, Davy, Hitchins, Hellins, Trevithick and Hornblower. In 1804, a new sphere of activities opened for him by his election as M.P. for Helston. Two years later he was elected to represent Bodmin and he continued to sit for that borough until December 1832. "He was," says Wild, "emphatically the representative of scientific interests in the House of Commons, and contributed by his exertions to carry many very important objects. Indeed, he was continually called on to serve on committees of inquiry touching scientific and financial questions." In 1808 he married Mary Ann Gilbert, only niece of Charles Gilbert of Eastbourne and then assumed the name and arms of Gilbert.

Gilbert had a wide range of interests. He contributed papers to the *Philosophical Transactions*, and the *Quarterly Journal of Science and Arts*, was a collector of traditions, songs and carols of Cornwall, and in 1838 published "The Parochial History of Cornwall". From 1814 until his death he was president of the Royal Geological Society of Cornwall. He calculated for Telford the lengths of the chains for the Menai Straits Suspension Bridge, selected Brunel's design for the Clifton Suspension Bridge, suggested the founding of an observatory at the Cape of Good Hope, was chairman of the committee for rebuilding London Bridge, and was an advocate for the construction of Plymouth Breakwater.

J. D. Forbes, Baden Powell and Melloni

WRITING from Edinburgh on December 27, 1839, to Prof. Baden Powell, J. D. Forbes said: "I own that I should be very glad to see a good synopsis of what has been done during the last eight years, well aware that, so far as my own contributions are concerned, they were published in a form repulsive to the generality of readers, and even to many men of science who would willingly glean from your critical pages how much has been established, and on what kind of evidence, without troubling themselves about details. . . .

"I hope that you will not treat Melloni's papers so slightly as you propose. His earlier ones are full of interesting and original experiments. So far as I am concerned, I have nothing to wish but that everything Melloni has done should be fully and accurately known, for by a rare good fortune there is not a single debate in point of priority between us, and every experiment we have in common, with a single exception—the variable polarizability—cor firms each other's results. It is for you as a criti to judge how far, if in any case my right conclusion were founded on false grounds, for this is the sur of Melloni's captious criticisms."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on before the dates mentioned

ASSISTANT LECTURERS IN AGRICULTURE at the Essex Institute Agriculture, Writtle—The Clerk to the Essex County Council, Count Hall, Chelmsford (December 30).

HEADMASTERSHIP OF THE HEREFORD CATHEDRAL GRAMMAR SCHOO—The Clerks to the Governors, A D Steel and Son, 30 Castle Stree Hereford (January 13).

LECTURER IN ENGINEERING—The Principal, Dudley and Staffordshire Technical College, The Broadway, Dudley.

SECTION ENGINEER for the Nigerian Government Railway—Th Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9071

ASSISTANT ENGINEER in the Chief Engineer's Department of th River Great Ouse Catchment Board—The Chief Engineer, River Gre Ouse Catchment Board, Brookland Avenue, Cambridge.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

National Physical Laboratory. Abstracts of Papers published in the Year 1938. Pp. iii+63. (London: H.M. Stationery Office. 1s. net. [2911

Other Countries

Memoirs of the India Meteorological Department. Vol. 26, Part 10: The General Circulation of the Atmosphere over India and its Neighbourhood. By K. R. Ramanathan and K. P. Ramakrishnan Pp. ii+189–246+74 plates. (Delhi Manager of Publications.) 10.8 rupees; 16s. 6d. [2211

Malnutrition in South Africa. By Dr. Ellen M. Radloff and Dr. T. W. B. Osborn. Pp. ii+34. (Johannesburg: Witwatersrand University Press.) 2s. [2311

Report of the Administration of the British East African Meteorological Service for the Year 1938. Pp. 52. (Nairobi: British East African Meteorological Service.) [2411

Cornell University: Agricultural Experiment Station. Bulletin 716: Relation of Market Quality to the Price Received for Long Island Cauliflower. By John D. Hartman. Pp. 36. Bulletin 717, Apple Orchards; Cost of Developing, Values and Financial Returns. By G. P. Scoville. Pp. 44. Bulletin 718: Downy Mildew of Spinach and its Control. By Mathias C. Richards. Pp. 30. Bulletin 719: Relation of Size of Cow to Production and Cost of Production of Milk on 94 Grade A Farms in the Tully-Homer Area. By E. G. Misner. Pp. 26. Bulletin 720: An Economic Study of Land Utilization in Chautauqua County, New York. By Alexander Joss. Pp. 52. Bulletin 721: An Economic Study of Fruit and Vegetable Wholesaling and Jobbing Firms in New York City. By T. N. Hearreald. Pp. 68. Bulletin 722: Soybeans as a Source of Fat in the Dairy Ration By L. A. Maynard, Karl E. Gardner and Adrian Hodson. Pp. 30. Memoir 225: The Culinary Quality of Apples as determined by the use of New York State Varieties. By Marion C. Pfund. Pp. 74. Memoir 226: Some Comparisons between Analyses of Narrative and Film Records of Behavior and Guidance of Children. By Ethel B. Waring, Frances Markey Dwyer and Elsie Junkin. Pp. 50. (Ithaca, N.Y.: Cornell University.) [2711

The Grasslands of the Falkland Islands. By William Davies. Pp. x+86+18 plates. (Stanley: Government Printer; London: Crown Agents for the Colonies.) 5s. [2711

Mitteilungen der Sternwarte Budapest-Svábhegy. Nr. 8: Untersuchungen über die Perioden- und Lichtkurvenänderungen von Kurzperiodischen δ Cephei Sternen, 2, Ar Herculis. Von Julia Balázs und L. Detre. Pp. 49. (Budapest: Sternwarte Budapest-Svábhegy.) [2711

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 26, Memoir No. 1: The Fossil Bovidae of India. By Dr. Guy E. Pilgrim. Pp. viii+356+8 plates. 15.4 rupees; 23s. 6d. Palaeontologia Indica, New Series, Vol. 28, Memoir No. 1: Fossil Fauna from the Tertiary of Garo Hills, Assam. By P. N. Mukerjee. Pp. viii+104+3 plates. 4.14 rupees; 7s. 9d. (Calcutta: Geological Survey of India.) [2911

Catalogues, etc.

Phytoferol: a Standardised Solution of Vitamin E. Pp. 14. (London: The British Drug Houses, Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 3, No. 22, September 1939. Pp. 65–78+iv. (London: Wild-Barfield Electric Furnaces, Ltd.)

Old Science and Medicine. (Catalogue 53.) Pp. 48. (London: E. P. Goldschmidt and Co., Ltd.)

Calendar for 1940. (London: Evershed and Vignoles, Ltd.)

Calendar for 1940. (Newcastle-on-Tyne: C. A. Parsons and Co., Ltd.)

Editorial & Publishing Offices:
Macmillan & Co., Ltd.
St. Martin's Street
London, W.C.2

Telegraphic Address:
Phusis, Lesquare, London

Telephone Number:
Whitehall 8831

Vol. 144 SATURDAY, DECEMBER 30, 1939 No. 3661

SPECIALISM, DEPARTMENTALISM AND PUBLIC SERVICE

IT has long been an argument against the admission of the scientific worker to adminisrative responsibility that the specialist is too mmersed in his own particular subject to be capable of taking the wide and detached views involved in administrative decisions, and that he does not possess either the wider vision or sense of values required. Even in scientific work excessive specialization is to-day an admitted evil, and the eam work necessary in the attack on many modern problems, whether in pure or in applied cience, is already tending to break down such solation and stimulate contacts between workers in different fields, to their mutual advantage.

While, however, this charge is still freely levied against the technical or scientific expert, it is trange that the analogy of this tendency with what may be termed 'departmentalism' is usually overlooked. The departmental mind, which limits its ange to the efficiency or welfare of one particular department without regard to the efficiency of the whole, is one of the commonest causes of weakness in industrial firms and one of the greatest obstacles o the introduction of new ideas and new methods. Nor is the trouble confined to industry. How erious it can be in great Departments of State is well shown by Sir Arthur Salter in one of the most suggestive passages in his recent book, "Security: Can We Retrieve It?" Even the most efficient department tends to be innately onservative and unresponsive or unreceptive to new ideas, which are rarely fostered in accordance with their deserts, either in regard to staff or o finance.

This tendency is all the stronger if the specialized character of the department takes on the professional type and is reinforced by the characteristic conservatism of the professions. Only a detached administrator, possessing both knowledge, vision and judgment, as well as the requisite authority, can hope to override such professional departmentalism and prevent the prestige and ideas inherited from the past from blocking the effective development of new ideas. Nor is this indeed purely a technical or professional question. As Sir Arthur Salter points out in a further illuminating chapter on the personal equation, even in the administrator there is a grave tendency to adopt a purely defensive attitude, and to be occupied solely with the immediate need.

The question of executive administration and leadership to-day is indeed only partly a question of securing the effective utilization of technical knowledge. It is at least as much a question of finding and training men free from the departmental mind and outlook, who, while imbued with all the highest ideals of professionalism in respect of service and competency, are willing to accept responsibility, to face new issues frankly, to explore new methods, to accept criticism and to try bold measures when required. This is true of leadership and administrators alike in national affairs as in local government.

It is to the question of national leadership that Sir Arthur Salter directs attention; but the question of local government has been raised from this point of view almost simultaneously in an admirable broadsheet, "The Mechanism of Local Government", issued by P E P (Political and Economic Planning) and by G. M. Harris in his study of the practice of local government in ten of the largest British centres ("Municipal Self-Government in Britain", by G. M. Harris. P. S. King and Sons). These two publications set forth very clearly the problems and issues involved both in the complexities of local government and the provision of councillors and officers of the requisite calibre for their service.

In local government, as in national government, there are three basic problems: the efficient development of each particular service; smooth co-ordination of different services to ensure the reconciliation of conflicting claims within each area; and the education of the citizen to create and maintain a vital and healthy community life, through both official and unofficial channels. The stress which in recent years has been laid on the efficient development of particular services has already shown that the attainment of a certain level of efficiency by arbitrary or bureaucratic methods may obstruct rather than help the general raising of standards. It may stifle personal initiative and judgment and encourage attitudes incompatible with the spread of a sense of responsibility. Local and sectional efficiency threaten at times to strengthen departmentalism and thus to hinder the development of the community as a whole.

This factor, as well as the growing complexity of central and local government, calls for councillors and administrators of the highest intellectual capacity, and above all of the constructive type who see possibilities and opportunities rather than difficulties and dangers, and who possess creative ability and the capacity to promote energetic and far-reaching projects. Technical factors in possibly half a dozen or more fields have to be assessed, and the indirect as well as the direct effects of the proposed action or policy have to be considered. Even if the administrator himself possesses the high capacity and foresight to determine the policy which will give the maximum social result or efficiency, he may still have to convince a council or cabinet of the soundness of his judgment and proposal.

Mr. Harris's inquiry into local government provides disturbing evidence that we are not getting men and women of the requisite intellectual calibre on our local or municipal councils. The increasing demands of time alone in such service deter many of the ablest industrial leaders from taking office, apart from their frequent reluctance to engage in the small politics of local elections. An analysis of the occupation of councillors will readily demonstrate the reluctance of professional men to take up such work, and the absence of int lectual leadership is accentuated by the delibera or indirect discouragement from engaging in lo or national politics given by many large organi tions to their employees.

The position is in fact equally serious fr the point of view of elected representatives a permanent staff. The large problem now confro ing us is that of achieving further co-ordinati between the efforts of public services in differe areas and between the effort of all the differe services operating within the same area. Su co-ordination raises many issues. Even from purely technical or business angle, a high order administrative capacity and advanced techniqu are required to determine the most efficient uni and areas of operation of many different servic and for keeping their development in step accor ing to a balanced programme to be realized ov a long period of years. Even when coupled wi dictatorial powers, such a task could not be pe formed satisfactorily without a clear grasp principle, knowledge of the essential potentialiti and limitations of different services, foresight a flexibility of outlook, and a keen eye for loc conditions.

What complicates the situation is, of cours the fact that the representative bodies which co trol the administrative officers are at the san time expected to serve as a large-scale experime in adult education. However firmly convinced w may be of the value of this system of responsible sel government, we cannot in the face of the deman and dangers of to-day ignore its weaknesses exposed in practice. Ways and means must b found of delegating the discussion of administrati detail on purely technical matters on which expe advice is available, and ensuring that long-ter issues and broad questions of principle recei adequate attention from the representative bodie This means that, on one hand, some attem must be made to give the average citizen son fuller insight into the functioning of democrat methods, their method of use and appropria fields of application, and on the other hand ensure that the recruitment of staff by loc authorities is not limited by local resources bu secures the ablest and most promising tale available.

Considerations of this kind of themselves ma determine the size of areas of local governmen If the unit of administration is too small poverty-stricken, it may be impossible to staff with administrators and experts who are really competent to advise the local councillors. The methods of recruiting the most efficient staff and particularly the senior administrative officers become all the more important if they are to co-ordinate a number of large departments. Even if the size of an area is satisfactory and the authority has able officials and far-sighted councillors, efficiency will not be attained if the local government machine is faulty. Apart from the difficulties which inevitably arise in the co-ordination of departments, the traditional system of committee rule has aggravated the situation, and without a delicate adjustment of the machinery and co-ordination of committees, departmentalism may be further encouraged.

While, however, as the P E P broadsheet points out, the present internal machinery of local government can be criticized from the point of view of its ability to secure the working of a consistent long-term policy applicable to all spheres of the work of a council, this does not imply that the committee system is a failure. A committee may be efficient as a representative body, bringing with it local acceptance, or as an executive body carrying out or directing the administration, or more rarely as both. The danger is that in seeking to combine the two we fashion an instrument efficient for neither purpose. Unless clear thinking and vigorous leadership can secure the integration of objectives throughout local services, a co-ordinating body may in practice prove no more than another committee in a committee-ridden world.

It should, of course, be remembered that already regional developments in such fields as national defence, transport, power supply or the water catchment areas are beginning to modify both the sphere and character of local government. Some of the new bodies are appointed, not elected. While this may make for efficiency on the part of the full-time officers and draw into public service a considerable body of qualified people who would not stand for public election, these developments raise questions of some importance, whether from the point of view of efficiency or of self-government. The overlapping of functions of local authorities and independently appointed *ad hoc* bodies merits close consideration in the light of scientific management, as well for national as for local welfare.

The dangers of the present situation are indicated both by the P E P broadsheet and by Mr. Harris's book, and there can be no doubt as to the urgency of the problem. While the complexity of the problems of government increase, plans for improving its efficiency in a democratic society are much slower to develop. One factor in this is obviously the necessity for the education of public opinion as to the imperativeness of reform. Only under the pressure of enlightened public opinion can we hope to remedy effectively some of the weaknesses in our present system and stimulate the best brains and ablest administrators to take their place in the local and national council chambers. Much the same stimulus will be required to implement proposals already detailed for the more efficient utilization of the university graduate in local government, and for improved methods of recruiting and promoting staff. It is only simultaneously with the improvement in the recruitment of the permanent staff and the attraction of the best brains of the community to the council chamber that we can hope for the vision and leadership which will promote the constructive integration of services and administration so seriously needed. Meanwhile there is a wide field open for investigation into the size of administrative units, the comparative merits and value of different methods or techniques for their administration, apart from the exploration of such ideas as the staff college in reference to training and selection for the higher administrative posts in the permanent staff of industrial or local government or the civil service, and the much more difficult question of personal competence or qualification for executive responsibility in positions at present filled primarily on grounds of election and influence. Moreover, as the self-interest or profit motive in large-scale industry is replaced by a basis of service and team work, the problem of industrial management and leadership becomes closely allied to that of leadership and administration in public affairs. Here at least is an opportunity which should not be neglected by scientific workers any more than the responsibilities which they must accept as citizens for participating in the educational work required and in contributing their own share of service in the work of local and national government. Only as such opportunities are voluntarily seized can we expect that the services of the scientific or technical expert will be more wisely and effectively used, and the scientific administrator take the place in government which his administrative abilities as well as his scientific outlook both merit and demand.

JAMES GREGORY (1638-1675)

James Gregory Tercentenary Memorial Volume Containing his Correspondence with John Collins and his hitherto Unpublished Mathematical Manuscripts, together with Addresses and Essays communicated to the Royal Society of Edinburgh, July 4, 1938. Edited by Prof. Herbert Western Turnbull. (Published for the Royal Society of Edinburgh.) Pp. xii + 524 + 5 plates. (London: G. Bell and Sons, Ltd., 1939.) 25s. net.

THAT James Gregory was an outstanding figure in the scientific world of the seventeenth century must be generally known. The Gregorian telescope and Gregory's series are familiar evidence that he was an exceptionally gifted man. It is also known that his name, the Anglicized form of Macgregor, is that of a family distinguished in academic circles in no ordinary degree. Perhaps that celebrity owes something to the powder, wholesome but nauseous, prescribed by the great-grandson of James. At the same time it is probably less well known that in a space of two centuries this family produced a round score of men who rose to professorial or equivalent rank. But of James himself even the few who had studied his published works could have gained only an imperfect estimate. For a more adequate view it will be necessary to consult this admirable volume produced under the editorship of Prof. Turnbull for the Royal Society of Edinburgh.

The largest section of the book contains the correspondence. Of the 111 documents now printed the chief source is a collection of 57 letters at St. Andrews. These include fifty letters from Collins to Gregory. The letters from Gregory to Collins are partly reprinted from Rigaud's "Correspondence of Scientific Men" (being now inaccessible otherwise) and partly from Royal Society MSS. The other documents, less than thirty, are drawn from various sources and involve other writers. No correspondence passing directly between Gregory and Newton has been included.

Gregory's life was unhappily short. After publishing his early work, the "Optica Promota", he travelled on the Continent as far as Rome during the years 1664–1668. The greater part of the time was spent at Padua, where he imbibed the ideas of Cavalieri (d. 1647) and published two of his works, the "Vera Quadratura" and the "Geometriae Pars Universalis". The "Exercitationes Geometricae" is a short and remarkable tract published in London during the winter after his return. In the meantime, in the autumn of 1668, Gregory had been appointed to the professorship of mathematics newly founded by Charles II at St. Andrews. The last year of his life he spent as the first occupant of a similar chair at Edinburgh.

It was in 1663 and in London that Gregory became acquainted with Collins. John Collins was a remarkable man, with a gift for correspondence which has made him a pivot in the scientific history of the seventeenth century. He is described as an accountant; but as he was generally employed in government service, he may be regarded like Pepys as an early type of civil servant. Like Pepys he, too, was drawn into the circle of the Royal Society. His own special interest lay in the theory of equations, but the problem of quadratures appealed to him in his professional capacity and he had a wide appreciation of all the mathematical developments and writers of his time. Gregory, on the other hand, was cut off from the outer world and intellectually isolated at St. Andrews. He therefore found in Collins an invaluable correspondent and agent.

Each letter is here followed by editorial notes which give a lucid and succinct explanation of the allusions. Letters and notes together afford a mine of information on the scientific events and personalities of the day. On the tercentenary of the first observation of a transit of Venus, references to Horrocks have a topical interest. His "Opera Posthuma" appeared about August 1672, and reached Gregory the following spring, bringing the acknowledgment: "I received these letters ye mention, as also that box, together with the things contained, and particularly Horrocii Posthuma, for which I must acknowledge myself exceedingly engaged to you. I have perused him, and am satisfied with him beyond measure. It was a great loss that he died so young, many naughty fellows live till eighty." A month later Newton closes a letter to the same intermediary Collins with the laconic sentence: "I must joyn with Mr. Gregory in admiring Mr. Horrox."

These characteristic appreciations are familiar to readers of Rigaud. What is new is the account of an incident which might have led to a rupture between Gregory and Collins, and did in fact lead the latter in his agitated apology to pen a sentence which has fair claims to be considered the longest in the English language. Gregory had produced a series solution of Kepler's equation and Collins had offered to have it printed at the end of the "Opera Posthuma". Gregory assented, but the addition was not made. Taxed with the omission, Collins explains very late in the day that "Hickman a Bookseller the undertaker broke" and the printer refused to throw good money after bad by making any addition. Prof. Turnbull blames Collins for not keeping Gregory informed of these circumstances. Possibly also Collins may have exceeded his authority in making the original suggestion, since Wallis, not Collins, was the editor of the work. In any case the piece had only a mathematical interest, and though it must be deplored that it was not published, a book consecrated to Horrocks was not the place for it.

But valuable and interesting as the correspondence will be found, illuminated as it is by editorial comments, the book owes its most important feature to another circumstance. Gregory was a careful man and he used the blank spaces of the letters he received to record his own mathematical notes. With patient industry and no little ingenuity Prof. Turnbull has reconstructed these notes, and the result reveals the remarkable progress made by Gregory in attacking the mathematical problems of his day. Though this work was, with slight exceptions, never published, it must be taken into account in arriving at any estimate of Gregory's powers.

The notes touch on a variety of subjects. Not the least interesting are those which deal with the theory of numbers and show that Gregory, like Wallis, had entered seriously into a field in which it has commonly been supposed that Fermat reigned supreme and alone. But in view of their date, it is naturally the notes which deal with the calculus which possess the most general interest.

Since the days of the "Commercium Epistolicum" the dispute over priority between Newton and Leibniz has lost its edge. If the question is asked: Who was the inventor of the calculus, the preliminary question arises, what is meant by "the calculus"? If the answer is made to depend, as it reasonably can be, on the notation which is now associated with the operations of the calculus, the inventor was Leibniz, and about that there has never been any dispute. If the question refers to the general ideas and principles of the calculus, the invention can scarcely be attributed to one of two men, for it was the work of a generation of which the history has certainly not been fully explored yet. As to the subject, the problem of quadratures was old enough, and isolated solutions had been found as early as the Greeks. Similarly the calculation of rates of change (fluxions) could present no great difficulty when the need arose. Hence the critical step is to be seen in recognizing the inverse relation between these two processes. Now this relation was first pointed out, if in only a geometrical and limited form, by Gregory in his "Geometria pars universalis" (1668), two years before Barrow published the same result.

It is therefore of peculiar interest to follow the evolution of Gregory's ideas as Prof. Turnbull has reconstructed them. At the time, the knowledge of geometry was far in advance of what Gregory calls "analyticks" He himself was well equipped for the task of promoting this side of mathematics. In his "Vera Quadratura", where convergent sequences are explicitly introduced, he had shown an exceptional sense of the nature of infinite processes. The resulting conflict with Huygens was most unfortunate, for Huygens was essentially a fair-minded and generous man, as he showed afterwards when he recommended Gregory for a position in the Paris Academy. It was from the geometrical side that Gregory approached the subject, and indeed by calculating the subtangents of curves ($y. dx/dy$). Only later he recognized the primary significance of the derivative, and from this point he was quickly led to the process of successive differentiation. Armed with this weapon, he used his results to calculate power series and thus anticipated Taylor's theorem by nearly half a century. It has always seemed strange that this discovery was reserved for Brook Taylor; perhaps Colin Maclaurin appears a more natural heir to his own part of the legacy. But Prof. Turnbull has now shown that Gregory was in effective possession of the secret. By his failure to publish the method not only has Gregory lost his due recognition, but also, what is more important, the progress of mathematics must have been retarded at the time. As it is, while applications of the method by him have been established, there is no trace of a general proof. It is also to be noticed that there is no sign of any attempt to devise or employ an appropriate notation. Apparently Gregory felt no need for one. He was working for his own satisfaction.

Gregory's short life closed in 1675. The date and the shortness of the span combine to make what he accomplished remarkable. The more important formulæ of interpolation were his discovery. So was the general binomial theorem, under the guise of finding "the number of a logarithm". A set of excellent essays on the published works of Gregory completes the work, and suggests that a valuable source of information has been too little regarded. But the feature which distinguishes this from the generality of memorial volumes is the reconstruction of Gregory's fragmentary original notes. Under Prof. Turnbull's expert guidance it is possible to look over the mathematician's shoulder and see him actually at work. For this reason the book is not only a valuable contribution to the history of mathematics: those who are interested in the subject cannot fail to find it as fascinating as it is instructive.

H. C. PLUMMER.

CHEMISTRY OF THE ALKALI AND ALKALINE EARTH METALS

Gmelins Handbuch der anorganischen Chemie Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft.

(1) System-Nummer 22: Kalium. Lief 4: Verbindungen bis Kaliumacetat. Pp. 805–932+xxv. 15 gold marks.

(2) System-Nummer 22: Kalium. Lief 5: Verbindung bis Kalium und Wismut. Pp. 933–1074. 19.50 gold marks.

(3) System-Nummer 24: Rubidium. Pp. xviii+x+250. 31.50 gold marks.

(4) System-Nummer 25: Caesium. Lief. 1: Verkommen, Darstellung und Eigenschaften des Metalls. Pp. 104. 12 gold marks.

(5) System-Nummer 25: Caesium, mit einem Anhang über Ekacaesium. Lief. 2: Verbindungen des Caesiums, Ekacaesium. Pp. xx+105–268+ix. 21.75 gold marks.

(6) System-Nummer 27: Magnesium. Teil B, Lief. 1: Verbindungen bis Magnesium und Jod. Pp. vii+200. 23.25 gold marks.

(7) System-Nummer 27: Magnesium. Teil B, Lief. 2: Verbindungen bis Magnesiumcarbonat. Pp. 201–330. 15.75 gold marks.

(8) System-Nummer 27: Magnesium. Teil B, Lief. 3: Verbindungen bis Magnesium und Wismut. Pp. 331–422+xiv. 12 gold marks.

(Berlin: Verlag Chemie, G.m.b H., 1937–38.)

(1, 2) SECTIONS 4 and 5 of the volume on potassium of this great work deal with its compounds with boron, silicon, phosphorus, arsenic, antimony and bismuth. Three derivatives of the boranes have been identified, namely, $K_2B_2H_6$, $K_2B_4H_{10}$ and $K_2B_5H_9$, of which the first is the most stable. Stock and his collaborators have shown that although boroethane acts as a dibasic acid, it is also unsaturated, so that when potassium acts upon it the ionized hydrogen is not discharged but is used to saturate the boron complex, its charge being transferred to the metal: $H_2(BH_2:BH_2) + 2K = K_2(BH_3.BH_3)$. On hydrolysis of the product, a dihydroxydiborane $K_2[H_4B_2(OH)_2]$ is formed, which was formerly regarded as a hypoborate, KH_3BO. Further hydrolysis yields potassium metaborate. The existence of five anhydrous and three hydrated potassium borates is indicated on the phase-rule diagrams, but only one borofluoride is mentioned.

In dealing with the manufacture of potassium carbonate, although many different methods are given, chief stress is laid upon the Engel-Precht process from sylvine and magnesium carbonate and the electrolytic process. The manufacture of potassium cyanide is dealt with fully and some organic salts are also described. Varying results seem to have been obtained for the solubility of potassium bitartrate according to the method chosen.

The constitution of the metaphosphates of potassium is not yet completely established. Only polymeric forms appear to exist, namely, tri-, tetra- and hexametaphosphates. The hexametaphosphate is obtained as a hygroscopic mass by precipitating the lead salt and allowing it to react with potassium sulphate. On heating this to 660° C. the insoluble Kurrol salt is formed. There is also some uncertainty as to the actual constitution of the antimonate and of tartar emetic, for the latter of which three possible structures are suggested.

(3, 4) The heavy alkali metals rubidium and cæsium are both obtained from artificial carnallite, a by-product in the extraction of potassium from the mineral, which contains 0·02 per cent of rubidium chloride and only 0·0002 per cent of cæsium chloride. By the action of water much of the potassium chloride can be crystallized out, when both rubidium and cæsium may be precipitated from the concentrated mother-liquor as silicomolybdates. The molybdenum is then removed by volatilization as oxychloride in a current of hydrogen chloride. From an acid solution of the residue, potassium and rubidium free from cæsium can be precipitated as chlorides by addition of alcohol, and antimony chloride will precipitate cæsium antimony chloride free from the other alkali metals. The rubidium is freed from potassium by repetition of the silicomolybdate process. It is obtained pure by the electrolysis of the fused hydroxide. Iron wire surrounded by magnesite is used as cathode and two diaphragms are needed to protect the metal from anodic oxidation.

Cæsium is obtained chiefly from the mineral pollucite, a cæsium aluminium silicate found in the felspar quarries in the State of Maine, U.S.A. It can be obtained pure from its cyanide by electrolysis, and on account of its low melting point (28·6° C.) it can be filtered under petroleum. The metal is used in the construction of photo-cells and thermionic valves. Very thin layers of cæsium on a metallic surface give a much stronger photo-electric effect than compact layers, but the action is rather complex. Up to a certain minute thickness, while the cæsium is held solely in the form of *ions* on the surface it produces no selective effect, the photo-emission proceeding entirely from the under layer of metal. Beyond that point *atoms* of cæsium begin to be adsorbed which can themselves emit photo-electrons, but when the layer is about one atom in thickness reversal of the dipoles occurs with a consequent shift of the photo-chemical threshold towards shorter wavelengths.

Rubidium chloride and bromide become coloured under the influence of radium or X-rays, and rubidium tri-iodide, unlike potassium tri-iodide, can be obtained in the anhydrous form. The rubidium salts of the tartaric acids show reversal of sign in optical rotation for sodium light.

(5) Compounds of cæsium, though similar to those of other alkali metals, exhibit certain peculiarities. Thus we find no fewer than four sub-oxides in addition to the basic monoxide and the two peroxides, and although the fluoride crystallizes like sodium chloride and other alkaline halides in face-centred cubes, the chloride, bromide and iodide of cæsium assume the body-centred cubic lattice. Of the last three compounds the chloride alone is dimorphous, its crystal form changing at about 445° C. to the face-centred type. Again, various polyhalides such as $CsBr_3$, CsI_3, CsIBrCl, etc., have been isolated in stable unsolvated form. The cæsium analogue of tartaremetic has been prepared and like the latter is now formulated as a co-ordinated aquo-salt $Cs[Sb(C_4H_2O_6).H_2O].\frac{1}{2}H_2O$.

Many attempts have been made to isolate element No. 87, Mendeléeff's eka-cæsium, but so far the evidence of its existence rests on a somewhat slender basis. If the element exists at all, it appears to be extraordinarily scarce. In 1929 Papish and Wainer obtained several alums from the alkalis extracted from samarskite, a mineral rich in uranium, and after repeated recrystallizations the fraction richest in cæsium and poorest in potassium was found to give five of the X-ray spectral lines calculated for eka-cæsium by Moseley's rule. Examination by the mass-spectrograph of this alum indicated the existence of ions of mass 220 ± 1 at 600–700° C., but their intensity was about 10^{-4} of that of the cæsium ions.

(6, 7) Compounds of magnesium with most of the non-metals are described in Parts B 1 and 2. At present only spectrographic evidence is available of the existence of a hydride. The oxide is very stable and is not reduced by hydrogen at 2,500° C. under a pressure of 150 atmospheres. The dioxide has not been obtained in the pure state, but by the action of hydrogen peroxide on salts a product rich in oxygen has been obtained which gives a stable compound, $MgO_2.3MgO.Aq$, on exposure to air. In addition to the well-known nitride, magnesium yields an explosive azide MgN_6, a diamide, a hexammine and many co-ordination compounds with organic bases.

The hydrolysis of magnesium chloride by water vapour occurs in two stages, the formation of basic salt being exothermic, whereas above 505° C. an endothermic decomposition to oxide occurs. On the other hand, the salt is not hydrolysed by liquid water even under pressure, although the solution has a strong corrosive action on metals and alloys. At room temperature, pyrites is oxidized in presence of a solution of magnesium chloride to ferrous sulphate and sulphuric acid. Magnesium chlorate and its tri-hydrate are very powerful dehydrating agents, the anhydrous salt being twice as effective as the hydrate. Both can be used with advantage for drying gases; and since they are neutral in reaction, have a greater capacity for absorbing water than phosphoric anhydride, do not become pasty on exposure to air and can be regenerated after use, they may be regarded as superior to other dehydrating agents. The tri-hydrate can absorb about 20 per cent of its weight of water to form the hexahydrate. As it yields a hexammine, it is not suitable for drying ammonia.

Magnesium sulphide can be obtained in an exceptionally pure state by the action of carbon disulphide on magnesium sulphate in a current of nitrogen at 700–900° C. It is not luminescent unless it contains traces of other metals with smaller atomic diameters than magnesium. The colour of the phosphorescence depends on the foreign metal.

Several hydrates of the sulphate are known; the anhydrous salt is not obtainable from a solution in water, but can be prepared by careful dehydration of the heptahydrate, although hydrolysis is apt to occur during the process. The dehydration of magnesium carbonate tri-hydrate is generally accompanied by loss of carbon dioxide unless the experiment is carried out in a closed vessel, when the basic salt which is first formed slowly reabsorbs the gas to form the anhydrous salt. The precipitation of *magnesia alba* is a rather complex process. When the proportion of sodium carbonate to magnesium sulphate in solution is insufficient to cause precipitation, magnesium carbonate trihydrate can be crystallized out, whereas excess of the alkali will precipitate a basic salt. A table is given showing the composition of the mother-liquor resulting under various conditions.

(8) In this part will be found accounts of salts of magnesium with a few of the commoner organic acids, together with compounds containing silicon, phosphorus, arsenic, antimony and bismuth.

Naturally occurring silicates of the metal are dealt with elsewhere, although the phase-rule diagram of the system MgO : SiO_2 is given and also full details of the physical properties of the anhydrous orthosilicate and the varieties of metasilicate, namely, clino-enstatite, enstatite, and the monoclinic and rhombic amphiboles. The phosphates present some rather formidable structural problems on account of their number and variety.

It would be interesting to discover the orientation of the stable salt $Mg_3(PO_4)_2.22H_2O$, which Bassett and Bedwell observed to change to the octahydrate, in presence of the mother-liquor, in the course o a few weeks. The work of these authorities on the glowing of orthophosphates and pyrophosphate might have been given in fuller detail, particularly their observations on the heat evolution on glowing and their co-ordination theory of the structura changes which accompany the glow. A structura formula has recently been assigned by Beintema from X-ray analysis to magnesium antimonate $MgO.Sb_2O_5.12H_2O$, in which six molecules of water are co-ordinated with the cation and six hydroxyl groups with each of two anions, thus : $[Mg(H_2O)_6]\,[Sb(OH)_6]_2$.

CLIMATE AND MAN

Klima, Wetter, Mensch

Von E. Brezina, W. Hellpach, R. Hesse, E. Martini, B. de Rudder, A. Schittenhelm, A. Seybold, L. Weickmann. Herausgegeben von Heinz Woltereck. Pp. viii + 446. (Leipzig : Quelle und Meyer, 1938.) 18 gold marks.

THE subject of this book is climate and weather as part of man's environment—*Lebensraum* in the literal sense—including not only the natural air of the free countryside, but also the modified air of great cities, houses, air-conditioned buildings and, on a still smaller scale, within clothing. These studies on the borderlands of meteorology and biology or medicine are highly specialized, and they are dealt with in a series of memoirs by different authorities. In the first and longest section, Prof. L. Weickmann sets out the fundamental basis, the elements of climate and weather. This is to some extent orthodox meteorology, but with a difference. It starts with a detailed account of solar radiations of all wave-lengths and their biological effects ; other climatic elements in turn are treated from the same point of view. 'Sensible' temperature and the cooling power of air are fully discussed, while for humidity the important quantity is taken as the physiological saturation deficit.

The processes of weather come next ; here the biological aspect is to some extent lost sight of, and the author is drawn aside into his favourite topic of rhythms in barometric pressure. This is followed by an account of seasonal and other long-period weather changes, and the section ends with a thorough and interesting account of the modern study of micro-climatology, the effect of small surface features—hills and valleys, streets, forests and growing crops. These minute studies have been pursued very thoroughly in Germany in recent years, and the book contains a great deal of information which is not otherwise readily available, as well as some striking illustrations.

In the rest of the book the emphasis is mainly on the biological aspect. B. de Rudder has an important memoir on the basis of human bioclimatics, divided into the influence of the separate climatic elements, of climate in general and of weather (meteorobiology). Solar radiation still holds pride of place, from such diverse aspects as rickets, sunburn, and the coincidence between outbreaks of cerebro-spinal meningitis and sunspot maxima. In questions of bioclimatics there are still plenty of unknown quantities. A. Schittenhelm deals with the curative factors of different types of climate, stressing the need for medical advice in selecting the correct treatment, for example, for nervous diseases. E. Martini describes the part played by climate in the causation of disease—a highly complex subject involving the life-history of the organisms responsible for epidemics such as malaria, which is treated at length. The remaining chapters, comparatively short, are : Man in an Artificial Climate (E. Brezina) ; Plants, Climate and Weather (A. Seybold) ; The Animal and the Climate (R. Hesse) ; and Culture and Climate, by W. Hellpach, a philosophical essay on 'culture', relating not only material civilization but also political development, religion and other spiritual values to the natural environment, of which climate is an important part.

The book is well printed, but in the Gothic type which he who runs (or travels by train) finds difficult to read. There are no exact references, merely citations of a few names ; there is no bibliography and no author index, so that it is very difficult to follow up or find the authority for any particular statement.

C. E. P. BROOKS

A SYNOPSIS OF GENETICS

An Introduction to Genetics
By Prof. A. H. Sturtevant and Prof. G. W. Beadle.
Pp. 391. (Philadelphia and London: W. B. Saunders Co., Ltd., 1939.) 14s. net.

THE increasing number of publications of recent years which deal with the subject of inheritance is testimony to the keen interest in the laws and principles of this science. Our knowledge of it increases daily through the research activities of universities, experiment stations and other institutions, and it is becoming exceedingly important now to disseminate this knowledge in order to make further progress possible. Genetics is taught in the universities of the United States as an important subject in biology, and in Great Britain, where the teaching of biology is still backward, genetics has been given the place of a Cinderella. A few years ago it was perhaps sufficient to acquaint the student only with Mendelian ratios; nowadays, however, the rapid advancement of genetical discoveries makes it necessary to study in greater detail the intricate mechanism by which characters are transmitted.

At present there are several introductory textbooks. All have some defects due chiefly to over-simplification, omissions, or lengthy discussions of insignificant details, which prevent these textbooks from satisfying in all respects the needs of teachers and students of genetics. The book under review is written by two well-known authors, and it is planned as an introduction to genetics for the use of students with an elementary knowledge of biology. The senior author is one of those pioneers who are responsible for the foundation of modern genetics; to him we owe much of our concept of the linear arrangement of genes in the chromosomes and the construction of the first chromosome map. Dr. Beadle's researches on maize genetics are widely recognized, and his recent contributions in collaboration with Dr. B. Ephrussi have opened up a new approach to the study of the developmental properties of the hereditary material. Obviously, a book written by such eminent authors should be judged by a high standard.

The order in which the material is presented is claimed to be a natural one and the reader will find the approach to genetics entirely novel. The opening chapter deals with the inheritance of sex, sex being the most widely spread and generally recognized discontinuous character and the mechanism underlying its inheritance the most simple and easily understandable. The other chapters follow in logical sequence, though it is difficult to explain why Chapter xv, inheritance in trisomics and tetrasomics, is separated from that on polyploidy (Chapter xix) by discussions on sex determination, population genetics and selection. An encyclopædic tendency is often revealed by bringing together apparently unrelated phenomena; for example, Chapter xvii, which deals with multiple genes, also includes a discussion on asexual reproduction and identical twins.

Throughout the book emphasis is laid on the mechanical aspect of heredity. Mendelian laws and probability expectations are presented in a way that will soon convince the student that genetics is a 'mathematically developed subject'. Nothing has been omitted which will help to elucidate to the student the method of character transmission. The authors direct special attention to crossing-over, a process responsible for new combinations of characters. It is the first textbook of genetics in which the consequences of crossing-over are presented correctly; crossing-over is described as an event which takes place during the meiotic prophase when the associated homologous chromosomes are in the four-strand stage, and its products are interpreted in this sense throughout the whole book. To illustrate the various characteristics of the process of crossing-over, the behaviour of attached-*X* chromosomes in Drosophila is presented at great length. One may wonder, however, why the authors failed to direct attention to the effects of age, sex and temperature upon crossing-over, since these are of practical importance. Teachers and students will regret that the various topics are discussed too briefly, for while in this way the student can get a clear idea of the principles involved, he will need a teacher's assistance to understand all the essentials. This difficulty will become obvious in working out the problems, for in many cases the student will not be able to solve these very interesting and instructive problems unless he makes use of the references quoted at the ends of the chapters.

The authors, wishing to appear impartial and objective, confine themselves to a strict presentation of facts. Certain data are recorded without any interpretations whereas others are completely omitted, presumably because the authors do not consider them proved experimentally. This alone is probably the reason for omitting an account of Haldane's interesting method and results relating to partial sex-linkage and the first chromosome map in man. No reference is made to Fisher's theory of dominance, which as a scientific thought is worthy of report. As an example of where caution can be excessive, we should like to direct attention to a statement (p. 301) that new shoots which develop from the callus tissue in decapitated tomato seedlings "for some unknown reason" are frequently tetraploid. It would appear entirely reasonable—and it is moreover supported by Mather's observation (*J. Genet.*, **27**, 127; 1933)—that somatic doubling of chromosomes may have resulted from failure of wall formation in the dividing cell, followed by a fusion of the two nuclei during the next resting stage or division. May not such extreme caution in avoiding references to plausible suggestions defeat the very purpose of the book, namely to stimulate thought and inspire inquiring reasoning in the student?

However, these few criticisms cannot belittle the great value of the book. The most striking impression which the reader gets is of the great wealth of information which has been condensed into the twenty-three chapters it contains. Much of this has been gained by the personal experience of the authors. Various genetical phenomena, especially those which have been experimentally tested, for example, homozygosis attached-*X* chromosomes, ring chromosomes. somatic crossing-over, preferential segregation and others too numerous to mention, which are either omitted or only briefly dealt with in other text-books, are here described and explained in detail. The diagrams are particularly excellent and instructive. It is evident that the authors' interests are centred in Drosophila and maize genetics, most of the examples given to illustrate the working mechanism of heredity being taken from these fields—perhaps more than are necessary. The novelty of presentation and inclusion of fresh material render this book a particularly important contribution to genetical literature, and its value will be fully appreciated only when it has been in use. The book is comprehensive, up-to-date and reliable, and the information which it contains is accurate—thus it can claim to be more than a text-book; it will be regarded by many a teacher and student as a veritable encyclopædia of genetics.

P. C. KOLLER.

RADIO-COMMUNICATION

(1) The Elements of Radio-Communication
By O. F. Brown and E. L. Gardiner. Second edition. Pp. viii + 551. (London: Oxford University Press, 1939.) 16*s*. net.

(2) Télégraphie et téléphonie sans fil
Par C. Gutton. (Collection Armand Colin: Section de physique, No. 6.) Neuvième édition entièrement refondue. Pp. 183. (Paris: Armand Colin, 1939.) 15 francs.

(3) The Radio Manual
For Radio Engineers, Inspectors, Students, Operators and Radio Fans. By George E. Sterling. Third edition. Pp. vi + 1120. (London: Chapman and Hall, Ltd., 1938.) 25*s*. net.

THE science and practice of radio-communication have, during recent years, advanced at such a rate that it is desirable that the books dealing with fundamental principles should be revised to keep abreast of the progress, and also that new books or monographs should deal in an up-to-date manner with the latest phases or applications of the subject.

(1) The first book under consideration here was produced by the first-named author about twelve years ago, and a second edition has now been prepared in co-operation with the second author. This work gives a comprehensive survey of the elementary principles underlying radio-communication and is suitable either for the general reader or for the student making an early acquaintance with the subject. Although it is almost entirely devoid of mathematics and formulæ, the treatment of the whole subject is on a very sound and easily understood basis. This second edition covers the whole subject from the generation and study of high-frequency oscillations to their application in the various forms of radio-communication, including telegraphy, telephony, broadcasting and television.

In covering this wide field, the authors have very wisely avoided giving any detailed attention to those specialized sections of the subject which are adequately treated in other works, to which the serious student may refer. They rightly suggest that this work forms a useful elementary text-book on the subject, and with the view of enhancing its utility in this respect, a number of questions have been appended to each chapter, the majority of these questions having been extracted from the examination papers of various technical institutions granting certificates to successful candidates.

The general production of the book is very good; misprints are rare, but it would have been an advantage if more of the chapters had been sectionalized and provided with sub-headings.

(2) Although the second book under notice is

described as the ninth edition, it is explained in the preface that the text has now practically been rewritten in order to produce a comprehensive survey of the principles of radio-communication in the light of modern knowledge and practice. The subject is treated in a general but not too elementary manner, it being assumed that the reader has some slight acquaintance with electrical circuits and alternating currents. The volume is of a very handy pocket size and should be appreciated by those who desire a general survey of the subject in the French language.

(3) The sub-title of the third book indicates the class of reader for whom it has been especially prepared, namely, those engaged in the production, operation, inspection or maintenance of radio-communication apparatus of all types. The first edition of the work was published in the United States some ten years ago, and it has undoubtedly been a success in its right sphere. The present edition of more than a thousand pages is a working manual of the practice of radio-communication on land, at sea, and in the air, with illustrated descriptions of the equipment used, and including detailed explanations of the general regulations and operating procedure appertaining thereto.

So far as the publication of the book in Great Britain is concerned, its usefulness is severely limited by the fact that the majority of the systems, apparatus and regulations described are representative of American practice, and so they are not of general direct interest to those engaged in radio-communication outside the United States.

R. L. S.-R.

STEAM DATA

(1) Abridged Callendar Steam Tables

By the late H. L. Callendar, revised by G. S. Callendar. Fourth edition. Centigrade Units. Pp. 8. 1*s*. net. Fahrenheit Units. Pp. 8. 1*s*. net. Charts for above. 18½ in. × 16 in. 6*d*. net each. (London: Edward Arnold and Co., 1939.)

(2) The 1939 Heat-Entropy Diagram for Steam Plotted from the 1939 Callendar Steam Tables

Based on Research by Prof. A. C. Egerton and G. S. Callendar. (Published for the British Electrical and Allied Industries Research Association.) 38½ in. × 33½ in. (London: Edward Arnold and Co., 1939.) 4*s*. net.

(1) IN association with the 1939 Callendar Steam Tables [Fahrenheit Units] there have also been published, in convenient octavo pamphlet form, two sets of Abridged Callendar Steam Tables. These, which are now in their fourth editions, are available both in centigrade units and in Fahrenheit units, and appropriate to each there has also been prepared a total heat-entropy chart, 15 in. × 18 in.

In these tables and charts a considerable amount of revision has been effected in order to bring the figures presented into accord with the results of recent work in this field of research. To meet also the extending needs of those concerned with the design, testing and operation of steam plants, the values have been carried on to a pressure of 3,000 pounds per square inch. Included are a number of equations for saturated steam and general equations for steady flow, so that for most general purposes these publications supply such information as will be required at very moderate cost—a consideration which should place them within the reach of students.

(2) Where, however, the nature of the work demands more extensive data and a chart of larger scale, the 1939 Heat-Entropy Diagram for Steam is now available. This is of large size, on a sheet 38½ in. × 33½ in., and has been plotted from the 1939 Callendar Steam Tables based on research by Prof. A. C. Egerton and Mr. G. S. Callendar, on behalf of the British Electrical and Allied Industries Research Association. It has been produced in three colours and, as a result, any one of its closely grouped series of lines can be followed with ease to the desired point or vice versa. The lattice on which the diagram is plotted and which represents co-ordinates of entropy and heat is shown in green, the scales being 1 cm. to 0·01Φ and 1 cm. to 10 B.Th.U. per pound. The pressure, temperature and dryness curves are in black, while those of volume and superheat appear in red. Recalling the trend of these several curves in this type of chart, it will readily be seen that the arrangement adopted is the most favourable to ease of interpretation.

The care which has been taken in plotting the vast number of values which have been necessary for the preparation of so extensive a diagram, and the remarkable accuracy with which it has been reproduced in three different colours, reflect the highest credit on those responsible for the original and on those also to whose technical skill its reproduction is due.

TISSUE RESPIRATION

By Prof. R. A. Peters, F.R.S.,

Department of Biochemistry, Oxford

A DISCUSSION on tissue respiration was organized for August 31 jointly between Sections B and I (Chemistry and Physiology) of the British Association at Dundee. Owing to the imminence of war several of the proposed speakers were unable to attend, namely, the organizer and opener Prof. R. A. Peters, Dr. Malcolm Dixon, Prof. H. Theorell, Dr. D. E. Green and Dr. T. Mann. Prof. D. Keilin also did not attend. Prof. H. S. Raper, who was intending in any event to give a contribution towards the end of the discussion, kindly offered to introduce the subject and ably substituted for the absent speakers, so that the comparatively large attendance was not in vain. In order to give a more comprehensive survey of the subject, it has been thought advisable to follow in this account the lines of the addresses as originally planned.

To make a coherent account of tissue respiration for the benefit of those unfamiliar with it, the subject was divided into the parts concerned with the organized tissue cell and those relating to the isolated tissue component. Starting with the present position of knowledge of the isolated components, the discussion worked through to the respiration of the more highly organized tissue slice, and ultimately to the chemical control of the whole system.

The address of the opener was intended to deal briefly with the historical background, pointing out that the subject had roots in the distant past, but had developed rapidly only in the most recent years. In a short time it was clearly impossible to do justice to the work of the pioneers; but the following must be especially mentioned: the importance of Wieland's theories of hydrogen activation, of Hopkins' isolation of glutathione, of Thunberg's methylene blue technique, of Keilin's cytochrome, and of the various contributions from Warburg and his co-workers and from the Stockholm school under von Euler. Much advance in knowledge had come from the use of the *in vitro* study; to allay any doubts as to the value of the isolated tissue preparation, it must be emphasized that in studies at Oxford there has been found to be a remarkable parallelism between the improvement of respiration in the avitaminous pigeon's brain by the addition of vitamin B_1 *in vitro*, and the similar action of the latter in curing symptoms of deficiency *in vivo*. Such studies form a valuable bridge for the interpretation of *in vivo* happenings by the use of *in vitro* preparations. Owing to the short time available, some important aspects of the subject had to be pruned, among them being glutathione, vitamin C, oxidation-reduction potential in relation to tissue respiration processes, adequate discussion of the Szent-Györgyi catalytic system of C_4 acids, also the plant oxidase reactions, which, though not strictly tissue respiration in the animal in this sense, have been so valuable a feature of contributions from the laboratory of Prof. Raper.

Dr. Malcolm Dixon's introductory address (Cambridge) dealt with the general subject "Catalysis in Respiration". Defining tissue respiration as the utilization of molecular oxygen for the oxidation of organic substances in tissues, Dr. Dixon stressed the fact that tissue respiration is essentially a problem of catalysis, and dealt with the questions: How do the catalysts work? What is their chemical nature? And how do they cooperate in respiration? Owing to recent work, the main features of this mechanism are now fairly clear. We have the two types of respiratory catalysts, the *activators* and the *carriers* respectively. "The *activators* are enzymes, very highly specific in many cases, which combine in a loose but highly specific way with their substrates, so that the combined substrate is reactive". The *carriers* work differently; though mostly not enzymes, they enable two compounds which we may designate AH_2 and B, incapable of reacting with one another directly, to react through their agency along the lines of equations 1 and 2:

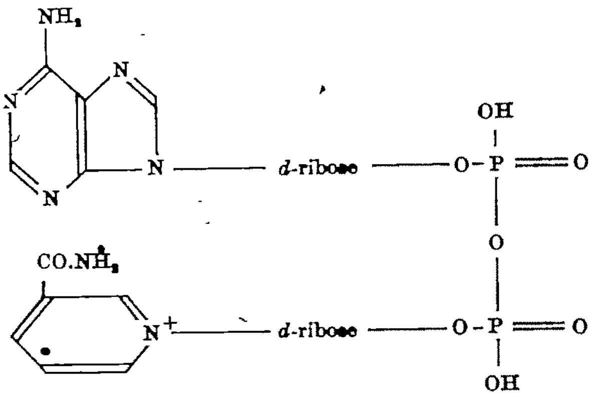
$$AH_2 + C = A + CH_2 \qquad (1)$$

$$CH_2 + B = C + BH_2, \qquad (2)$$

in which 2H is so transferred from A to B. Since the organic 'substrates of respiration' are oxidized in an ordered series of successive reactions (steps of 2H at a time), a large number of activating catalysts is involved; about twenty-five distinct dehydrogenases (enzymes concerned in H transfer) are known. There is the further complication that activated substrates require further carriers to bring them into relation with molecular oxygen. As an example,

$$\underset{\text{(Triosephosphate D)}}{\overset{(1)}{\text{Triosephosphate}}} \rightarrow \overset{(2)}{\text{CoZ}} \rightarrow \overset{(3)}{\text{FP}} \rightarrow \underset{\text{(Cytochrome oxidase)}}{\overset{(4)}{\text{Cytochrome}}} \rightarrow \overset{(5)}{O_2} \qquad (3)$$

FP = Flavoprotein D = dehydrogenase



COZYMASE

Fig. 1

In such a scheme H is transferred in the direction of the arrows. The carrier cozymase (CoZ) (Fig. 1) is very important. It is a compound of adenylic acid and nicotinic amide-ribose-phosphate, in which the essential group is the nicotinic amide; one double bond of this is capable of reversible reduction. The cozymase like the triosephosphate combines loosely with the dehydrogenase; the enzyme then catalyses the bimolecular reaction which results in the oxidation of the triosephosphate and reduction of the cozymase. The latter then combines loosely with the flavoprotein and becomes re-oxidized. In its turn the reduced flavoprotein reduces Keilin's cytochrome *C*, a specialized hæmochromogen, the latter being oxidized by oxygen in presence of the enzyme cytochrome oxidase. This means that the real function of respired oxygen is to keep the tissue cytochrome in an oxidized state; and that the oxidations of tissue constituents are really a succession of H transfers from them to the oxidized cytochrome, sometimes interpolated with reactions involving the addition of the elements of water.*

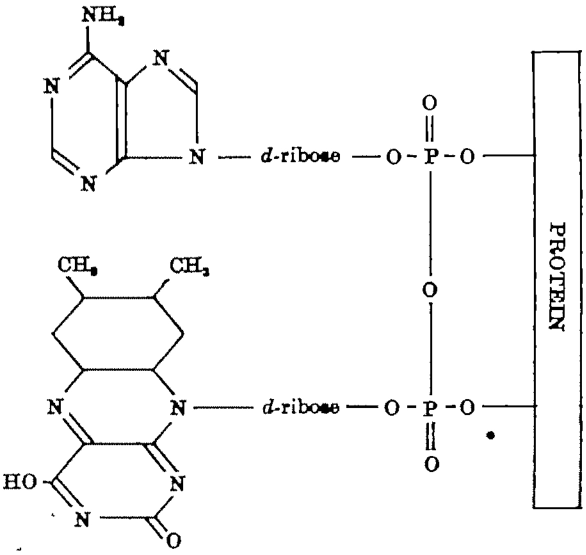
It is important to realize that these enzymes are quite general for both yeast and animal tissues. Parts 2, 3, 4 and 5 of equation 3 are common for the oxidation of many different substances; only the dehydrogenases are different; the reactions in which cozymase plays a part are reversible and in the absence of oxygen the dehydrogenase systems may react with one another through cozymase, producing fermentations. Dr. Dixon concluded by reference to known variations upon the main theme. In some cases there is a substitution of coenzyme · II (triphosphopyridine nucleotide) for cozymase; there exists a small group of dehydrogenases which react direct with cytochrome; Szent-Györgyi has produced evidence that in total respiration a definite part is played by the C_4 dicarboxylic acids (fumaric, etc.) which bring about the oxidation of reduced cozymase by cytochrome in an indirect way. Dixon further pointed out that most links in the chain can be represented artificially with other substitutes such as dyes. The use of methylene blue instead of molecular oxygen plus the cytochrome system is the basis of the well-known Thunberg method of investigating dehydrogenases.

Dr. Dixon's succinct but comprehensive paper was to be followed by Dr. Theorell (Sweden), dealing with the developments in our knowledge of the flavoproteins (Fig. 2). These are compounds of proteins with the component of the vitamin B_2 complex, which is known as riboflavin, di-methyl-alloxazine-ribose-phosphate. The old yellow ferment of Warburg and Christian, which was finally obtained in quite pure condition by Theorell himself, and which consisted only of riboflavin-protein, is probably an artefact. In its place now six new flavoproteins have been described. All of these have as their prosthetic group riboflavin and adenylic acid, called after Warburg alloxazine-adenine-dinucleotide; the protein component differs.

FLAVOPROTEINS

No.	Transfers H between		Workers	Source
1.	O_2; di-H_2-pyridine		Warburg and Christian	Yeast
2.	O_2; amino-acids	Krebs' *d*-amino-acid oxidase	Das, Straub, Warburg and Christian	Kidney
3.	Meth. blue; di-H_2-pyridine		Haas	Yeast
4.	O_2; xanthine	Xanthine oxidase	Ball, Green	Milk
5.	Cytochrome; di-H_2-pyridine		Corran and Green	Milk
6.	Cytochrome; di-H_2-pyridine	Diaphorase	Green, von Euler, Straub	Heart muscle

With the exception of No. 1, all have protein



FLAVOPROTEIN (STRAUB)

Fig. 2

---

* Such a view of the function of respiratory oxygen is revolutionary as compared with views of, say, ten years ago.

components different from the original Warburg and Christian 'yellow ferment'.

The contribution given by Dr. F. Dickens (Newcastle) formed the first bridge between the properties of the isolated systems and those systems organized in the tissue cells themselves. Directing attention to the tissue slice technique of Warburg for studying respiration, he considered that this proved in practice a fruitful compromise between the intact and macerated state, though minced tissue 'brei' where cell boundaries were destroyed was valuable for substances to which intact cells were impermeable. Tissue slices must be of appropriate thickness to allow of proper gas and substrate exchange. Under good conditions, slices of tissue in glucose solutions (Ringer bicarbonate or phosphate) will maintain remarkably constant rates of respiration, whereas with succinate as substrate this is not so; useful information as to the type of substance undergoing change can also be obtained by an estimation of the respiratory quotient, CO_2/O_2, as also by employing poisons which inhibit certain parts of the respiratory system. Dr. Dickens pointed out in a striking way the essential difference between the views of Szent-Györgyi and Krebs and Johnson as to the effect of the C_4 dicarboxylic acids. In the former case, catalysis is considered to be due to a series of reversible reactions, whereas in the latter the reactions proceed only in *one* direction, citric acid being supposed to form part of the reaction chain. In a discussion of this, Dr. H. A. Krebs (Sheffield) considered the dismutation of keto acids in bacteria and animal tissue, along the lines indicated by the following equations.

Anaerobic:

$$\begin{aligned}2\mathrm{COOH.CH_2CH_2.CO.COOH} + \mathrm{NH_3} = {} & \mathrm{COOH.CH_2CH_2CHNH_2.COOH} + {}\\ & \mathrm{COOH.CH_2CH.COOH} + \mathrm{CO_2} \qquad (4)\end{aligned}$$

Aerobic (with O_2 present):

$$\begin{aligned}\mathrm{COOH.CH_2CH_2.CHNH_2.COOH} + \mathrm{O} \rightarrow {} & \\ & \mathrm{COOH.CH_2CH_2.CO_2.COOH} + \mathrm{NH_3} \qquad (5)\end{aligned}$$

Glutamic acid can here act as a hydrogen carrier. This is a special modern example of the so-called Krebs' dismutations of α-keto acids in which carbon dioxide arises by decarboxylation of one molecule with simultaneous formation of the corresponding hydroxy acid from another molecule. In this paper we get the first introduction to one mechanism for the formation of carbon dioxide, probably a subsidiary one. In other cases in bacteria Dr. Krebs alluded to the use of succinic acid as a hydrogen carrier in the oxidation of acetic acid, part of the C_4 catalytic system being so employed. Dr. Mann's contribution should have dealt not only with the processes of H transfer involved in fermentation and respiration, but also with that of phosphate transfer; attention was directed to the coupling of oxidations with phosphorylations recently shown by Meyerhof, Needham and Lipmann, and to the fact that these reactions can be studied with advantage in tissue brei in which the fundamental cell organization has been destroyed.

With the contribution of Dr. J. H. Quastel (Cardiff), we turn to the reactions of the organized tissue respiration system (as found in the brain-slice) to the action of narcotics. Though it has been long considered that narcosis was due to diminished oxidations, it has only recently been emphasized by his school at Cardiff that narcotics have specific effects on tissue oxidizing systems; at low concentrations they greatly inhibit the oxidation by brain tissue of glucose, lactate and pyruvate, but not that of succinate or α-glycerophosphate, leaving cytochrome oxidase unaffected. Their inhibiting effects on brain respiration in the presence of glucose are definite at concentrations of narcotic which would be narcotizing *in vivo*; and with several narcotics the effects even on the tissue slice can be proved to be reversible. Though anaerobically there is no inhibition of pyruvate dehydrogenation by low concentrations of narcotics, in presence of oxygen there is marked inhibition; this may be related to the cocarboxylase (? diaphorase). These experiments were carried out with pyocyanin and ferricyanide. In a new point, they had found that suspensions of bacteria grown in media deficient in vitamin B_1, and suspended in pyruvate, showed a stronger inhibition of oxygen uptake by narcotics in absence of added vitamin B_1.

While Dr. Quastel's paper showed how tissue respiration could be altered by the action of drugs, Prof. Raper dealt with the equally fundamental and fresh point of how *in vivo* the cell controlled the rate of its respiration; How is the increased respiration consequent upon tissue activity regulated? He described experiments with slices of cat's submaxillary gland; the oxygen uptake is markedly stimulated with acetylcholine, this stimulation being inhibited by atropine. This important observation brings the whole question into relation with modern work upon the nervous system in its relation to these two substances, and forms a further valuable and much needed 'bridge' study. Acetylcholine did not affect anaerobic glycolysis though it slightly increased aerobic glycolysis. The effect of atropine suggests that acetylcholine does not act by increasing the available substrates, but rather by changing the availability of the catalysts concerned. (I think that this may have interesting relations to the address by Prof. E. K. Rideal upon surface film action.)

The question of carbon dioxide production through one of the main channels for this in tissue respiration was dealt with by Dr. S. Ochoa (Oxford), namely, the oxidation of pyruvic acid ($CH_3.CO.COOH$). There is a strong probability of a common path of carbohydrate breakdown to the pyruvic acid stage; the phosphorylated triose is oxidized anaerobically by dismutation, aerobically by giving up hydrogen to the cytochrome system through coenzyme I, flavoprotein and C_4 dicarboxylic acids. The phosphorylated oxidation product (phosphoglyceric acid) yields pyruvic acid which anaerobically is reduced to lactic acid, but aerobically is decarboxylated and oxidized; this gives, so far as is known, the main reaction in which carbon dioxide is liberated in the cell, and so forms the main source of respiratory carbon dioxide. It is catalysed, as has been shown for brain in Oxford, by cocarboxylase (vitamin B_1 pyrophosphate). (1 mol. cocarboxylase catalyses optimally the uptake of 1,500 mol. oxygen, producing 2,000 mol. carbon dioxide per min.) For complete oxidation inorganic phosphate, fumarate, adenylic acid and coenzyme I are required. During oxidative decarboxylation in brain brei, there appears to be an unstable C_2 intermediate which may appear as acetic acid in the absence of the rest of the enzyme system. There is some indication of a possible cycle of phosphorylation of pyruvate beyond this stage. Recent available evidence suggests that when dialysed brain preparations are incubated aerobically with fluoride, some inorganic phosphate disappears and a phosphate ester (not phosphopyruvate) accumulates in equivalent amounts only if pyruvate is present.

Striking a much more practical note, Dr. E. P. Poulton dealt with the question of local tissue anoxia in arterial disease and its treatment with oxygen, by the use of an oxygen tent. The improvement in the oxygen saturation of the tissues *in vivo* was of the greatest value in conditions such as rheumatism, a man being kept in the tent for days on end. That this is related to the oxidation changes in the tissues is shown by the fact that a high level of blood lactic acid, which would be caused by tissue anaerobiosis, is much reduced.

To summarize, it may be said that, with the exceptions mentioned in the opening address, the whole field of tissue respiration was well covered in summary form as it stands at the present time. As compared with twenty or even five years ago, the advance is truly marvellous and forms a fitting further chapter to the accurate knowledge of the carriage of oxygen and carbon dioxide in the blood, which has formed until now a main line of physiological research and thought upon respiration. From the purely chemical as distinct from the biochemical point of view, the strange medley of substances assembled by the cell to form the complex of catalytic systems necessary for the combustions in the tissue must always appear without logic and in strong contrast to the ordered schemes of pure organic chemistry. They will only receive a chemical meaning when we know more about the details of electron activation and exchange. Then we may be able to understand better why catalyses requiring low conditions of temperature and comparatively neutral reactions necessitate the compounds which we find. Until then, with biochemists, we can merely continue to record and wonder, and to enjoy the opportunities of intellectual interest to scientific workers of varied outlook which are presented by a study of this subject; actually it lies at the basis even of the material foundation of thought.

NOTE.—I am grateful to Dr. M. Dixon for access to the manuscript of his proposed address, and also to Dr. S. Ochoa for valuable notes of the proceedings at the meeting.

TWO BRITISH EXPEDITIONS TO UBEKENDT ISLAND, WEST GREENLAND

BY DR. H. I. DREVER, UNIVERSITY OF ST. ANDREWS

THE motive directly responsible for the organization of two British expeditions, the Cambridge West Greenland Expedition, 1938, and the St. Andrews University West Greenland Expedition, 1939, to West Greenland, was the inviting geological problems of Ubekendt Island (see Fig. 1) first encountered in 1937[1]. It was clear to me that apart from geological research, other work could also be undertaken in the same area, and that a party with a varied programme would offer, among other things, the further intrinsic interest of an 'expedition', the successful organization and conduction of which is in direct relation to the best working conditions and congenial co-operation. It is, in itself, a real problem in a non-scientific sphere.

Apart from the detailed geological examination of Ubekendt Island and similar work in parts of Upernivik Island, psychological, ethnological, archæological and botanical work was carried out, and high-altitude balloons flown in 1938[3] and, again in addition to geology, a small area in the south of Ubekendt Island was surveyed in 1939.

A detailed geological study of Ubekendt Island and also an extension of the work regionally in Nugssuaq south and in Svartenhuk north of the island had been planned in 1938. The rocks of these areas largely belong to the Tertiary Igneous Series. Geological work on Ubekendt Island was of first importance, but it was clear that the study of such an isolated area must necessarily be supplemented by more extended observations on a regional scale. This regional work was curtailed in favour of a Danish geological expedition under A. Rosenkrantz, although the Cambridge expedition was in no way restricted by the Greenland Commission for Scientific Research. Eventually it was thought fit to withdraw entirely British geological 'interests' in the regional aspect of the problems. Accordingly, in 1939 further work was confined to the areas examined in 1938, while a relatively large Danish expedition devoted its attention to the more extensive areas of Upper Cretaceous and Tertiary rocks (see Fig. 2 in black).

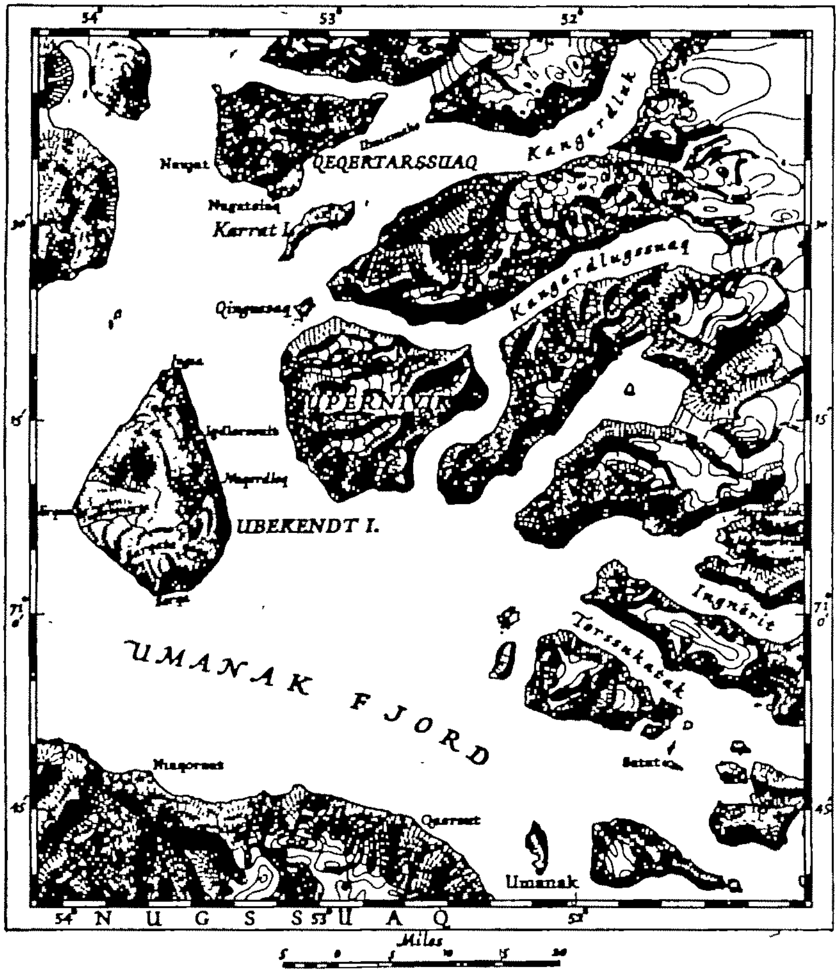


Fig. 1.

FROM THE *Geographical Journal*, 94, 388 (NOVEMBER 1939).

Recent research on the Scottish, Icelandic and East Greenland Tertiary igneous rocks has been of great petrological value, particularly that of H.M. Geological Survey. It was the purpose of the two expeditions to further our knowledge of this—the North Atlantic—Petrographical Province.

Ubekendt Island is composed essentially in the north of basic lavas and an intrusive complex of granite, gabbro and acid dykes in the south. Pyroclastic rocks are almost confined to the west coast near the remnant of a large volcanic neck. Cutting the lavas over the whole island are a large number of basic dykes with a local and variable rather than a constant regional trend. Representative collections have been made of all the rock types and the island has been geologically mapped.

Upernivik Island, on the other hand, is mainly Archæan orthogneiss, except in the south-west corner, where Cretaceous-Tertiary grits, sandstones and shales are faulted against the gneiss. A number of basic dykes and sheets cut the sediments, and there is one large sheet between 40 ft. and 60 ft. thick which has, in one place, a gabbroic centre. This area has been examined in some detail. Excursions were organized round the island, through the centre, up three of the western glaciers and the highest peak (6,893 ft.).

The psychological work was conducted in Igdlorssuit, the outpost settlement on the east coast of Ubekendt Island, and also in Umanak, the administrative centre of the district. The natives were the subject of experiments in social psychology, three individual tests were used and a study was made of group-contacts referring in particular to the relationships between Europeans and the Greenlanders. Some ethnological work was

(*Continued on page* 1083)

NATURE

SUPPLEMENT

Vol. 144 SATURDAY, DECEMBER 30, 1939 No. 3661

SHORT REVIEWS

AGRICULTURE AND HORTICULTURE

Los Suelos de la Peninsula Luso-Ibérica (Soils of the Lusitano-Iberian Peninsula) (Spain and Portugal)
By Emilio H. del Villar. International edition in Spanish and English, the English Text (somewhat abridged) by Prof. G. W. Robinson. Pp. 416. (London: Thomas Murby and Co., Ltd., 1937.) 40*s*. net.

THE problem of devising a universally applicable system of soil classification calls for a wide knowledge of the soils found in different parts of the world as well as an intimate acquaintance with soils in the field. An attempt at devising such a system is made, by a pedologist with both these qualifications, in Prof. del Villar's work on the soils of Spain and Portugal.

Prof. del Villar groups soils according to their stratigraphy, composition and metabolism, choosing those factors which most directly affect vegetation. Seven main series are distinguished, including acid-humic, siallitic, calcareous and hydropedic groups. The calcareous series, which embraces rendzina, terra rossa and the peculiarly Spanish *calvero* soils, is perhaps the one which will prove of most interest to soil workers beyond Spain, since information on soil processes under Mediterranean conditions is still comparatively meagre.

The somewhat refreshingly unorthodox system of classification described appears to fit the soils of the Peninsula adequately and satisfactorily, but it is doubtful whether it could be generally applied to soil groups occurring elsewhere. Prof. del Villar's exposition of his system of classification includes many ideas and points of view which throw a new and constructive light on the difficulties of soil taxonomy, and the book is one which students of this comparatively undeveloped branch of pedology would do well to study.

The book is printed in Spanish, but it contains abridged English translations of each chapter, in which Prof. del Villar's views are clearly set forth. The translator, Prof. G. W. Robinson, in a prefatory note, adds tribute to the importance of the work, which, he says, must inevitably modify current ideas on soil genesis and classification.

The Soils of Palestine
Studies in Soil Formation and Land Utilization in the Mediterranean. By Dr. A. Reifenberg. Translated by Dr. C. L. Whittles. Pp. viii+131+8 plates. (London: Thomas Murby and Co., 1938.) 14*s*. net.

THIS authoritative account of soil conditions in Palestine, the outcome of thirteen years uninterrupted work at the Hebrew University, Jerusalem, is opportune. Part of the book is devoted to a description of soil formation within the framework of the Mediterranean type of weathering. The intense summer insolation destroys most of the soil organic matter and causes a predominantly upward movement of water containing silicic acid, ferric oxide and alumina. It is maintained that the colloidal silicic acid exerts a peptizing effect on the latter, and this accounts for their translocation in the presence of calcium during the formation of terra rossa on limestone. Terra rossa profiles are described, and theories of their formation with reference to rock weathering under different climatic conditions are discussed.

In dealing with the agricultural utilization of the soils it is emphasized that, since moisture is the main factor limiting crop production, irrigation is essential, and its success depends on the choice of water in which the concentration of salts is low enough to avoid injury to crops.

One of the most striking examples of the recent intensification of agriculture in Palestine is afforded by the citrus industry, the growth of which has revolutionized the whole of the country's agriculture. This progress is mainly due to the Zionist colonization, of which an account is given in the final chapter.

A. J. L. L.

Diseases of Bulbs
By W. C. Moore. (Ministry of Agriculture and Fisheries: Bulletin No. 117.) Pp. vi+176+20 plates. (London: H.M. Stationery Office, 1939.) 4*s*. net.

THE need for this book was great. Advisory mycologists, teachers of horticulture, and gardeners had to search for any knowledge about the diseases of bulbs among scattered journals in several languages. The almost dramatic expansion of the bulb industry in Great Britain, moreover, brought new problems in pathology, and it would be no exaggeration to say that disease occurrences had over-run mycological information.

Mr. Moore's volume is worthy of the occasion; it deals in great detail with fungal and virus parasites of all the commoner bulbs and corms of horticultural commerce, it illustrates the descriptions with fifty-eight excellent half-tone plates, and it considers several physiological irregularities akin more to ailments than to actual disease. The practical grower will find no difficulty in separating the descriptions of symptoms and control measures from the more technical matter, which the mycologist will find quite adequate to his purpose.

A list of 709 references to the world literature on bulb diseases should satisfy any further desire for study evinced by the reader, and the international scope of the volume makes it possible to provide information in advance about any maladies which are not yet widespread in Great Britain, but which may appear later. Among all the detailed excellence of the volume, the reader will probably feel the need for an alphabetical index of parasites. The book has a description of eelworm disease, which often occurs in close association with fungal maladies.

ARCHAEOLOGY AND ETHNOLOGY

The Maria Gonds of Bastar

By W. V. Grigson. Pp. xxi + 350 + 24 plates. (London: Oxford University Press, 1938.) 30s. net.

MR. GRIGSON'S anthropological investigations were undertaken largely owing to the suggestion of the late Sir Montague Butler; but his immediate objective in his contact with them was the remedy of certain grievances, more especially those caused by the application in a primitive State, of criminal, civil and revenue laws framed for British Indian districts some centuries more advanced. He found that it was by observation of their ceremonies and rituals and their daily occupations, as well as by inquiry into their family and social organization—in short through thorough-going anthropological investigation, by which science is the richer in this volume—that he was best able to arrive at their genuine and inmost opinions of, and attitude towards, the methods by which their affairs were being administered. Hence he was able, as Prof. Hutton says in his introduction, to introduce certain reforms.

Mr. Grigson's own comment on the relation of his anthropological investigation to the performance of his official duties is extremely illuminating. He points out how completely it refutes the arguments put forward by members of the Indian Legislative Assembly, in the debate on reserved and excluded areas which took place on February 18, 1936, when N. M. Joshi and M. S. Aney "heartily damned" all anthropologists as wanting to keep the primitive races in a state of barbarism as raw material for their science, and to add to their stock of knowledge. Mr. Grigson clinches the argument from his own experience by reference to the disastrous post-War attempt to force prohibition on Bhils, Gonds and Korku.

The scientific importance of this carefully detailed account of the relatively simple culture of the Marias is, however, underlined in an introduction contributed by Prof. Hutton. Dr. Ramesh Chandra Roy contributes an appendix on the physical characters of the Marias, in which he attributes evidence of a strain of brachycephaly in this predominantly dolichocephalic people to the influence of the central Asiatic or Alpine. Prof. Hutton, on the other hand, while admitting a certain subjectivity in his own view, inclines to see a Mongoloid strain, such as is present in the Assam tribes with whom he is most familiar. Turning to the cultural evidence, he supports his view in a very brief but masterly analysis of the cultural evidence.

Salween

By Ronald Kaulback. Pp. xi + 331 + 16 plates. (London: Hodder and Stoughton, Ltd., 1938.) 15s. net.

THE expedition to south-eastern Tibet which Mr. Ronald Kaulback describes in this volume started from Upper Burma in April 1935, and returned by way of Assam at the beginning of 1937. Of its twenty-two months duration, eighteen were spent within the borders of Tibet. The objective of the expedition was the exploration of the Nagong Chu valley, an affluent of the Brahmaputra, and the Brahmaputra–Salween watershed, as well as of so much of the course of the Salween as could be effected, with the upper waters of the Salween as the final goal. The project of exploring the hitherto unknown sources of the Salween had been formed by the author when a member of the Kingdon Ward expedition of 1933.

Unfortunately, this final piece of exploratory work had to be abandoned. Three months delay, while the further progress of the expedition was referred to Lhasa, made success too problematical. Not only was it questionable whether financial resources would be adequate—all cash for the needs of the duration of the expedition had to be carried—but also it was necessary to abandon the projected line of return through unexplored country, owing to local disturbances. The expedition returned by the Salween valley. Notwithstanding the disappointment of the author and his colleague, J. Hanbury-Tracy, the value of the survey work of the expedition in country, much of which had not been trodden previously by Europeans, was recognized by the award to Mr. Kaulback of the Murchison Grant of the Royal Geographical Society.

The author's graphic narrative makes light of the difficulties and discomforts of his journey, while throwing into relief the idiosyncrasies, individual and collective, of the people he encountered on his way. He was fortunate in obtaining an intimate view of several of the Tibetan seasonal festivals and of a remarkable prophetic ceremonial under possession. The photographic illustrations are of a high standard.

Philippine Pagans

The Autobiographies of Three Ifugaos. By R. F. Barton. Pp. xxi+271+24 plates. (London: George Routledge and Sons, Ltd., 1938.) 15*s.* net.

THE three Ifugao autobiographies comprised in this volume were collected in the course of an ethnographical investigation, which lasted for the greater part of 1937, in the island of Luzon. They attain a new standard in the attempt to eliminate the point of view of the white observer in cultural investigation. The subjects, two men and a woman, were told to record matters which they considered of most interest and importance in their lives. The narrative was, of course, taken down by the author, as the narrators were both pagan and illiterate. The result is significant in every sense. The topic which bulks largest is the pre-marital sexual relation, although for the woman, its special interest was its bearing on marriage and child-birth; but the influence of omens and the social ties of kinship and propinquity are also prominent in their influence on the course of events. Head-hunting figures repeatedly but it seems to be treated as of incidental, rather than of primary importance.

The institution which is pivotal in these narratives is that of the custom of the unmarried of both sexes sleeping in dormitories, either empty or occupied houses, apart from their families, and the consequent visiting of the females by the males, adolescent and mature. It is interesting to note that the author, as a result of the employment of this method of investigation and the intimate insight it has afforded him into native mentality, has had to reconsider an interpretation of the pre-marital sexual relation which he had based upon his experience of native institutions acquired in a residence among them over a period of seven years.

Archæology and Society

By Grahame Clark. Pp. xv+220+24 plates. (London: Methuen and Co., Ltd., 1939.) 7*s.* 6*d.* net.

ARCHÆOLOGY, no less than other branches of research, has profited from the increased popular interest in the results of scientific inquiry and their application to social ends which followed on the close of the War of 1914–18. If the practical bearing of archæological aims was less immediately apparent, this was counterbalanced by a number of spectacular discoveries, of which it will suffice to recall that of King Tutankhamen's tomb in Egypt and Sir Leonard Woolley's excavations at Ur. While it is beyond question that the study of archæology has profited much and gathered strength from this enhancement of popular interest, the constant stimulus of sensation needed to keep it alive has obvious dangers which may affect the quality of the investigation.

The present excellent review of the aims and methods of modern archæological investigation is designed to supply the public outside the ranks of the specialist with the basis of knowledge requisite to enable them to appreciate the bearing of archæological results achieved in the field, as well as the technical skill and the acumen in interpretation which contribute to the result. Thus in successive chapters he deals with discovery, in which it is explained how the archæologist knows where to dig, the preservation of early remains, depending upon the survival value of different materials, the methods and aims of the actual excavation, chronology, based upon stratigraphy and sequence, and interpretation, in that last tracing how the interest of modern archæological investigation no longer centres on the discovery of exceptional examples of the artistic products of the past, but in the reconstruction of the essential elements in the day-to-day life of the peoples of vanished civilizations.

In his final chapter on "Archæology and Society" Dr. Clark discusses certain aspects of archæological studies as a factor in modern life, and reviews briefly its relation to the development of nationalist sentiment in the smaller States which came into being after the War of 1914–18, as well as in Russia, Italy, Germany and Eire. While his readers will concur in his praise for what is being done in Eire, they will find his account of archæological activities in Russia, in which he relies on the evidence of Prof. A. M. Tallgren, more than disturbing, and probably feel that his view of the tendentious character of German theory under the Nazi regime is all too lenient.

BIOLOGY

British Purbeck Charophyta

By Prof. Thomas Maxwell Harris. Pp. ix+83+17 plates. (London: British Museum (Natural History), 1939.) 7*s.* 6*d.*

THE Charophyta have usually been regarded as a somewhat isolated group of Thallophyta, but the author of this monograph probably rightly regards them as a family of the Chlorophyceæ. Like some members of the Rhodophyceæ and Siphonales, they have left as records of their existence in past ages the calcareous clothing with which they invested their thallus. With the exception of the oospore membrane all the original plant substance has disappeared.

There are two important families in the group, the Characeæ and the Clavatoraceæ. By careful analysis of large numbers of fragmentary specimens which were extracted from the rock, the author has been able to distinguish some new and interesting types. A new genus, Charaxis, has been instituted for vegetative organs of fossil Charophyta, and one new species, *C. durlstonense*, is described. The most interesting and important part of the monograph consists of very complete descriptions of three species of the genus Clavator; *C. reidi* Groves, and two new species *C. grovesi* and *C. bradleyi*. A new genus, Perimneste, with one species, *P. horrida*, is of exceptional interest. These forms are all included in the Clavatoraceæ. There are careful detailed analyses of the construction of the thallus and the oogonia, and the descriptions are fully illustrated with photographs of a high order of excellence. Clear diagrammatic reconstructions are also given. Some parts of the descriptions might have been improved and clarified by the use of letters and indicator lines on some of the plate-figures. On p. 22 there is a paragraph on an exceptional cortical structure. It is not clear what is meant by opposite, and the reference to the figure in the plate (Pl. III, Fig. 8) does not help, for the figure appears to bear no relation to the written description. The technique employed in the investigation is a great advance on anything used before in work on the Charophyta, and in spite of the few obscurities to which reference has been made, the author has produced what is probably the best existing description of any collection of fossil Charophytes, and has provided us with a model of how such an investigation should be conducted.

J. WALTON.

Between Pacific Tides

An Account of the Habits and Habitats of some Five Hundred of the Common, Conspicuous Seashore Invertebrates of the Pacific Coast between Sitka, Alaska, and Northern Mexico. By Edward F. Ricketts and Jack Calvin. Pp. xxii + 320 + 46 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1939.) 27*s*. net.

THIS delightful book, which was written chiefly for the layman interested in the seashore, deals with the littoral fauna from the ecological point of view. No scientific account of the animals is given, but most have been illustrated and their habits described. There are many beautiful photographs, though the recurring black background does not always make for clarity, and is, moreover, tiring to the eye. The sketches are variable, and one wonders whether the layman will understand a Pycnogonum or an Aplysia drawn upside down. The Latin names should have been more carefully revised; for example, *Reneira cineria* is incorrect both historically and philologically. The English reader cannot fail to note the similarity between the inhabitants of the various shore zones of California and of his own country. The species is rarely the same, but the genus often is. Even the commensals group themselves in the same way, and the description of the fat innkeeper, *Urechis caupo*, and its guests, written in the lively American style, should be read by all British marine zoologists. For more advanced readers the species are classified at the end of the volume, with references to the literature.

Animal Families and Where they Live

Written and illustrated by Arnrid Johnston. Pp. ix + 27 + 24 plates. (London: *Country Life*, Ltd., n.d.) 7*s*. 6*d*. net.

THIS attractively produced book is composed of a series of twenty-four plates (9 in. × 12 in.), each containing coloured sketches of animals grouped under such headings as 'egg-laying and pouched mammals', 'gnawing mammals', 'primates: New World monkeys', etc. Altogether 320 animals are featured, but the title of the book is misleading in that all the animals portrayed are mammals. Opposite each plate is a short description of each animal, one useful feature (often so unfortunately ignored) being the general measurements of the animal. Also on the opposite page is a world map showing distribution. This is of great value.

The book will make a very acceptable present for any animal lover, and if used during a visit to the Zoo will be a valuable aid in studying mammals especially in relation to each other.

Palæozoic Fishes

By J. A. Moy-Thomas. (Methuen's Monographs on Biological Subjects.) Pp. x + 150. (London: Methuen and Co., Ltd., 1939.) 5*s*. net.

IN view of the tremendous advances in our knowledge of the anatomy of fossil fishes during the past twenty years, the appearance of this little book should prove most opportune. A good deal of recent work, such as the classical researches of Stensiö on the Cephalaspids and Placoderms, has been published in journals not readily accessible to the average student or teacher, who will welcome the concise summary of these and equally important papers by other workers provided by Mr. Moy-Thomas. The recent work of Brough, Gross, Heintz, Kiaer, Nielsen, Säve-Söderbergh, Watson, Westoll, White and several other palæontologists, as well as that of Mr. Moy-Thomas himself, all finds a place in this volume of less than 150 pages, and the author is to be heartily congratulated upon the skill with which he has managed to reduce this mass of technical material to reasonable and readable limits. The book is at once competent, comprehensive, and concise, and may be confidently recommended to teachers and students of both zoology and geology. Evidence that it is right up to date is provided by the statement on p. 91 that the Coelacanths start in the Upper Devonian and continue to the present day, and a reference in the list of literature to the first account in Great Britain of the recent discovery in South Africa of the living Latimeria.

The many text-figures are admirably clear and well reproduced, and there is an excellent bibliography as well as an adequate index. The general production of the book well maintains the standard set by the earlier volumes of this series of pocket monographs on biological subjects.

Essays in Philosophical Biology

By William Morton Wheeler. Selected by Prof. G. H. Parker. Pp. xv + 261. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1939.) 12*s*. 6*d*. net.

THE late Prof. W. H. Wheeler began his career as a naturalist and later subjected his interests in living organisms to the disciplinary influence of scientific training. His philosophical outlook was conditioned not only by the naturalist's disciplined imagination arising out of a vast, first-hand acquaintance with animals and their behaviour, for he was, in addition, a great man of letters and a distinguished prose writer. His bibliography contains some 467 titles, most of them concerned with the classification, structure and behaviour of ants, but a considerable number deal with problems of embryology, evolution, parasitism and the social life of insects in general. These formal books have had great influence upon the world of biological thought, but his observations of insects in the field caused him to make incursions into psychology and sociology, and he became a master of the comparative branches of these sciences.

This book has been prepared in order to present in collated form some of Wheeler's philosophical beliefs which are distributed throughout the various scientific journals to which he contributed. The topics range from a discussion of instincts to a discourse about the dry-rot of academic biology, from the attractions of the field study of ants to biology and society. Reading them, one is reminded of the cogency of Prof. A. N. Whitehead's remarks about Wheeler when he described him as the only man he had ever known who would have been both worthy and able to sustain a conversation with Aristotle. Whilst the book stands primarily as a memorial to Wheeler, it represents a valuable addition to the world's scientific literature. T. H. H.

Outlaw of the Air

By Leslie Brown. Pp. x+246+8 plates. (London: Geoffrey Bles, 1939.) 8*s*. 6*d*. net.

THIS is an interesting account, told in the form of fiction, of the life of the great skua, a bird which is found only on the northern islands of Britain.

The author has evidently studied his subject with care, and he gives a convincing picture of the skuas at their island home. He describes them (as the reviewer has seen them do) standing on the backs of gannets flying at full speed, and forcing them to disgorge the herring they are carrying to their young; he has seen them attacking kittiwakes and even greater black-backed gulls. From a turf 'hide' he has watched the skua brooding its eggs and hatching its chicks, and a number of interesting photographs are a record of these hours of watching, although it is a pity that almost all the illustrations are over-enlarged, and thus suffer from a want of definition.

The book is thoroughly readable, and would make an acceptable Christmas present either to young folks or to their elders, and will keep the mind focused on the beauty and charm of Nature during the dark days through which the nation is passing. The book is very free from inaccurate observations, but surely a gannet (p. 93) does not "oar itself" cormorant-fashion below the surface when it fishes, but counts on the velocity of its aerial dive to enable it to approach, with closed wings, the fish beneath the surface; and when its momentum is exhausted re-emerges, still with closed wings, on the surface? Puffins (p. 52) do not arrive on their nesting islands off the Scottish coast so early as March—not indeed until the beginning of May as a rule. But these are minor criticisms, and the book deserves to be read by all who are interested in the birds of the coasts of the British Isles. S. G.

Physikochemische Grundlagen der histologischen Methodik

Von Prof. Dr. K. Zeiger. (Wissenschaftliche Forschungsberichte. Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 48.) Pp. xi+204. (Dresden und Leipzig: Theodor Steinkopff, 1938.) 11.25 gold marks.

HISTOLOGICAL technique was once a mere rule-of-thumb affair, and there are some to whom it is so still! One stain gave red, another blue; one stained the nucleus, another cellulose; but how or why was no concern of the histologist so long as the result seemed good. But following Sir William Hardy's lead, men began to wonder how much of all their pretty preparations was artefact; and then came a growing desire to understand the rationale of fixing, staining and clearing in their chemical and physical relation to the colloids of the cell. So the histologist began to learn from the dyer the difference between an acid and a basic dye, and was some way along the road to skill and wisdom by the time he understood, for example, that a red blood-corpuscle was permeable to anions, and that eosin was, *ipso facto*, an appropriate dye.

Dr. Zeiger tells us in a couple of hundred pages the very things which the histologist now wants to know. He discusses hardening processes in relation to diffusion, permeability, shrinkage and so forth; staining as a chemical, an adsorptive, an electrostatic, or an electrocapillary phenomenon; Golgi's silver-method and its many variants and corollaries; intra-vital staining, including methods by which a single reagent may be made to differentiate various organs, tissues or cells; Ehrlich's methylene-blue, and its innumerable developments and consequences; *p*H and the ever-present need of keeping watch upon it (though without mentioning Bailey and Zirkle's work)—and many other useful and interesting things. D. W. T.

CHEMISTRY

Revision Notes in Inorganic Chemistry

To Higher School Certificate. By E. P. Wilson and F. W. Ambler. Pp. viii+240. (London: William Heinemann, Ltd., 1938.) 4*s*.

THE object of this book is to provide a revision course in inorganic chemistry up to higher certificate standard. The opening chapter deals with the classification of the elements, and subsequent chapters are devoted to the chemistry of the elements, arranged in the groups and sub-groups of Mendeléeff's table, though not in quite the same sequence. Questions from higher school certificate examination papers are given at the ends of the relevant chapters, and the book is provided with an adequate index.

In the reviewer's opinion the authors have considered too many unimportant compounds, and have not compared sufficiently the same compounds of different elements. In addition, the notes on 'non-certificate' elements are too brief to be of value to university students and should have been omitted. A. C. C.

The Essentials of Volumetric Analysis

By John Lambert, in conjunction with A. Holderness and Dr. F. Sherwood Taylor. Pp. vii+92. (London: William Heinemann, Ltd., 1938.) 2*s*. 6*d*.

THIS book provides a suitable course in volumetric analysis for the higher school certificate examinations. Thus an account is given of the preparation and use of standard solutions of acids, alkalis, potassium permanganate and dichromate, iodine, thiosulphate, and silver nitrate in neutral and acid solution. A concise and clear explanation is also given of the theory of indicators, including adsorption indicators. A useful feature of the book, especially from the point of view of scholarship candidates, is the list of practical problems at the ends of the chapters. Atomic weights, tables of logarithms and an index are given at the end of the book.

A. C. C.

Ergebnisse der Vitamin- und Hormonforschung

Herausgegeben von E. Mellanby und L. Ruzicka. Band 2. Pp. xv+520. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 34 gold marks.

THIS survey of current knowledge in selected fields of hormone and vitamin research, of which the first volume was reviewed in NATURE, **143**, 659 (1939), maintains the cosmopolitan aspect to which we then directed attention. Four articles are in English, all from England: four are in German, one from the United States, one from Switzerland and two from Germany: three are in French, two from France and one from the Argentine.

The authoritative nature of the various contributions leaps to the eye. Profs. Haworth and Hirst write on the chemistry of ascorbic acid and its analogues: Prof. Bertrand contributes an essay on the physiological significance of manganese and other 'trace' elements: Dr. Hans Brockmann discusses the chemistry of the antirachitic vitamins, and Prof. Rominger their physiology and pathology. Prof. J. W. Cook describes the chemical and biological properties of the carcinogenic substances, while an analysis by Prof. Lacassagne of the connexion between cancer and the sex hormones is reassuring in its conclusions. Prof. Houssay and Dr. Deulofeu have some forty-five pages on the chemistry and secretion of insulin. Prof. Karrer appropriately reviews the chemistry of the flavins. Articles by Dr. Haagen-Smit on the plant growth-hormones and by Prof. Korenchevsky on the bisexual (and other) effects of pure male hormones on females make up the eleven sections of the book.

Thus it will be seen that, like its predecessor, this volume ranges from chemistry to clinical medicine, with adequate attention to the intermediate co-sciences of bio-chemistry, physiology, therapeutics and pathology. A change of editorship is to be observed in the replacement of Prof. W. Stepp by Sir Edward Mellanby; one can only speculate as to where and when subsequent volumes will be published and hope that these "Ergebnisse" will not have to be included among the war victims.

A. L. BACHARACH.

ENGINEERING

Les gisements de pétrole

Géologie, statistique, économie. Par Prof. Georges Macovei. Pp. vii+502. (Paris: Masson et Cie., 1938.) 120 francs.

M. GEORGES MACOVEI is well qualified to write a text-book on petroleum since he brings to the task twenty years of experience as a lecturer at the Polytechnic School in Bucharest and thirty years of practical experience of the Carpathian deposits. He has not hesitated to consult the works of already established authorities on the subject in England, France, Germany, the United States and elsewhere, but in addition has embraced many of the precepts of his fellow countrymen, in particular those of M. Louis Mrazec, of whom he is an admiring disciple. Those who are looking for originality may therefore be disappointed, certainly in regard to text figures, only about twenty of which are entirely new out of a total of two hundred and twenty-two.

The first part of the book follows conventional procedure in petroleum text-books, and the accepted principles of petroleum origin, constitution, production, etc., are unfolded along familiar lines. The author relieves monotonous sequences of facts wherever possible by reference to practical examples he has encountered in the field; but, being most familiar with the Rumanian oilfields, he tends perhaps to over-emphasize their importance in relation to oil deposits in other parts of the world.

The second half of the book is devoted to a description of the known deposits of petroleum throughout the world. No attempt is of course made to give complete details of all deposits, but indications are in each case given of extent, yield and potential reserves.

Few writers of text-books on petroleum can withstand the temptation to estimate world resources of this product. M. Macovei succumbs in the last chapter and quotes some astonishing figures. From statistics gleaned from a variety of sources he estimates that world reserves at the beginning of 1938 were 5,173 million tons. He then proceeds to calculate on a basis of 1937 withdrawals that petroleum will be exhausted in Mexico in five years, in the United States in twelve years and in Rumania in thirteen. Even Iraq, the supplies of which are expected to outlast those of the rest of the world, will have exhausted her reserves in less than a hundred years according to this author's approximations.

Petroleum Production Engineering

Oil Field Exploitation. By Prof. Lester Charles Uren. Second edition. Pp. ix+756. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 36*s*.

THE fact that Prof. Uren has had to expand the first edition of this work, which he wrote fifteen years ago, into two volumes and approximately twice as many pages is yet another indication of the steadily accumulating mass of technical knowledge now available to the petroleum industry. The work is of necessity still academic in its bias, but, if thoroughly digested by students during their university course, must provide an excellent preliminary to practical experience in the field. It may also prove useful as a book of reference for those who have already had practical experience in the industry and yet desire to consolidate their knowledge in terms of academic principles.

Statistical Year-Book of the World Power Conference

No. 3: Data on Resources and Annual Statistics for 1935 and 1936. Edited, with an Introduction and Explanatory Text, by Frederick Brown. Pp. 138. (London: World Power Conference, 1938.) 20*s*. net.

THE same principles are followed in this third Year-Book as in No. 1 (1936) and No. 2 (1937), the ultimate aim being to give *comparable* statistics of world power resources. Two noteworthy advances have, however, been incorporated in this volume, quite apart from progress made towards publication of complete statistics for the whole world. For the first time a table is included at the beginning of the volume showing the area and population of most of the countries from which statistics have been obtained. Also there is clear indication that the several countries have made a greater effort to return statistics in conformity with definitions adopted by the World Power Conference.

MATHEMATICS

Tables for Converting Rectangular to Polar Co-ordinates

By Dr. J. C. P. Miller. Pp. 16. (London: The Scientific Computing Service, Ltd., 1939.) 2*s*.

DR. J. C. P. MILLER has compiled these tables to facilitate the conversion of rectangular to polar co-ordinates, and after several years of experiment he is convinced that they afford the maximum efficiency. Acknowledgment is made of the advice and assistance of Dr. L. J. Comrie both in the computation and publication of the tables. A full description of the method of application with a computing machine and also with a slide rule is given, and, generally speaking, only one set-up of the machine or rule is necessary. Where maximum accuracy is essential, two settings are sometimes required with the slide rule, and examples are given which show the various degrees of accuracy that arise with one or two settings. The tables have already been extensively used in manuscript form for the transformation of harmonic constants a and b, obtained by harmonic analysis, to amplitude c and phase angle ϵ, in accordance with the relation

$$c \sin(nt + \epsilon) = a \sin nt + b \cos nt.$$

As further applications may be mentioned the evaluation of the magnitude and direction of a vector from rectangular components, and the conversion of complex numbers from the form $x + iy$ to the form $re^{i\theta}$.

The tables will be very useful in various branches of applied science.

Trigonometry, with Tables

By Prof. Howard K. Hughes and Glen T. Miller. Pp. viii+190+79. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 7*s*. 6*d*. net.

TEACHERS of elementary trigonometry may discuss the order in which to introduce the tangent, the cosine, and the sine, and there are substantial and interesting arguments in favour of each as the first to be studied, but there has been general agreement for many years that in a first course the tangent and the sine or cosine should be introduced separately, whether the actual definitions are in terms of right-angled triangles or of co-ordinates. It is typical of the teaching of Messrs. Hughes and Miller that they throw the six circular functions simultaneously at the pupil's head at the very beginning, and this implies, on the kindest interpretation, that the subject has been deferred far beyond the age at which the elements of it can profitably be studied. We need scarcely give other reasons for doubting whether this text-book is suitable for the use for which it is intended. On principle, the inclusion of a chapter on spherical trigonometry is to be commended, and an attractive set of tables is paged independently at the end of the volume. The printing and production are exceptionally good. E. H. N.

MISCELLANY

Bibliographie de Maurice Maeterlinck

Littérature, science, philosophie. Par Maurice Lecat. Pp. 208. (Bruxelles: Libr. Castaigne, 1939.) 35 francs.

M. MAURICE LECAT, the relentless and indefatigable critic of the "Belgian Shakespeare", has issued separately the bibliography which forms part of his work entitled "Maeterlinckisme", of which the first volume was published in 1937 and the third is to appear shortly. The bibliography consists of two parts devoted respectively to works by or about Maeterlinck. Appended is a bibliography of the publications of M. Lecat, who is a doctor in mathematical and physical sciences, a mining engineer, and a laureate of the Académie des Sciences.

The Psychology of Physics

By Blamey Stevens. Pp. xvi+282. (Manchester: Sherratt and Hughes; New York: G. E. Stechert and Co., 1939.) 7*s*. 6*d*. net.

NEITHER the psychology nor the physics of this book is of the conventional type. In a previous book, "The Identity Theory" (1936), Mr. Blamey Stevens put forward views which are now presented in a simpler form. To begin with, he suggests that space and time have no objective reality, and are merely two different subjective or *perceptual* aspects of an identical thing, which may be called substance. On bases such as these, a complete perceptual theory of physics is built up, rejecting many of the accepted laws, but replacing them by others which, it is claimed, are in accordance with empirical facts.

Ethics in Modern Art

By Marjorie Bowen. (Conway Memorial Lecture delivered at Conway Hall, Red Lion Square, W.C.1, on April 19, 1939.) Pp. x+50. (London: Watts and Co., Ltd., 1939.) Paper, 1*s*. net; cloth, 2*s*. net.

THIS lecture must have been a stimulating and provocative discourse, for surely many hearers must have itched to refute and debate its many inconsistencies. For example, while apparently condemning 'escape' stories, Miss Bowen praises the effect of music and poetry in taking us away from our petty troubles, trivial fears and everyday worries—surely an appeal for 'escape'.

The reviewer feels that, while admitting the complete freedom of modern art, plastic or otherwise, Miss Bowen would seem to consider that this freedom should be one-sided, and that the percipient of art should support monetarily that which to him is repulsive.

For art to have an ethical value, we must surely have some *rapport* between artist and percipient. If the artist can use his keener vision in such a way as to reinforce that of the percipient, then we admit his power, ethical or the reverse, in influencing his fellows. But the public liking for purely objective stories and pictures seems to show that the artist of the more intense school has lost rapport with the normal man, who dismisses the detailed character study and self-representation school as long-winded and faintly repulsive. The many works of this nature are meat for the few, and the rest of the world will ignore them.

Miss Bowen pleads for æsthetics in education: "Children could be taught æsthetics, to understand and to value the work of the artist. . . . Children should see, hear and read the ugly, the trivial, the silly as little as possible". Surely this was the system of the Victorians, used according to their lights, which produced the intolerance of novelty so deplored by Miss Bowen. On the same page we are told that the child is not to study great poets, nor to have fine music offered it, nor have great pictures analysed for it. As æsthetics are to be studied, and the great and the trivial alike are to be avoided, we have here the apotheosis of mediocrity.

There is much in the lecture with which all must agree, and the rest of it, being controversial, arouses the more interest.

PSYCHOLOGY

Incentives and Contentment

A Study made in a British Factory. By Patricia Hall and H. W. Locke. Pp. xii+190. (London: Sir Isaac Pitman and Sons, Ltd., 1938.) 2*s*. 6*d*. net.

THIS book describes the results of some research work carried out in a pioneer factory, which has attempted to put into practice a system of democratic government. The object was to discover those factors involved in the production of good work allied with contentment.

An analysis was made of the factors around which satisfaction and discontent centre; for example, remuneration, promotion, suitability for the job, the value of creative work, conditions inside and outside the working situation. The many motives that might play a part in actuating human endeavour were also considered. Lastly, the important subject of leadership, both managerial and in the workroom, was discussed, and this led on to the subject of the 'difficult' employee.

There is an interesting reference to the psychological department, which endeavours by vocational studies to reduce the number of maladjusted workers, by taking into account such factors as temperament, ability, interests.

This research has shown quite clearly that if incentives are to be effective, and contentment real, they must be contingent upon the satisfaction of those abiding instincts and desires that are present in every man and woman. It also emphasizes the importance of selecting for managerial posts people who have the power of leadership and can enter sympathetically into the point of view of their subordinates.

The book is one to be recommended to all students of industrial problems.

Fifty Years of Psychical Research

A Critical Survey. By Harry Price. Pp. xii+383+15 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 10*s*. 6*d*. net.

ALTHOUGH this work purports to be a critical survey of the work undertaken by psychical research workers during the last fifty years, and even to be a continuation of the late Mr. Frank Podmore's history of modern spiritualism, it is, if the truth be told, nothing of the kind. It consists of a miscellaneous collection of material, written in a popular style and forming more than anything else a kind of abstract or digest of some of the more sensational cases of recent times. There is no attempt to present the subject-matter in historical sequence with due regard and appreciation of the factors underlying the changes in technique and experimentation during the course of time, and moreover a good deal of space is given to accounts of cases of no conceivable scientific or even historical importance, whilst others of considerable psychological value are omitted altogether.

Regarded as a well-documented and popular guide to the less serious side of psychical research during the last fifty years, this work will doubtless fulfil a useful purpose; but it cannot be claimed that it is in any sense a well-balanced, historical or critical account of a period in psychical research when much has been done and foundations laid for a better and more scientific approach to the problems in dispute. In order to meet this claim, what is required is a long and detailed account of the work accomplished, together with a running commentary dealing with the developmental history of experimental methods and a careful evaluation of the results obtained, with suggestions for improving both technique and constructive criticism.

E. J. D.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS.

(*Continued from page* 1074)

undertaken in Igdlorssuit. An examination of five ancient habitation sites was made on Ubekendt Island, and two of these, on the south and south-west coasts, were very productive of material. In the more easterly of the two sites, two houses were excavated and showed traces of both Eskimo and European cultures. The latter is of eighteenth century origin and the former up to two centuries earlier.

A collection of 405 plant specimens was obtained for the British Museum in 1938, chiefly from Ubekendt Island.

In continuation in 1938 of the work by Carmichael and Dymond[3], a number of pilot balloon flights were made. Evidence was obtained confirming the work of the previous year, very small wind velocity being again noted in the stratosphere at heights above 15 km. and a velocity maximum about 9 km. in the troposphere. The single theodolite (R.A.F. type) method was employed on the assumption that the balloons rose at constant rate. The same type of balloon was used as in 1937.

Longitude and latitude observations made at Igdlorssuit by means of a Watts 3½-inch micrometer theodolite indicate that the position of Ubekendt Island is correctly shown in the existing charts and maps. The topography of this island and also that of Upernivik is very inadequately and sometimes wrongly represented. A detailed plane-table triangulation on the scale of 1 : 50,000 was made of a small area embodying the most interesting geological features on the southern half of Ubekendt. Observations taken during excursions on Upernivik will amplify the topography and correct some errors.

Finally, it is thought desirable, on the whole, that work along similar lines should be encouraged, and, with the permission of the Greenland Administration, continued.

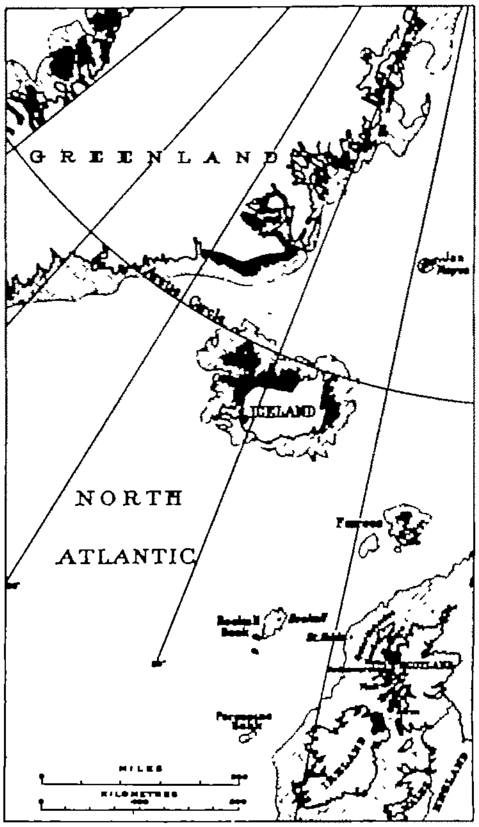


Fig. 2.

REPRODUCED FROM "SCOTLAND: THE TERTIARY VOLCANIC DISTRICTS", BY DR. J. E. RICHEY, BY PERMISSION OF THE CONTROLLER OF H.M. STATIONERY OFFICE.

---

[1] Wordie, NATURE, 140, 1083 (1937); *Geogr. J.*, 92 (1938).

[2] Drever, *Geogr. J.*, 94 (1939).

[3] Carmichael and Dymond, NATURE, 141, 910 (1938); *Proc. Roy. Soc.*, A, 171, 345–359 (1939).

OBITUARIES

Prof. W. Lindgren

PROF. WALDEMAR LINDGREN, deeply respected by all mining geologists, died at Brookline, Massachusetts, on November 3 at the age of seventy-nine. He was born at Kalmar in Sweden, and, after a general education in his own country, qualified for the diploma of mining engineer at the well-known *Bergakademie* of Freiberg in Saxony. In 1884 he emigrated to the United States, and soon after was appointed an assistant on the United States Geological Survey, where he passed through successive grades to be chief geologist in 1911.

Lindgren's field work was mostly done on the mining fields of the western States, in Arizona, California, Colorado, Idaho, Oregon, and Utah, his results being described in a series of remarkable memoirs which were characterized by carefully detailed records of the geology and mineralogy of the ore deposits, supplemented always with cautiously restrained excursions into the field of theory regarding their origin. On the data recorded in these earlier papers was built up the theory of 'secondary enrichment', especially of sulphide-ore deposits; for he noticed that the solutions formed by meteoric waters near the outcrops of the lodes passed down along the ore-bodies, and became deoxidized at greater depths preparatory to re-precipitation of the metals as sulphides by reaction with the primary ores at lower depths in the deposits. The theoretical aspects of this question and their variations due to previous changes in the physiography of the areas were afterwards discussed by Lindgren in various papers published in *Economic Geology*.

At a later stage in his long career of activity, and based partly on a study of the tin deposits in Bolivia and elsewhere, Lindgren formulated the principles of metasomatism as a process in the formation of ore-deposits. This subject he analysed in all its theoretical aspects in his presidential address to the Geological Society of America in 1925.

Occasional by-products of his main line of work appeared as descriptions of new mineral species and new occurrences of known forms. He was the first to recognize analcite as a primary mineral in igneous rocks, and this led to the necessity of re-examining the colourless, isotropic substances previously assumed to be residual glass in many basalts.

In 1912 Lindgren was appointed professor of economic geology at the Massachusetts Institute of Technology, and in the following year he published the first edition of his comprehensive treatise on "Mineral Deposits". In 1933 he retired from his chair after twenty-one years of distinguished service; and Prof. Palache, the eminent mineralogist at Harvard, two years later took the opportunity of giving the name lindgrenite to a new natural molybdate of copper, in the year in which Lindgren received also the honorary D.Sc. from Harvard. At "Technology", as the Institute is locally known, Lindgren's name is deeply respected, and is there preserved as the name given to the library of mining and geology. In 1933 he was elected president of the International Geological Congress, and two years ago the Geological Society of London conferred on him the highest honour at its disposal, the Wollaston medal, which has the peculiar interest of being struck in palladium, the relatively rare metal first isolated in 1802 by W. H. Wollaston.

Lindgren's massive record of facts about mineral deposits has been and will be extended by others; but it is unlikely that his theoretical deductions will ever undergo serious change, for he was too wise to stray beyond the deductions immediately justified by the facts, and he knew far too much about his subject to regard any present theory of ore-deposits to be complete to the exclusion of all others.

T. H. HOLLAND.

Prof. W. P. Lombard

THE death of Warren Plimpton Lombard at the age of eighty-four years removes one of the last direct links between the laboratory of Carl Ludwig and experimental physiology in the United States—a link with which American physiologists, like those of Britain, have always been proud. Born on May 29, 1855, the son of Israel Lombard by his wife, Mary Ann Plimpton, he was descended on both sides of his family from Puritan stock which had emigrated to the American continent early in the seventeenth century. He was born and spent his boyhood in West Newton, Massachusetts, and obtained his preparatory education in the public schools of that town. He received his baccalaureate degree from Harvard in 1878; and also an M.D., Harvard, in 1881.

On the advice of Henry Pickering Bowditch, who was a pupil of Ludwig as well as the first experimental physiologist of Harvard, Lombard went to Leipzig in 1881 to spend three years in the stimulating and liberal atmosphere of Carl Ludwig's laboratory. There he became interested in muscular contraction, in spinal reflexes and in the various recording techniques which Ludwig had devised and of which he was an accomplished master. His first paper, published from the Leipzig laboratory, dealt with the sequence of contractions of various muscles of the hind limb of the frog under reflex stimulation (*Arch. Anat. u. Physiol.*, 408; 1885). He designed elaborate recording myographs which made possible simultaneous records of as many as twenty muscles attached simultaneously to the lever system.

Lombard was one of the first after Descartes to consider the problem of reciprocal innervation of antagonistic muscles. Later he studied the knee-jerk, vasomotor reflexes, skin temperature and its control; and his successor, Robert Gesell, states that much of Lombard's time during his early years was devoted to the study of the mechanics of two-joint muscles (see *Amer. J. Physiol.*, 20, 1; 1907). "The fact that a two-joint muscle can make use of the tendon action of another two-joint muscle on the opposite side of the leg accounts for the paradox that a two-joint muscle, when in a position to have a stronger extensor than flexor leverage, may extend a joint of which it is a flexor". He was likewise interested in respiration and worked out a balance sufficiently sensitive to record the minute changes in weight incident to the fluid loss which accompanied each expiration. His technique for observing capillary circulation in man has been almost universally adopted in the many subsequent studies carried out in this field. As a teacher he followed Ludwig in being an ardent exponent of 'practical' laboratory instruction, and few better laboratory guides have ever been written than his "Directions for Laboratory Work in Physiology for the use of Medical Students (2nd ed. 1914).

On returning to the United States from Europe, Lombard became an assistant in physiology at the College of Physicians and Surgeons in New York City. Thereafter he went back to Europe for several years and on reaching America again in 1889 he accepted the appointment of assistant professor in physiology at Clark University in Worcester, Massachusetts. In the same year, William Howell took the chair of physiology at Michigan as successor to Henry Sewall, whose health had forced him to abandon the inclement weather of Michigan for the clearer and warmer climate of Colorado. Howell was called to Johns Hopkins in 1892 and Lombard was then asked to fill the chair of physiology at the University of Michigan, where he remained until his wife's death in 1923, at which time he retired.

Lombard was a warm and friendly person, who had wide interests apart from science, and in the years between his retirement and his death he devoted himself to drawing, water-colour painting and etching. He spent his summers at Monhegan, Maine, and his friends paid tribute each year to his increasing artistic skill. Shortly before his death, he read a paper to a scientific club in Michigan in which he characterized himself in the following terms: "I have always been an optimist and I cannot claim to have ever been religious. I have thoroughly enjoyed life and feel that the finest one can do is to bring pleasures into the lives of others. In this I find a worthy reason for living and shall be glad to live as long as I can enjoy life and help others to do so."

J. F. FULTON.

WE regret to announce the following deaths:

Mr. George Eumorfopoulos, the well-known collector of Chinese porcelain and other examples of Oriental art, on December 19, aged seventy-six years.

Prof. Eduard Fischer, professor of botany in the University of Bern from 1897 until 1933.

Senatore Prince Ginori Conti, a well-known Italian industrial chemist, on December 3.

Prof. A. J. Hopkins, emeritus professor of chemistry in Amherst College, known for his work on the early history of science, on November 10, aged seventy-five years.

NEWS AND VIEWS

Scientific Research and Technical Development

AN Advisory Council on Scientific Research and Technical Development has been set up by the Minister of Supply to advise him on scientific and technical problems. The main functions of the Council will be to ensure that the work of the Directorate of Scientific Research is carried out with due regard to recent advances in scientific knowledge, to introduce new fields of research and development, and to make recommendations regarding the most effective use of scientific personnel. The chairman of the Council is Lord Cadman, emeritus professor of mining and petroleum technology in the University of Birmingham, chairman of the Anglo-Iranian Oil Co., Ltd. and of the Iraq Petroleum Co., Ltd. The Admiralty, Air Ministry, and Ministry of Home Security are also represented on the Council, of which the joint secretaries are Mr. E. T. Paris and Mr. F. Roffey, Ministry of Supply, Adelphi, W.C.2.

THE Council is constituted as follows: Prof. E. N. da C. Andrade, professor of physics, University College, London; Dr. E. V. Appleton, secretary, Department of Scientific and Industrial Research; Sir Joseph Barcroft, formerly professor of physiology, University of Cambridge; Prof. W. L. Bragg, Cavendish professor of physics, University of Cambridge; Major-General E. M. C. Clarke, director of artillery (military adviser), Ministry of Supply; Prof. J. D. Cockcroft, professor of natural philosophy, University of Cambridge; Major-General A. E. Davidson, controller of mechanization development (military adviser), Ministry of Supply; Dr. H. J. Gough, director of scientific research, Ministry of Supply; Dr. H. L. Guy, chief engineer, Mechanical Engineering Department, Metropolitan-Vickers Electrical Co., Ltd.; Sir Harold Hartley, vice-president and director of research, L.M.S. Railway, and chairman of the Fuel Research Board; Prof. I. M. Heilbron, professor of organic chemistry, University of London; Prof. A. V. Hill, secretary, Royal Society, and Foulerton research professor (physiology); Prof. R. S. Hutton, professor of metallurgy, University of Cambridge; Sir Robert Robertson, director of the Salters' Institute of Industrial Chemistry, formerly Government chemist; Sir Robert Robinson, professor of chemistry, University of Oxford; Mr. J. Rogers, deputy director-general of explosives, Ministry of Supply; Sir Frank Smith, director of instrument production, Ministry of Supply, director of research, Anglo-Iranian Oil Co.; Prof. R. V. Southwell, professor of engineering, University of Oxford; Prof. G. I. Taylor, Yarrow research professor of the Royal Society (engineering); Sir Maurice Taylor, senior military adviser, Ministry of Supply; Sir Henry Tizard, rector of Imperial College of Science, chairman, Aeronautical Research Committee.

Early Man and his Forerunners

IN the two years 1937–39 a series of researches carried out by P. Teilhard de Chardin, Prof. Franz Weidenreich and their fellow-workers of the Cenozoic Research Laboratory of the Geological Survey of China, papers on which have only just reached Great Britain (see NATURE, December 23, p. 1054 and December 30, p. 1097) has made a notable contribution to anthropological study, not merely in so far as it deals with early man in China, but also in its bearing upon fundamental problems of the development of the human stock and the origin and distribution of its varieties. How far Teilhard de Chardin's suggested need for a revision of Tertiary and Quaternary classification in geology and palæontology will be accepted as of general application may remain in abeyance for the moment; but his brilliant synthetic study of recent geological and palæontological discovery provides a new diagnosis—in China at least—for the much-debated division between Pliocene and Pleistocene in the form of the definite break, almost catastrophic in its proportions, in fauna and physiographic conditions between the Nihowan and Choukoutien phases of the so-called Sanmenian, which is followed by the appearance of man, who in some sort, it may be suggested, now might be regarded as a characteristic fossil.

THE work of Prof. Weidenreich, more especially with the supplement of the cultural study of the contents of the palæolithic cave at Choukoutien, by W. C. Pei, offers too many points of interest for detailed comment here. One matter of special moment is the inference he draws that the important body of knowledge which has been derived from the specimens of Sinanthropus calls for "a radical transformation of our conceptions of the problem of mankind", and he then proceeds to the significant conclusion that while human development has been orthogenetic, it has also been polycentric, certain consequences following logically upon this as affecting the mode of that development, in which Lamarckian and Darwinian conceptions are set aside as unimportant in favour of an evolutionary progressive development of the type. At the same time, his remarkable diagnosis of three racial types—Melanesian, Eskimoid and Mongoloid—in a single and small palæolithic population at so early a date is scarcely less significant for the further development of racial theory at large. Mr. Pei's cultural study of this same palæolithic population affords a view of its technological capacity which is little less than surprising. This is also, be it noted, the first site in China on which cultural material of palæolithic age and human skeletal remains have been found in association.

Universities and Government Grants

IT is generally known the Government grants to the universities of Great Britain have been stabilized for a limited period from the beginning of the War. As that time approaches its end, the Government and the University Grants Committee will be faced with a difficult task. The incessant call for economy at this time of stress must be heeded. No sum that can be saved, however small it may be, is negligible in the present circumstances; indeed it may be in the multitude of minor economies that the best hope lies. Nevertheless, in the matter of the universities, great caution and careful scrutiny will be necessary. Any move which curtails the efficiency of the universities in the discharge of their duties would be sharply criticized. It will readily be granted that the undergraduate population of the universities has decreased substantially, and national service has also claimed a varying proportion of the teaching and supervisory staffs. Teaching and research must, however, still go on. Apart from present needs, there is the future to consider. When the time comes for reconstruction, the universities must be ready to expand rapidly and to play their part in building up the new order. This they can do only if they retain their efficiency throughout the days of war-time activity. The task of those in authority will be to satisfy present needs and also to enable the universities to meet their obligations to the future.

British Social Hygiene Council

IT has been found impossible to continue meetings of the full Educational Advisory Board of the British Social Hygiene Council during the War. A representative Emergency Committee has been formed, however, and held its first meeting on December 19 at Tavistock House, London, W.C.1. It was decided that the long-term policy of stimulating the development of biological education should be maintained so far as is possible. The possibilities of educational activities are to be explored on a regional basis; particular attention is to be directed towards providing short courses of lectures and talks for youth leaders, adolescents and men and women in the military forces. The development of biological education in the Colonies is being continued and negotiations for the production of text-books of biology for use in schools in East Africa should soon be completed. Tentative inquiries are also being made to determine the possibilities of holding a Summer School for teachers, if circumstances permit.

Dendrochronology in the Eastern United States

THE dream of the archæologist, for whom from the nature of his material an absolute chronology is rarely available, has been the attainment of a system of dating which should be universally valid; but diversity of conditions, as a rule, precludes anything approaching certainty when attempts are made to apply any given method of time measurement outside a more or less restricted area. For this reason much interest is attached to attempts which are being made to extend the tree-ring method of dating outside the south-western United States, where it has been applied with conspicuous success to the dating of Pueblo remains and structures. The first successful observations in the eastern United States are recorded by Prof. Charles J. Lyon, of Dartmouth College (*Science*, **90**, 419; Nov. 3, 1939), who has compared the rings of virgin white pine felled by a hurricane in September 1938 at Wolfeboro, N.H., with buried logs of the same species uncovered in an excavation at the site of an ancient bridge abutment nearby. The skeleton plot method of Douglass gave the date of 1806 for the last ring formed in the trees used to build the bridge, a result said to be "very reasonable in the light of Wolfeboro history". Further, from North Sutton, N.H., thirty-nine miles south of this bridge, a record of white pine was obtained for a 260-year period, establishing a link with the buried logs in a 128-year overlap between the outer rings of the latter and the inner rings of the Sutton trees. Although not sufficient for a standard scale, yet this marks a beginning in the formulation of an efficient instrument for the eastern archæologist; but it is noted that the identification in detail is less perfect than in the south-west. Apart from the cross-check, however, the rings agreed with a number of entries of drought in a diary.

History of Intensive Cultivation

AN interesting historical review of progress in the production of early vegetables by methods of intensive cultivation has recently been issued by R. J. G. Hopp (*J. Roy. Hort. Soc.*, **64**, Pt. 2; Nov. 1939). The first record of forcing plants appears to be in the time of the emperor Tiberius, when cucumbers were grown in boxes of dung and sheltered during cold days with thin plates of *Lapis specularia*. Lettuce is mentioned by Charlemagne, and in the time of Albertus Magnus (1193–1280) it was grown throughout the year. From the Norman invasion of England until the middle of the sixteenth century, gardening appears to have been very greatly subordinated by the political unrest. Its development in the seventeenth century was closely bound with the herbalists Gerard and Parkinson. The initiation of French gardening, involving the protection of early plants with glass *cloches*, appears to have been due to Jean de la Quintinye in the second half of the seventeenth century, and crops were then brought to maturity upon hotbeds. John Evelyn, John Woolridge and Prof. Bradley added their quota of horticultural development in the succeeding hundred years, to be followed by J. C. Loudon. French gardening declined in the later half of the nineteenth century, however, only to give place to the more workable and convenient methods of glasshouse culture which provide our present supplies of extra-seasonal vegetables.

A New Cyclotron

The cyclotron constructed in the workshop of the Physics Department of Purdue University, Indiana, is described in the November issue of the *Journal of the Franklin Institute* by the five members of the staff who designed it. So far as possible standard materials available in industry have been used in its construction. The magnet is of low carbon steel 3 m. long and 2 m. high, and the pole pieces of special shape 1 m. diameter. The magnetizing coils are of thin copper tube through which cold water circulates. Each coil is square in section with side 30 cm. The oscillator is of the tuned grid tuned plate type, of frequency 10·9 Mc., with neutralizing condensers. It takes 3 amperes at 8,500 volts. The chamber is of the Berkeley type with floor and top of steel plate 3 cm. thick with special arrangements for controlling the bending due to external pressure, which has been found to increase the beam intensity. The ions are supplied by an arc near the centre of the cyclotron. The instrument yields 16·5 million volts for He^{++} ions.

The National Institute for Research in Dairying

The annual report of the National Institute for Research in Dairying, Reading, covering the year ending September 30, 1938, has just been published; this seems an unnecessarily long delay. Developments, administrative matters and changes in the staff are outlined, and a summary is given of the research work that has been carried out in the various departments. Among the last named is an investigation in the Department of Physiology and Biochemistry on the nutritive value of spray-dried milk, roller-dried milk and evaporated milk. The biological values of the proteins, and the content of vitamin A and of vitamin C are much the same for all three products, but vitamin B is much reduced in the evaporated milk—to half that present in the other two. The results show that properly dried milk retains to a remarkable extent the nutritive value of the raw product and that modern methods of spray drying yield a powder of high nutritional quality. An appeal is made for donations to meet the cost of new buildings which are urgently needed to relieve the acute congestion in the existing laboratories.

International Society of Medical Hydrology

A meeting of the general purposes committee of the International Society of Medical Hydrology was held in London on November 17 last to deal with emergency measures made necessary by the War, and also by the death of the Society's chairman of council, Dr. E. P. Poulton. Dr. J. Barnes Burt was elected interim chairman of council, and four additional vice-chairmen, all in countries 'neutral' in the present conflict, were appointed. It was further resolved that the cash balance remaining should be set aside for reconstruction of the Society after the War, and the general secretary was given indefinite leave of absence without pay and instructed to close the London office. The Society's address will be, until further notice, that of the honorary treasurer, Dr. G. D. Kersley, 6 The Circus, Bath.

Medical Organizations of India

The medical organizations of all-India are reviewed by Major-General Bradfield, director-general of the Indian Medical Service, in a volume of 658 pages entitled "An Indian Medical Review" (Government of India Press, New Delhi, 1938). Administrative organization and the medical profession and services, hospitals and nursing, maternity service and pharmacy, and medical education and research, are all surveyed in the first 280 pages, the remainder of the book containing full statistics of hospitals, dispensaries and other medical institutions. This volume should prove a useful supplement to the "Annual Report of the Public Health Commissioner with the Government of India".

The Night Sky in January

During this month, the night shortens in the latitude of London by 1 hour 10 minutes, reckoning from sunset to sunrise. The moon is new on January 9, and full on January 24. Occultations of stars by the moon include three stars of magnitude 3–4 of the Hyades cluster which precedes Aldebaran. The disappearances as seen from Greenwich take place on January 20 as follows: δ Tauri at 21h. 37·9m. at position angle 107° from the north point of the moon's disk: 64 Tauri at 22h. 31·1m. at 142° and 68 Tauri at 23h. 29·0m. at 16°. On January 23, λ Geminorum (3·6 m.) is occulted at 20h. 20·9m. at 121°. There is a fine array of planets in the evening sky—Venus, Mars, Jupiter and Saturn—whilst Uranus, a faint 6th magnitude object, is in Aries near the 6th magnitude star 53 Arietis. At the beginning of the month, Mars is overtaking Jupiter in the eastward shift of the two planets among the stars by about ½° a day, and on January 7 at 15h. there is a conjunction, the geocentric distance between the two objects being 1·2°. It is interesting to compare the colours and magnitudes of Mars and Jupiter when close together. Lunar conjunctions with the planets occur as follows: Jan. 8d. 10h. with Mercury; 12d. 13h. with Venus; 15d. 22h. with Jupiter; 16d. 7h. with Mars; 17d. 17h. with Saturn. In mid-January at about 22h., the southern meridian is bright with the stars of Taurus, Auriga, Orion, Gemini, Canis Minor and Canis Major. The Great Nebula of Orion shows to the naked eye as a hazy patch. The photographic plate is required to show the nebulosities, which, enveloping the Pleiades, are but the central condensation, according to Barnard, of an enormous nebula covering at least 100 square degrees. Not far from φ Tauri is a dark nebulous region giving the strongest proof, according to the same authority, of the existence of obscuring matter in space. Near ζ Tauri is the so-called Crab Nebula, which is No. 1 in the catalogue of 103 nebulæ drawn up in 1781 by Messier for his own use when searching for and identifying comets.

Announcements

THE Royal Meteorological Society's Symons Gold Medal for 1940 has been awarded to Prof. Dr. J. Bjerknes of the Geofysiske Institutt, Bergen.

THE Secretary for Mines has appointed Lord Cadman to be honorary adviser on oil, and Sir Harold Hartley to be honorary adviser on the development of home-produced fuels.

THE Minister of Health and the Secretary of State for Scotland have jointly appointed Dr. Edward Ellice Henderson, a medical officer of the Ministry of Health, to undertake the duties of inspector of anatomy in England, Scotland and Wales.

IT is of interest to put on record that Major-General A. G. L. McNaughton, commanding the Canadian Active Service Force which has recently landed in Great Britain, is a science graduate of McGill University and was president during 1935–39 of the National Research Council of Canada.

THE popular series of Gaumont British Instructional Films called "Secrets of Life" have now been made in colour using the Dufay process, and three of the present series of six were demonstrated at Film House on December 20. The valuable teaching aid that colour gives in educational films was apparent, and although many technical difficulties remain to be overcome, these films portraying the life-history of the burnet moth, the genetics of the lupin, the habits of badgers and other subjects have already reached a high level of efficiency. Mr. Oliver Pike's photographs in the badger film represent a real contribution to natural history.

DR. GEORGE W. CORNER, who has occupied the chair of anatomy in the University of Rochester (New York) since 1924, has been appointed director of the Department of Embryology, Carnegie Institution, Washington, D.C. He succeeds Dr. George Streeter, who has done so much to give the Department of Embryology of the Carnegie Institution its high place in the estimation of embryologists in all parts of the world. Dr. Streeter, who now retires, succeeded the first director—the late Prof. Franklin Mall. Dr. Corner's appointment has the warm approval of his fellow embryologists.

SIR WALTER LANGDON-BROWN has been appointed president of the British Social Hygiene Council in succession to the Right Hon. L. S. Amery, M.P.

A CHILD Guidance Clinic providing a limited service is available at Guy's Hospital for the hospital area.

ACCORDING to official statistics of the last fifty years, there has been a considerable reduction in the tuberculosis mortality in Germany. In women the mortality per 100,000 has fallen from 28·4 to 6·4 and in men from 34·2 to 7·8.

ACCORDING to the latest provisional figures issued by the United States Bureau of Census, the infant mortality reached a record low level of 50·9 per 1,000 live births in 1938, as compared with 54·4 in 1937. The rate has been decreasing steadily for twenty years: in 1915, when the birth registration area was established, it was 99·9.

THE Pan-American Congress of Rural Hygiene organized by the Government of Mexico and the International Congress of Otorhinolaryngology which were to have been held in 1940 have been postponed indefinitely owing to the War.

WE have received the first annual report of the Council of the Institute of Medical and Veterinary Science, Adelaide, South Australia. New laboratories of the Institute have recently been opened, of which an illustration is given. The Institute provides for the Adelaide Hospital, and for practitioners resident in the district, services in pathology, bacteriology and biochemistry, as well as work in veterinary pathology. A summary is given of the research work conducted by the staff of the Institute. This Institute was described by Sir Charles Martin in NATURE of August 26, p. 392.

Chronica Botanica, the international botanical journal published under the editorship of Dr. Frans Verdoorn, is to appear weekly from January 1940. This journal is unique among scientific journals, and contains digests, correspondence, quotations, comments on international affairs, news of institutions, experiment stations, gardens, societies, etc., personal notes and news, reviews, etc. The annual subscription will be 15 guilders, including postage. Further information can be obtained from *Chronica Botanica*, P.O. Box 8, Leyden, Holland.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "Letters" will not be submitted to correspondents outside Great Britain.

Notes on points in some of this week's letters appear on p. 1094. Correspondents are invited to attach similar summaries to their communications.

Scientific and Technical Literature and Information

I have read with interest the editorial in Nature of November 25, 1939, concerning the need for a centre of documentation with the purpose of supplying original papers to scientific institutions and to libraries. Further aims of such a centre might be to prepare abstracts and translations, to set up complete documentation indexes and to take the role of a link between research institutes.

The difficulties pointed out in the editorial have been met with in France, too. I have the pleasure of announcing that a body similar to that suggested in Nature has just been brought into existence in this country, under the auspices of the "Centre National de la Recherche Scientifique" which is an autonomous Department of the Ministère de l'Education Nationale. This "Service de Documentation" undertakes the following tasks:

(1) to receive and to keep all scientific periodicals which are considered to be of importance for complete documentation covering the fields of chemistry, physics, applied chemistry, technical physics, biochemistry, and some branches of biology;

(2) to abstract these periodicals in the form of very short summaries including title, reference, and a few lines intended to locate accurately the contents of each paper;

(3) to edit and to publish a printed bulletin, to appear twice a month, and to supply it to the institutions concerned;

(4) to reproduce on microfilm single original papers wanted by laboratories and research institutes; to supply positive copies of such microfilms; to keep the negatives;

(5) to establish several card indexes of the abstracts, by authors, by subject matter and so forth, so as to facilitate quick compilation of complete dossiers on a given subject, whenever asked for;

(6) on request, to supply translations of papers published in unusual languages.

This "Service de Documentation" was created on November 16, 1939, and it is hoped that the first bulletin may appear within a few weeks. The Service is to act in close collaboration with French scientific societies, especially those which have been publishing scientific abstracts.

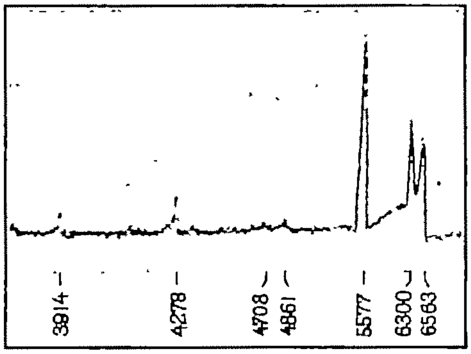
I shall be very glad to get in touch with people dealing with the same problem in Great Britain, in view of possible collaboration in this matter between our two allied countries.

P. Auger.
(Directeur.)

Service de Documentation
du Centre National de la Recherche Scientifique,
18 rue Pierre Curie, Paris, Ve.

Hydrogen Showers in the Auroral Region

Previous investigations have shown that the hydrogen lines are usually absent from spectrograms of the auroral luminescence. Even when the stronger lines and bands are much over-exposed and also very faint lines appear, there may still be no trace of the H-lines visible on the spectrogram[1,2,3,4]. This does not mean, however, that hydrogen may not occasionally appear in these regions. On the contrary, some years ago I gave, for the luminous night clouds, an explanation[5] based on the assumption that showers of hydrogen, coming from the sun, entered into the atmosphere and combined with oxygen, for example, in the atomic or ozone state, to form water vapour. At the altitude of the luminous night clouds (80 km.), the atmospheric pressure might be sufficiently great for the water vapour to condense and produce clouds of ice needles.



During an auroral display on October 18 this year, we obtained at Oslo auroral spectrograms indicating the existence of such hydrogen showers. In the region of long waves, two spectrograms from auroral arcs showed the green line (5577) and the red one (6300) with considerable density. The 1st positive group, however, was scarcely visible; but far in the red end and well separated from the line (6300), a strong line appeared with a wave-length (6560) which within the limit of error coincides with H_α (6563). Now this coincidence might be accidental, but on the first of our spectrograms (exposure from 19.15–20.13 M.E.T.) where the spectrum appeared with greatest density, another line appeared for which we found the wave-length 4860, which within the limit of error coincides with H_β (4861).

This line, which is usually absent in the auroral spectrum, now appeared with a density twice that of the negative band 4708 and about two thirds that of the strong band 4278. A spectrophotogram of the spectrum is shown in the accompanying reproduction.

The simultaneous great enhancement of two lines, one of which coincides with H_α, the other with H_β, can scarcely be accidental, and our spectrogram thus would show that *occasionally considerable quantities of hydrogen are present in the auroral region.*

The fact that the hydrogen concentration usually is too small to give detectable lines would show that *the occurrence of strong hydrogen lines must be due to showers of hydrogen or to a kind of 'hydrogen radiation' occasionally coming from the sun.* The hydrogen is then removed from the auroral region through the formation of water vapour and condensations, which may appear as luminous night clouds.

L. VEGARD.

Physical Institute,
Oslo.
Nov. 20.

---

[1] Vegard, L., *Phil. Mag.*, 46, 193 (1923); *Z. Phys.*, 16, 367 (1923).
[2] Vegard, L., *Geof. Publ.*, 9, No. 11 (1932).
[3] Vegard, L., *Geof. Publ.*, 10, No. 4 (1933).
[4] Vegard, L., and Harang, L., *Geof. Publ.*, 11, No. 15 (1936).

Origin of the λ 4932 Emission in the Spectra of Novæ

MESSRS. J. DUFAY AND M. BLOCH[1] have recently discussed the presence of a faint emission band at about 4932 A. in the spectra of Nova Herculis (1934) and of Nova Aquilæ (1918), and have suggested that the radiation is to be identified with the forbidden ${}^3P_0-{}^1D$ transition of O (III), the companion of the N_1 and N_2 lines at 5007 and 4959 A. respectively. This assignment, as was mentioned by Dufay and Bloch, was made by Bowen and Wyse in the spectra of N.G.C. 6572 and 7027, and the line was later observed also in N.G.C. 7662[2].

While the identification is probably correct in the nebulæ cited, it appears to be open to question in the novæ, particularly in Nova Aquilæ (1918). The maximum observed by me at 4932 A. in the spectrum of this nova is very probably only a subsidiary maximum in the broad N_2 emission band, centred at 4959 A.; such is the interpretation in my paper[3], to which Dufay and Bloch make reference. The relatively strong continuous spectrum, as well as the great width of the bands themselves (approximately 50 A.), tends to obliterate the faint radiations. Therefore if a *bona fide* emission band were present at 4932 A., it would probably have to be at least 1/10 or 1/20 as bright as N_2 in order to be detected, and thus it could not be the ${}^3P_0-{}^1D$ emission, which is much fainter both by prediction and by observation in the nebulæ.

The case for Nova Herculis (1934) is not so clear-cut. The Lick Observatory spectrograms of 1935 and 1936 confirm the observation of Dufay and Bloch of a faint emission at 4932 A. The emission appears to be several times stronger with reference to N_1 and N_2 than in the nebulæ, thus suggesting some other identification. The difference, however, may possibly be attributed to the differing contrasts of the two emulsions involved. Another approach to the question consists in examining the constancy or variability, in Nova Herculis, of the intensity ratio, I_{4932}/I_{4959}, which should be an atomic constant for O III. Two Lick Observatory spectrograms, dated September 26, 1935, and May 1, 1937, both record the N_2 emission as of about equal density, the image on the latter plate being slightly denser than on the former. The 4932 A. line appears definitely on the former plate (density about 0·8), while on the latter plate it is absent. Inasmuch as the two spectrograms have been made on the same type of emulsion and have been developed in the same way, and further, since both plates are capable of showing the lines resolved, the inference is that the 4932 A. line faded in the interval, with respect to N_2, by a factor of at least 10, and that it is therefore not chiefly attributable to O III.

Perhaps this observation should not be taken at its face value, in view of the possibility of solarization of the strong lines on one or both of the plates, or other spurious photographic effects. In any event, there appears to be room for doubt regarding the assignment of the nova emission at 4932 A. to O III.

A. B. WYSE.

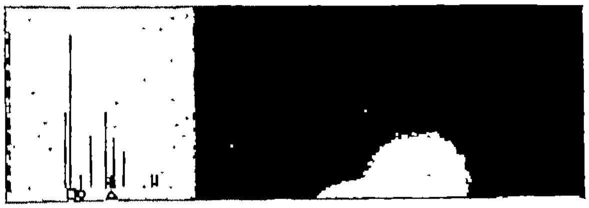
Lick Observatory,
Mount Hamilton,
California.
Nov. 20.

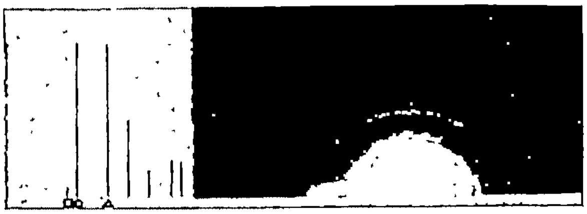
---

[1] NATURE, 144, 593 (1939).
[2] *Lick Obs. Bull.*, 19, 1 (1939).
[3] *Publ. Lick Obs.*, 14, Part 3 (1939).

Electron Diffraction Examination of Oxide Films on Light Metals

WHILE iron rusts quite easily in air, such baser metals as aluminium, magnesium, zinc, etc., do not manifest this tendency and retain their metallic lustre for a considerable length of time. This commonplace fact is interesting but requires experimental study for a full understanding. For a study of metal surfaces as in these cases, the method of electron diffraction is most powerful.


MAGNESIUM AT ROOM TEMPERATURE.


MAGNESIUM AT 400° C.
□ INDICATES THE EXISTENCE OF MG. ○ AND △ INDICATE THE EXISTENCE OF MGO.

Electron diffraction photographs of magnesium specimens, prepared by polishing the surface with a coarse sandpaper, were taken after exposing them to air at room temperature, at 200° C., at 300° C., and at 400° C. Of the two photographs reproduced, one is that of the specimen at room temperature and the other is that of the specimen heated at 400° C. In the graphs, the horizontal distance from the origin is the radius of the ring while the length of the lines is a measure of the intensity by visual estimation.

The most intense ring of MgO is found, though faint, in the pattern of the specimen left in the air at room temperature; likewise, the most intense ring of Mg is seen faintly in the pattern of the specimen heated at 400° C. It has therefore been concluded that magnesium metal is masked with a thin film of magnesium oxide (MgO) even at room temperature, and the film is still quite thin even after heating at 400° C. Such a thin film, 10 A. or so in thickness, protects the metal and keeps it lustrous for a long time.

Although it is very difficult to obtain the patterns of the aluminium oxides by the reflection method[1], we succeeded in producing them by making deep ditches on the metal. Precisely as in the case of magnesium, it was possible to verify that the surface of aluminium at room temperature is covered with a film of γ-Al_2O_3, while the specimen heated at 500° C. is covered with a film of α-Al_2O_3.

With beryllium left exposed at room temperature, the pattern obtained from the surface precludes the possibility of even a trace of rings belonging to the oxide BeO.

Full details of these experiments will be published in the *Scientific Papers* of our Institute.

ICHIRÔ IITAKA.
SHIGETO YAMAGUCHI.

Institute of Physical and
Chemical Research,
Tokyo.

---

[1] Preston, G. D., and Bircumshaw, L. L., *Phil. Mag.*, 22, 654 (1936).

Decomposition of Hydrogen Peroxide by Catalase

THAT the catalytic decomposition of hydrogen peroxide by catalase requires the presence of molecular oxygen was demonstrated by a number of manometric experiments previously described[1]. Being, however, well aware of certain difficulties in this kind of work, we have given a detailed account of our methods so that our experiments could easily be repeated.

The failure by Weiss and Weil-Malherbe[2] to confirm our results can only be ascribed to some defects in their experimental procedure and to the fact that they have not closely followed the recommendations put forward in our paper.

Our criticism[3] of experiments with luminescent bacteria was not solely due to the purely qualitative character of this work[4], but mainly to the fact that under the conditions of these experiments even a 90 per cent inhibition of catalase could not be detected.

That the curves of inhibition shown in our paper are not of autocatalytic type can be explained by the instability of pure catalase at high dilutions (0·0005 mgm. per flask) used in our experiments.

Moreover, our manometric experiments, which we have repeated several times since the publication of our paper, are in complete agreement with the results we have obtained from the study of catalase inhibited by sodium azide or by hydroxylamine[5]. Both these inhibitors combine reversibly with catalase giving well-defined compounds.

It is, however, important to remember that free catalase and azide- or hydroxylamine-catalase are very similar compounds displaying the same general properties. Thus, their iron is in the trivalent state, they show a typical methæmoglobin-like absorption spectrum, they share the remarkable property of not being reduced by a powerful reducer like sodium hyposulphite and they react with hydrogen peroxide.

While the reaction of free catalase with hydrogen peroxide is extremely rapid and therefore inaccessible to spectroscopic study, that of azide- or hydroxylamine-catalase is on the contrary slow and can easily be followed spectroscopically. The study of this reaction clearly shows that azide-catalase treated with hydrogen peroxide undergoes reduction which is marked by a distinct change in its colour and its absorption spectrum and by the appearance of the property, shared with other divalent haematin compounds, of combining with carbon monoxide. On the other hand, the reduced azide-catalase cannot be oxidized by hydrogen peroxide although it can be oxidized by molecular oxygen, which in this reaction is reduced not to hydrogen peroxide but to water. In this respect catalase, unlike many autoxidizable compounds, resembles cytochrome oxidase and probably polyphenol oxidase which on reoxidation reduce oxygen to water. Azide and hydroxylamine inhibit the activity of catalase only because they slow down the reoxidation of ferrous catalase by oxygen.

Our conclusion that catalatic decomposition of hydrogen peroxide is brought about by a constant reduction of catalase iron by hydrogen peroxide and its reoxidation by molecular oxygen is therefore well supported by two independent experimental approaches to the problem, namely the manometric and spectroscopic studies of the enzyme. The importance of specific inhibitors and of spectroscopic methods in the study of enzymes is now universally recognized and can scarcely be over-estimated. In very few cases, however, can the importance of these methods be so clearly demonstrated as in the study of catalase.

Considering that a pure or even crystalline catalase showing strong colour and absorption spectrum can be so easily prepared, the workers[2] interested in the intimate mechanism of catalatic activity should attempt to prepare such an enzyme and to acquire thus a first-hand knowledge of its properties.

The fact that the results of our experiments do not agree with certain theoretical considerations[2,6] concerning the possible mechanism of catalytic activity of this enzyme suggests only that these considerations require some revision.

D. KEILIN.
E. F. HARTREE.

Molteno Institute,
University,
Cambridge.
Dec. 13.

---

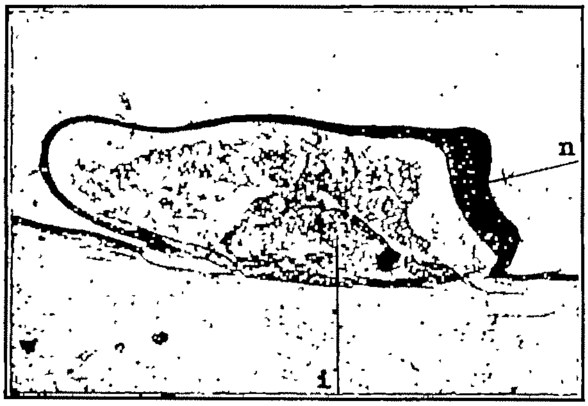
[1] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, 124, 397 (1938).
[2] Weiss, J., and Weil-Malherbe, H., NATURE, 144, 866 (1939).
[3] Keilin, D., and Hartree, E. F., NATURE, 144, 787 (1939).
[4] Johnson, F. H., and van Schouwenburg, NATURE, 144, 634 (1939).
[5] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, 121, 173 (1936).
[6] Weiss, J., *J. Phys. Chem.*, 41, 1107 (1937).

Evocation in the Chick

WORK on the evocation of neural tissue in vertebrate embryos by chemically prepared substances has hitherto been confined to the Amphibia[1]. But since in the induction of neural tissue in general the chick has shown considerable similarities to the newt, especially in the inducing activity of its organizer when coagulated[2], and in the inducing activity of fully differentiated tissues[3], there was reason to believe that it would respond in a similar way to chemicals. This was not tested, however, owing to a technical difficulty: any implant of dead material becomes surrounded by mesenchyme, and consequently isolated from the reactive ectoderm[2].

This difficulty has recently been surmounted. The substance to be tested, dispersed in a piece of coagulated egg albumen by Waddington's method[4], is inserted between the endoderm and ectoderm (presumptive epidermis) in the antero-lateral region of the area pellucida of a blastoderm in the early primitive streak stage. This region of the area pellucida, together with the adjacent area opaca, is then isolated, no part of the primitive streak being included with it, and the isolate is grown *in vitro* by Waddington's method[3]. At the time of isolation no mesoderm is present in this part of the blastoderm, and since the primitive streak is eliminated none afterwards appears in it.

Controls with no implant formed no neural tissue, and only very occasionally a slight epidermal thickening, provided the antero-medial region of the area pellucida was not included. Controls of albumen alone commonly showed a slight epidermal thickening.



EVOCATION BY SODIUM-1:2:5:6-DIBENZANTHRACENE-ENDO-α-β-SUCCINATE.
i, IMPLANT; *n*, NEURAL PLATE.

All the chemical substances tested on the chick had previously been shown to be active in the Amphibia[4]. One satisfactory evocation of a neural plate was obtained with sodium-1:2:5:6-dibenzanthracene-endo-α-β-succinate (see figure). The most usual result with this substance, however, was an extension in area of the ectoderm, together with a non-neural thickening; the latter varied from a histologically epidermal thickening little greater than those found in the controls, to a large thickening histologically like early neural tissue. One induction, in which, however, the origin of the ectoderm is not certainly established, was obtained with 1:2:5:6-dibenzanthracene, which is carcinogenetic in the adult fowl[6]. Styryl 430, very active in Amphibia[4], was only slightly more active than plain albumen in the chick. 1:2-dihydroxy-1:2-di-α-naphthylacenaphthene was no more active than plain albumen. A probably impure specimen of naphthalene, of moderate activity in Amphibia[4], was the most active substance tried: three good evocations were obtained with it. Impure glycogen, active in Amphibia, produced no neural tissue, but a very marked proliferation of epidermal cells.

Presumptive epidermis, coagulated by heat or acetone, was also tested. One good evocation, and one almost positive, were obtained (both acetone coagulation), and various degrees of thickening were produced in other specimens. As in Amphibia, therefore[7], the presumptive epidermis, which is the indicator of evocating activity, can itself be made to become an active evocator.

The conclusion from these results is that the process of evocation is fundamentally similar in the chick and in the newt, in that it can be produced by chemicals and by coagulated presumptive epidermis. But the chick is rather refractory material, and there are clear indications that the degree of its reactivity to individual chemicals is different from the newt's.

M. ABERCROMBIE.

Strangeways Research Laboratory,
Cambridge.
Nov. 23.

[1] Waddington, C. H., and Needham, D. M., *Proc. Roy. Soc.*, B, 117, 310 (1935); Waddington, C. H., *Proc. Roy. Soc.*, B, 125, 365 (1938); Fischer, F. G., Wehmeier, E., Lehmann, H., Jühling, L., and Hultzsch, K., *Ber. dtsch. chem. Ges.*, 68, 1196 (1935); Barth, L. G., *Physiol. Zool.*, 12, 22 (1939).

[2] Waddington, C. H., *J. Exp. Biol.*, 11, 218 (1934).

[3] Waddington, C. H., *J. Exp. Zool.*, 71, 273 (1935).

[4] Waddington, C. H., *Proc. Roy. Soc.*, B, 125, 365 (1938).

[5] Waddington, C. H., *Phil. Trans. Roy. Soc.*, B, 221, 179 (1932).

[6] Burrows, H., *Amer. J. Cancer*, 17, 1 (1933); Peacock, P. R., *J. Path. Bact.*, 36, 141 (1933).

[7] Holtfreter, J., *Arch. Entwmech.*, 128, 584 (1933).

Growth-stimulating Effects of Extracts of Normal Adult Tissues and Tumours

IN investigations on the physiology of neoplastic growth, the conceptions are often encountered that the malignant cell has an unusually high growth capacity as compared with the normal cell, and that neoplastic tissue is especially rich in growth-promoting factors.

Recent work has shown clearly that the first notion is untenable. Studies on tumour tissue growing *in vitro* have proved that the growth capacity of neoplastic cells is not greater than that of normal embryonic cells[1]. Furthermore, as we have recently shown, cells from adult organisms grow as well *in vitro* as those of embryos[2]. These facts make it clear that the distinction between normal and neoplastic cells is not to be found in any unusual growth potentiality of the latter. So long as growth-promoting substances are present, cells outside the body behave alike whether they originate from embryonic, normal adult, or tumour tissue.

The conception that neoplastic growth is connected with the presence of a large amount of growth-stimulating factors in tumour tissues would appear to have been confirmed by the experiments of Carrel and Burrows[3], Carrel[4,5], Mottram[6], Bisceglie[7] and Drew[8], all of whom demonstrated the marked cell growth-stimulating action of extracts of tumour tissue. However, since recent experiments[9,10] have shown that extracts of normal adult tissue are also powerful growth stimulators, we thought it important to determine whether the stimulating effect of tumours is in reality exceptionally high, and whether it is greater than that of normal tissue.

We compared quantitatively the growth-stimulating effect of extracts of tumour tissue with those of normal adult tissue extracts. Cardiac and smooth muscle of chickens were used in the preparation of extracts of normal adult tissue, Rous sarcoma for tumour extracts. Young tumours, about olive size, without visible necrosis, were selected. The finely minced normal and malignant tissues were each extracted in four times their volume of Tyrode. The resulting extracts were used in their original concentration. The stimulating action of extracts was tested quantitatively on fibroblast cultures grown in Carrel flasks, prepared according to the standard technique. The growth-rate of the colonies was measured daily, according to the method of Ebeling, over a period of seven days. The medium was not changed during this period. The fibroblast colonies in both cases were uniform and regular in structure but the cells growing in tumour extracts were somewhat more granulated.

Our experiments showed that the growth-activating effect of the sarcoma extract is certainly not greater, but on the average rather weaker, than that of adult muscle extracts. The mean for the growth-activating effects of the tumour extracts is about 75 per cent of the latter.

The peculiar behaviour of malignant cells in the organism is, therefore, obviously not to be found in any unusually high growth capacity of these cells, or in any unusually high amount of growth-promoting substances in neoplastic tissue. In order to explain the autonomous growth of the malignant cell it is necessary to postulate some intrinsic change in the mechanism which in the body normally controls and holds in check this *ever-present* growth potentiality.

Details of our experiments will appear elsewhere.

R. S. HOFFMAN.
E. TENENBAUM.
L. DOLJANSKI.

Department of Experimental Pathology,
Cancer Laboratories,
Hebrew University,
Jerusalem.
Nov. 26.

---

[1] Fischer, A., "Gewebezüchtung". Müller and Steinicke, München (1930).

[2] Hoffman, R. S., Goldschmidt, J., and Doljanski, L., *Growth*, 1, 228 (1937).

[3] Carrel, A., and Burrows, M. T., *J. Amer. Med. Assoc.*, 56, 32 (1911).

[4] Carrel, A., *J. Exper. Med.*, 17, 14 (1913).

[5] Carrel, A., *C.R. Soc. Biol.*, 92, 477 (1925).

[6] Mottram, J. C., *Brit. J. Exper. Path.*, 6, 53 (1925).

[7] Bisceglie, V., *Z. Krebsforsch.*, 23, 340 (1926).

[8] Drew, A., *Brit. J. Exper. Path.*, 8, 176 (1927)

[9] Trowell and Willmer, E., *J. Exper. Biol.*, 16, 60 (1939)

[10] Hoffman, R. S., Tenenbaum, E., and Doljanski, L., NATURE, 143, 764 (1939).

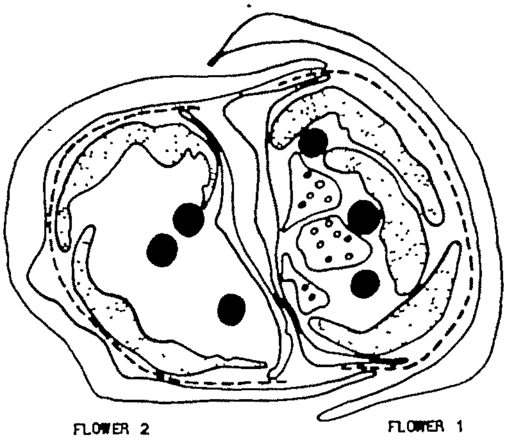
Stamen Lodicules in Maize

AMONG some maize plants (Sutton's White Horse Tooth) originally planted in connexion with other work, there appeared one which bore anomalous male flowers the morphology of which may be worth recording. In the tassel of this plant, in a considerable number of cases, the lower flowers in each spikelet possessed only two stamens; sections showed that often both flowers in the spikelet were abnormal.

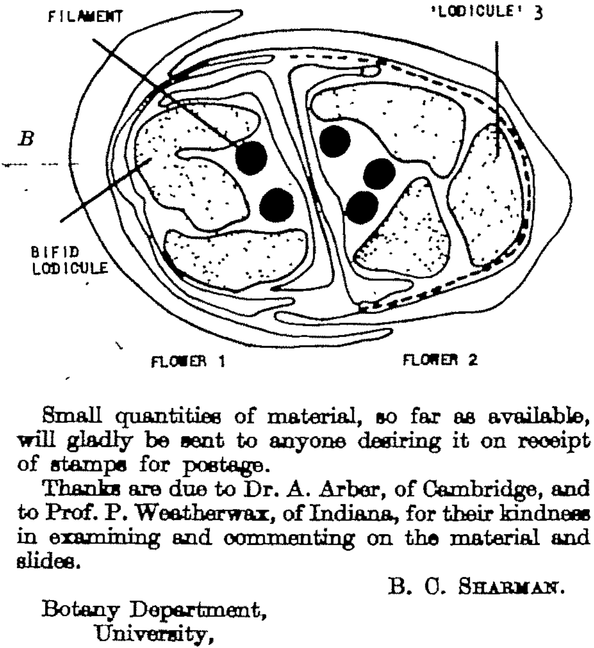
A illustrates a spikelet in which flower 1 has three 'lodicules' and three stamens, while flower 2 is normal. *B* shows flower 1 with two 'lodicules' (one of which is bifid at the tip) and two stamens, while flower 2 has three 'lodicules' and three stamens. In both flower *A*1 and *B*2 the 'extra lodicule' is united with the anterior stamen towards the base. In flower *B*1 the anterior part of the bifid lodicule would seem to represent the missing anterior stamen.

Thus the 'extra' lodicule does not seem to represent the 'missing third lodicule' of the grass flower but appears to be a replacement of or an outgrowth from the anterior stamen, and would come under the category of what Arber[1] has called stamen-lodicules and recorded for the bamboo Cephalostachyum, where it is also the front outer stamen which most frequently becomes lodicular.

A



B



Small quantities of material, so far as available, will gladly be sent to anyone desiring it on receipt of stamps for postage.

Thanks are due to Dr. A. Arber, of Cambridge, and to Prof. P. Weatherwax, of Indiana, for their kindness in examining and commenting on the material and slides.

B. C. SHARMAN.

Botany Department,
University,
Leeds, 2.
Nov. 21.

---

[1] Arber, A., "Gramineae II", *Ann. Bot.*, 41, 56 (1927).

Effect of Suint on Sheep Dips

EXPERIMENTS carried out in this Department have shown that the addition of wetting agents to an arsenic dip results in a decreased retention of arsenic in the fleece; the wetting agent causes the dip to penetrate the fleece more readily, but it also facilitates drainage from the fleece after immersion. Suint, the water-soluble matter in sheep's wool, is well known to have good wetting properties, and this material must accumulate in the bath when large numbers of sheep are dipped. In order to determine what effect suint has, observations were made at a routine dipping of 264 Welsh yearlings at the College Farm. Samples of the dip were collected at the beginning and end of the dipping; also, observations were made on the first and last three sheep through the dip, the wool samples being taken from the back. The accompanying table gives the results.

	Initial dip	Final dip
% soluble As_2O_3	0·118	0·125
% soluble matter	0·19	2·66
Surface tension: dynes/cm	73·0	48·3
	First 3 sheep	Last 3 sheep
Duration of protection against experimental myiasis (weeks)	3	2
% soluble As_2O_3 in wool at base of fleece 6 days after dipping	0·44, 0·51, 0·58	0·12, 0·23, 0·25
% decrease in soluble As_2O_3 content of whole staple from 6th to 20th day after dipping	23	57

It will be seen that there is a remarkable difference between the sheep dipped at the beginning and at the end; this result is not due to the dip becoming weaker but to the extraneous material introduced during dipping. The change in the physical properties of the dipping fluid was mainly due to suint; this material contains a high proportion of fatty acids and markedly lowers the surface tension of water. Shortly after dipping, the arsenic content of the fleece was considerably lower in the sheep dipped last as compared with those dipped first; also, the arsenic disappeared from the fleece more rapidly and poorer protection was afforded against experimental infestation with sheep maggots (by the method of MacLeod[1]).

It has long been realized by farmers that the dipping fluid becomes less effective in protecting sheep against maggot flies after a large number of sheep have been through the bath. This has usually been ascribed to contamination of the dip with dung and urine, materials which attract the fly. The present results suggest that the presence of suint in the bath may be of more importance, since this changes the physical properties of the fluid and results in a smaller and less stable deposit of poison in the fleece. Further work is in progress to find methods of preventing the deleterious effects of suint in the dipping bath.

This dipping at the College Farm was carried out in the spring with sheep in almost full fleece, but the animals were small and in poor condition after a hard winter. Higher concentrations of suint probably occur at larger dippings, especially of lowland sheep in good condition.

R. P. HOBSON.

Department of Agricultural Zoology,
School of Agriculture,
University College of North Wales,
Bangor.
Dec. 7.

[1] MacLeod, J., *Parasitology*, 29, 526 (1937)

Points from Foregoing Letters

IN spectrophotograms of the auroral spectrum taken on October 18, L. Vegard has observed great enhancement of two lines coinciding with the two well-known lines of the hydrogen spectrum. This indicates the occasional presence of considerable quantities of hydrogen in the auroral region, which are due possibly to 'hydrogen showers' from the sun.

A. B. Wyse discusses the interpretation of a faint band at about 4932 A. in the spectra of Nova Herculis (1934) and of Nova Aquilæ (1918). Radiation from nebulæ in this region is probably due to oxygen. On the other hand, that from novæ is believed to be due to nitrogen.

I. Iitaka and S. Yamaguchi submit electron diffraction photographs of specimens of magnesium at room temperature and at 400° C. These indicate that magnesium after polishing with glass paper is covered by a thin film of oxide even at room temperature. A film of oxide also appears to exist on aluminium, but no trace of a film was found on beryllium.

M. Abercrombie has shown that evocation of neural tissue by chemical substances, including carcinogens, is possible in the chick embryo. Coagulated presumptive epidermis is also an evocator. The process of evocation in the chick is fundamentally similar to that in the newt, though the degree of reactivity of the former to individual chemicals is different from the newt's.

R. S. Hoffman, E. Tenenbaum and L. Doljanski find that the activating effect of Rous sarcoma extracts on the growth of fibroblast cultures *in vitro* is not greater than that of extracts of normal adult tissue. The significance of the facts that neoplastic tissue has neither an unusually high growth-capacity nor an unusual wealth of growth-promoting agent as compared to normal tissue, and their bearing on the behaviour of malignant cells in the organism, is discussed.

Anomalous male flowers of maize (Sutton's White Horse Tooth) are described and illustrated by B. C. Sharman, where the anterior stamen is replaced by or arising in association with a third 'lodicule', akin to the stamen-lodicules described by Arber for Cephalostachyum.

Suint, the water-soluble material in sheep's wool, has good wetting properties. Observations by R. P. Hobson suggest that the accumulation of suint in the bath during dipping has a pronounced effect on the physical properties of arsenic dips; this results in a lower content of arsenic in the fleece and poorer protection against infestation by sheep maggots. Work is in progress with the view of finding methods of preventing the deleterious effects of suint in the dipping bath.

RESEARCH ITEMS

India and Crete

A SIMILARITY between pottery found at Maniyar Math in Rajgir, southern India, and finds in Crete is suggested by J. G. Aravamuthan in *Man* of December 1939. The Indian pottery vessels are attributable to an age roughly anterior to the Christian era, and are said to bear spouts varying in number from four to twenty, or even thirty-four in one instance. On the spouts were designs described as "serpents, sieves, animals, etc.". Associated with the finds were terra-cotta images of hooded snakes and a large stone slab containing a number of hooded figures. Mani Naga was the protector and rain-giver of Rajagirha. The name of the god implies association with the serpent. Finds in Crete resembling the Indian vessels appear to be adaptations of drain-pipes, on which the representation of snakes moulded in relief in certain instances points to their use as places of refuge for snakes, while cups on the outside might be used to supply them with milk or other refreshment. In another type a snake is coiled around a naturally formed honeycomb. In still another a snake peeps into the mouth of the jug. Several show snakes approaching or peeping into a cup. The earliest known of this class is a vessel in the form of a female with snakes coiling round the neck. The Cretan vessels are thus multifarious in form and have evolved into a number of varieties. The Rajgir spouted and perforated vessels embody features found in one or other of these varieties. The link between India and Crete seems evident, but beyond relation to a snake cult and a necessary connexion with bringing down rain, the purpose is obscure.

Volcanic Action in Minoan Crete

SIR ARTHUR EVANS has suggested that the catastrophes which archæological research has revealed overwhelmed the Cretan palaces of the Minoan civilization were caused by earthquakes. An alternative theory that they were due to volcanic action from the island of Thera similar to the explosion of Krakatau in 1883, is put forward by Sp. Marinatos in *Antiquity* of December. The ground for this suggestion is the result of a recent excavation on the site of Amnisos, a settlement on the coast of Crete, destroyed at the same time as Nirou Khani, Malia, Gournia, Zakro, and perhaps others. At Amnisos one of the buildings, quite near the sea, at the deeper levels was buried under a mass of pumice stone and sand, and a square pit inside the building was full of pumice stone. A reconstruction of the catastrophe suggests that sea waves broke over the building and carried it away almost to its foundations. It was abandoned and later the north breezes brought the pumice stone from the volcano. This receives support from the fact that the pieces of pumice were all small, rounded and polished like pebbles. At the "Villa of the Frescoes" higher up the beach there was no pumice, but the walls had collapsed in a remarkable fashion due to some tremendous natural force—surely the waves after an eruption. It has been pointed out that much additional support from excavation on selected sites would be necessary to convince archæologists generally of the truth of this explanation.

Toxicity of Indene

THE destructive action of heavy coal tar naphtha on the bed bug appears to depend largely on the presence of unsaturated constituents, especially indene (C_9H_8). The high price of this hydrocarbon prohibits its use on a large scale, but the indene content of naphtha can be increased without unduly raising the cost, and information concerning the toxicity of indene to man is therefore desirable. G. R. Cameron and Cecile R. Doniger have investigated its toxic effects on rats, mice and guinea pigs, and find that in high concentration or on administration of large amounts it causes necrosis of organs such as the liver and spleen. Indene cannot therefore be regarded as a highly noxious agent; but the authors consider that a limit should be imposed on the indene content of such insecticides as heavy coal tar naphtha (*J. Path. and Bact.*, 49, No. 3, 529).

Control of the Potato Root Eelworm

IN experiments carried out on small field plots at the Albert Agricultural College, Glasnevin, a very promising degree of control of the potato root eelworm, *Heterodera schachtii*, has been obtained by J. Carroll using trap-cropping with potatoes. Sprouted potatoes were planted in plots of 'potato sick' land on April 1, 1938. Five weeks after planting date the plants, and tubers from which they grew, were removed from the soil. No effort was made to remove the roots of the plants as this was found to be unnecessary. After removal of the trap crop plants, turnips were sown in the plots. In 1939 very good crops of potatoes, showing no obvious overground symptoms of eelworm infestation, were produced on the plots which had been trap-cropped in 1938. Control plots exhibited typical severe symptoms of eelworm infestation. Further experiments demonstrated that the removal of two successive trap crops in one season did not produce markedly better results than the removal of one trap crop. Experiments are proceeding on a larger field scale.

Trisomic Nicotiana

T. H. Goodspeed and P. Avery (*J. Gen.*, 38, 381–458; 1939) have given an account of the trisomic and other types found in *Nicotiana sylvestris*. 164 trisomic plants including eleven different primaries, 21 tetrasomics, 45 double trisomics, 13 triple trisomics and 30 variant trisomics have been found in about 9,000 plants. These have arisen from irradiation by X-rays, from plants homozygous for a gene causing asynapsis, or from the cross triploid × diploid. The morphological appearance of the trisomics are described, while the presence of an extra fragment also has a characteristic effect. Transmission of the primary trisomics through pollen and ovules is relatively high, but varies with the particular trisomic. The chromosomes of *Nicotiana sylvestris* and their relationship to nucleolus formation are described. The somatic expression of diploid *N. sylvestris* represents an interaction of the various growth rates of organs and tissues which differentiate the primary trisomics.

Breakdown in Stored Plums

INTERNAL breakdown is common in plums stored for protracted periods at low temperatures. The variety Monarch, which is particularly susceptible to this type of trouble, has been studied at various storage temperatures by W. H. Smith (*J. Pom. and Hort. Sci.*, 17, 284; 1939). The fruit, which was 'pre-climacteric' at the time of picking, was divided into 'more mature' and 'less mature' batches and stored at seven temperatures between 65° F. and 31° F. Samples were removed from store at intervals of seven days and cut open for examination. Greater maturity at picking had the effect of advancing the time of the first appearance and maximum development of physiological breakdown. The relative amounts of breakdown at different temperatures were unaffected by differences of maturity. Maximum breakdown after 14–21 days of storage occurred at medium temperatures. After longer periods higher maxima occurred at progressively lower temperatures. The minimum percentage of breakdown always occurred at 34° F., the amount rising rapidly at both lower and higher temperatures. Two distinct types of injury, appearing as 'internal browning' and 'jellying', were recognized. At 45° F. and above, the plums are susceptible only to jellying, this type of injury falling to nil with rise of temperature. At 34° F. and below, they are susceptible only to browning, susceptibility increasing rapidly with reduction of temperature. Between these temperatures both types of injury may occur in the same plum or different plums in the same batch.

Rose Propagation

ROSE cuttings generally root with considerable difficulty, yet little work on propagation by stem cuttings has hitherto been undertaken. Dorothy Brandon (*J. Pom. and Hort. Sci.*, 17, 233; 1939) has studied the differences in rooting properties of a large number of members of the genus Rosa and the effects of various treatments to encourage rooting. The suggestion that high starch content is correlated with easy rooting has been likewise examined. Hardwood cuttings of twenty-six species and varieties were taken at intervals throughout the winter, the highest percentage of rooting being obtained in the period October-December. June was found to be the best time for inserting softwood cuttings. The effects of treatment with ethylene chlorhydrin, thio-urea, sodium nitrate, glucose, and indolyl acetic acid were tried. The two latter increased rooting slightly whilst the two former substances depressed it. No treatment was found to give results sufficiently beneficial to be of practical value. Fluctuations in starch content during the season varied according to species and variety, botanically related species and varieties falling into the same groups. Starch persisted throughout the winter in some species and disappeared in others. No correlation was found to exist between the starch content of cuttings and facility of rooting.

Kernel Smut of Sorghum

A SMUT disease of the Sorghum plant causes damage in Egypt, but Dr. A. F. El-Helaly has recently shown that it can be controlled at negligible cost by treatment of the seed with an appropriate fungicide ("Studies on the Control of Kernel Smut of Sorghum". Min. Agric. Egypt, Tech. and Sci. Service Bull. 238. Govt. Press, Bulâq, Cairo, 1939. P.T.3). The disease is caused by the fungus *Sphacelotheca Sorghi*, and is usually most severe upon early sowings of the host crop. The range of temperature within which both grain and fungus spores will germinate is wide in the months of April and May, but becomes narrow in June and July, being so limited in the latter month that the disease is rare. 'Herati' sowing, where the soil has a considerable water content when the seed is sown, favours the parasite more than the 'Afir' method of sowing in dry soil which is irrigated later. Control was obtained by treating the seed with organic mercury germicides, either 2·5 or 5 gm. of agrosan *G* per kilogram of seed, or a 1–2 per cent solution of uspulun or germisan. An interesting effect was demonstrated with sulphur and copper carbonate, the toxic effect of which was increased by using soil filtrate in place of distilled water in the preparation of fungicidal liquid.

Composition of Ancient Greek Bronze Coins

A LONG monograph by E. R. Caley on "The Composition of Ancient Greek Bronze Coins" contains a large number of analyses and four plates of microphotographs (*Mem. Amer. Phil. Soc.*, 11). One interesting general result of the study is the variation in the proportion of tin and lead in the bronzes, the amount of lead increasing in the more debased coinage of later periods. The author discusses the probable causes for this varying ratio. Re-melting old coins with lead was one cause; others were the technical requirements of minting, adverse economic conditions, disruption of trade by wars, and scarcity of tin. The study is of considerable archæological and historical, as well as chemical interest. It is published at 2.50 dollars by the American Philosophical Society, Philadelphia.

Stereochemistry of Complex Inorganic Compounds

THE reaction of dichloro-diethylenediamine cobaltic chloride, $[\mathrm{Coen_2Cl_2}]\mathrm{Cl}$, with potassium and silver carbonates was the first example of the Walden inversion in the field of inorganic complex compounds, the *l*-form being converted into the *d*-form of the carbonate compound, $[\mathrm{Coen_2CO_3}]\mathrm{Cl}$, in the case of potassium carbonate, and the *d*- or *l*-forms of $[\mathrm{Coen_2CO_3}]_2\mathrm{CO_3}$ in the case of silver carbonate. J. C. Bailar and J. P. McReynolds (*J. Amer. Chem. Soc.*, 61, 3199; 1939) have now prepared two diastereoisomeric forms of the propylenediamine compound $[\mathrm{Copn_2CO_3}]_2\mathrm{CO_3}$ by a Walden inversion method. Rotatory dispersion curves for these and for *cis*-dichloro-di-*l*-propylene-diamine cobaltic carbonate, by comparison with the curves for the analogous diethylenediamine series, lead to a determination of which of the two carbonate forms is obtained by an inversion about the central cobalt atom in the latter case. It is further suggested that the mechanism of the production of the two forms of the carbonato complex is as follows: The non-inverted form is produced through the preliminary displacement of the Cl ions in the *cis*-dichloro-di-*l*-propylenediamine cobaltic chloride by water molecules, followed by displacement of H_2O by CO_3, whilst the inverted form is produced by direct substitution of CO_3 for Cl within the complex. Either form could be produced with silver carbonate alone or potassium carbonate alone by varying the experimental conditions, and the inverted form of carbonato diethylenediamine cobaltic carbonate was produced, for the first time, by using potassium carbonate.

RECENT RESEARCHES ON EARLY MAN IN CHINA. II

'MODERN MAN' IN EASTERN ASIA[1]

"THE Upper Cave" of Choukoutien, discovered in 1930, and excavated in 1933 by Mr. W. C. Pei, is situated at the top of the hill about 175 m. above sea-level, opening to the north and north-east side of the hill. It represents a dissolution cavity in the original limestone massif and is completely separated from the Sinanthropus beds except at the entrance and at the bottom of the so-called 'lower recess'. It seems, therefore, that at the time of Sinanthropus, the cave was not accessible, but was reopened later in Upper Palæolithic times. The deposit is quite different from that of the Sinanthropus cave, being a grey loam intermixed with small angular limestone fragments. In it was discovered an unimaginable wealth of bones of fossil animals: hares, deer, tigers, bear, hyæna, ostrich and representatives of other genera.

The remains of at least seven human individuals were found with a very interesting series of archæological objects. Both fauna and geological conditions assign the finds of the Upper Cave to the Upper Palæolithic. With the exception of the finds in Palestine, no similar discovery has been made anywhere in Asia, and interest turns at once to the character of the human remains, which Prof. Franz Weidenreich considers "of the greatest importance for . . . the racial history of entire mankind".

Although seven individuals are represented, three skulls only afford evidence of physical appearance. The remainder are too fragmentary for that purpose, and the individuals, who it is presumed belonged to one family, had suffered a violent death; although the presence of hæmatite points to the ritual of burial, either the bodies were violently disturbed, or were dismembered before burial.

Analysis of the characteristics of the three skulls sufficiently complete for evidential value in this connexion leads Prof. Weidenreich to the conclusion that while the skull of the male adult, an old man more than sixty years of age, bears some resemblance to European skulls of the Upper Palæolithic Cro-Magnon, Obercassel or Mechta, it is more primitive in the development of the supra-orbital region, and the lowness of the brain-case. Of the two females, however, one in its hypsacrocranial character and certain other features presents the appearance of Melanesian affinities, while the second is Eskimoid. Viewing the characters of the male skull in the light of these findings, it is possible to regard it as a primitive Mongoloid.

The occurrence of these three types among members of a single primitive group or family suggests that the mixture of types is not a consequence of the conditions of modern civilization, but that at an early stage of evolution individual variations appear which become fixed as a result of the dominance of certain features and of isolation. Hence the conclusion is reached that the tendency to breed and cultivate unitary groups corresponding to the suggestion of the theory of 'pure races' does not represent primary conditions, but a later acquisition.

THE UPPER CAVE INDUSTRY OF CHOUKOUTIEN[1]

The cultural evidence of the existence of man of Upper Palæolithic age on this site has been studied by Mr. W. C. Pei, who discusses the objects collected, the technique of workmanship, the character of the culture, and the relationship of the Upper Cave culture with that of Europe.

Objects collected. Among stone implements the choppers are remarkable. A great number of water-worn pebbles and boulders have been found, but only a few have been worked. A good example is a green stone which has been knocked into shape with a few heavy strokes, making a blunt edge on one part of the pebble, for use as a chopper or hammer-stone. Other implements are mostly made of flint or quartz flakes. 'Bipolar' implements made of vein quartz are very similar to those associated with Sinanthropus, though geologically much later. Of bone artefacts, one bone needle, broken just at the eye, was unearthed; also a polished antler of a deer (*Cervus elaphus*), of which the surface is scratched all over and highly polished; it resembles the *bâton de commandement* but is without the perforation.

Of ornamental objects, the most important and characteristic are the beads, made of calcareous limestone, at present undetermined. One face is caused by grinding, and on the other side a hole has been made by drilling to complete the perforation; the part not reached by drilling has been struck off. The seven beads collected have all been painted red with hæmatite. They were found near one of the female skulls.

Four bone pendants were collected. They are made, apparently, of the bones of big birds, and are highly polished and hollow inside. On the surfaces of all are transverse grooves, at present not understood. A perforated pebble is of some igneous rock. It is water-rolled, but one surface seems to have been ground to a certain extent. The perforation was made by drilling from two sides. The perforated marine shells belong to a species of Arca now found plentifully along the China coast. A large hole has been made near the beak of each shell by rubbing. The margin is also rubbed. The supra orbital bone of a very large fish, possibly more than three feet long, of the carp family, has a small perforation made from each side of the bone. It is a unique find on an Upper Palæolithic site, whether in China or in Europe. All these evidently were elements of a necklace. Vertebræ of fish found in association with archæological objects, though showing no trace of human handiwork, may also have been used as a necklace or ornament, as they have a natural perforation.

The most abundant and characteristic objects, however, are the canines of deer or small carnivores, with perforations. Of these, 125 have been found, among them some tens being painted red. The perforation was made by scratching from both sides, not by drilling. Often they were found in series, and obviously represent parts of necklaces or other ornament.

Working techniques. These comprise polishing, grinding, drilling, scratching, rubbing, and colouring. In reference to this last, pieces of hæmatite have been found showing traces of scratching.

Culture : (1) *Burial customs.* The Upper Cave was evidently a burial cave in which the remains were disturbed by animals. Of the mode of burial nothing is known beyond the fact that a quantity of hæmatite powder was scattered around the dead.

(2) *Communications.* Upper Palæolithic man of Choukoutien had relations over a wide area extending 150 kilometres to the north, 350 kilometres to the south and 200 kilometres to the south-east. The indications are marine shells from a sea-coast, of which the nearest point is now 200 km. to the south-east; hæmatite, large-grained and oolitic in structure, iron ore of this nature being known only in the district of Lungkuan, about 150 km. to the north, with high mountain ranges intervening; the big linocoid shell found at the present day only on the south bank of the Yellow River, 350 km. or more to the south.

(3) *Clothing.* The suggestion of the bone needle is the sewing of cloth, while perforated objects point to the passing of string for a necklace ornament. The inference is that some type of clothing with ornaments was in use.

(4) *Other elements.* Though of the daily life nothing is known, pieces of charcoal and layers of ashes full of free carbon imply the use of fire, while fish vertebræ point to the practice of fishing, though no harpoon or hook has been found. The presence of teeth of deer, fox, badger, and pendants of the bones of a big bird suggest that these animals may have been hunted.

Comparison with Europe. As there is no material in China for comparison, no chronological succession can be established. Geologically, the culture is contemporary with the Grand Loess of North China, that is, late Pleistocene, and as such comparable with the Upper Palæolithic of Europe. The technique of scratching instead of drilling in perforation is more primitive than either Magdalenian or Aurignacian; but at the same time, the technique of fashioning beads, the grinding, drilling, polishing, show that the culture could scarcely be more primitive than Magdalenian. Hence, though geologically contemporary with either of these cultures, the cultural relation remains an open question.

---

[1] Weidenreich, Franz, "On the Earliest Representatives of Modern Mankind recovered on the Soil of East Asia", *Peking Natural History Bull.*, 13, 3 (1939).

[2] Pei, W. C., "On the Upper Cave Industry." *Peking Natural History Bull.*, 13, 3 (1939).

THE VICTORIA FALLS HYDRO-ELECTRIC SCHEME

THE Victoria Falls and Transvaal Power Company has recently completed a very successful hydro-electric scheme at the Victoria Falls on the Zambezi River. About thirty years ago a proposal for supplying the Rand with power from the Victoria Falls was projected. The overhead transmission line was to be 700 miles long and the pressure 150,000 volts. Although owing to technical difficulties this project could not be realized at that time, yet the Power Company retained its right to develop the power at the Falls, so that if methods of transmission were improved and developed it might become commercially feasible at a later date. The scheme that has just been completed is the first outcome of that arrangement. It is especially interesting owing to the fact that it is completely automatic.

An article by Mr. H. L. Bazalgette giving a full description of the station is published in the October–December issue of the *English Electric Journal*, the contractors being the English Electric Co., London. The generating station is situated in the third gorge, known as the 'Silent Pool', at a hairpin bend in the river about two miles downstream from the Falls. It contains two 1,000 kilowatt, automatically controlled units, the purpose of which is to generate power for transmission over a distance of about seven miles to the town of Livingstone, until recently the capital of Northern Rhodesia, and also over a distance of about two miles to the Falls Hotel which, with the generating station itself, is in Southern Rhodesia.

In 1936 a comprehensive contract was placed with the English Electric Company for the power station and substation equipment. On March 17, 1938, the new power station was opened by the Governor of Northern Rhodesia, who by simply pressing a button started up the first unit under automatic control. In addition to the two purposes mentioned above, the plant will be able to supply any small industries arising around the town of Livingstone, which may eventually become the centre of an active industrial area.

The climatic conditions are damp and tropical and were exceptionally trying for the erecting staff, the engine room temperature rising at times to 110° F. Owing to the fact that the site is a famous beauty spot, great care was taken by the Power Company in South Africa to obviate disfigurement, and this has been done so successfully that the power station and penstock are practically hidden by vegetation from passers-by. Beyond a daily visit of inspection, the station runs automatically and is unattended. From the point of view of health the situation of the station would be unsuitable for the prolonged attendance of an operating staff.

Automatic devices are introduced which give protection from sustained over-current, over-voltage, over-speed, alternator field failure, internal faults, overheated bearings, oil failure and if it takes longer than the normal starting time. Any of these would automatically cause the unit to shut down and the main oil switch to 'trip'.

The erection and placing into service of the plant was carried out by C. G. T. Clarke, who spent fifteen months on the site. A very interesting and scientific account of the Victoria Falls, written by him, is quoted in the *Journal*. It was carried out in co-operation with the Survey Department of the Northern Rhodesia Government. Between the Main Falls and the Devil's Cataract there exists a small valley hitherto unseen by man which presents a splendid spectacle of beauty with its carpet of maidenhair fern and overhung by evergreen trees. The spray from Devil's Cataract there serves the glade as a natural water-can, and the water drops sparkle in the brilliant sunshine which penetrates the trees. At the bottom of the Devil's Cataract the great pool is always kept in a very turbulent state by the ever-falling torrent, creating waves at least two feet high on the far side of the pool, while the spray rises far above the precipitous sides and produces brilliant rainbows by day or by night at full moon. The wedge-shaped crevice cutting into Cataract Island gives clear evidence of earthquake activity and could not have been caused by erosion of the hard basalt rock. By descending hand over hand by means of a rope attached to a tree on the crest of the Falls on the Eastern Cataract, Mr. Clarke and his assistant got to the bottom of the abyss.

They observed that at the base of the Falls chasm the strata are vertical and run parallel to the Falls, yet the 300 ft. of basalt comprising the perpendicular face of the Falls appears to be in five distinct layers in the horizontal plane, each layer being a shade different in colour. They swam across the pool beyond the base of the Eastern Cataract after convincing themselves that no crocodiles were present. They explored the entire base of the Falls for the first time and state definitely that no traces of animal remains were seen.

With the help of the chief surveyor, Mr. Younger, twelve careful readings of the height of the Falls were taken. The maximum height was found to be 355 ft., and this spot is at a place on the west side of the "Arm Chair". Devil's Cataract has a drop of 200 ft., while the Eastern Cataract is 282 ft. high.

ELECTRICALLY MANUFACTURED STEELS

A PAPER on electrically manufactured steels by H. B. Sieveking, of the Central Electricity Board, originally allocated for reading before the Institution of Electrical Engineers on November 23, has been circulated owing to the decision not to hold meetings for the time being. He first gives a description of the two principal types of electric furnaces used; the main products are next discussed from a metallurgical point of view and the advantages and disadvantages of the two types of furnaces for meeting specific requirements are reviewed.

For the manufacture of steel two types of furnace have been developed—the arc and the high-frequency induction types. The low-frequency type is rarely used nowadays. Arc furnaces are used for melting or for keeping molten metal hot. Generally they are of the vertical 3-phase 3-electrode type. The furnace comprises a refractory hearth which may be of 'basic' (for example, magnesite, MgO) or 'acid' (for example, silica SiO_2) material as required and in which the charge is placed. The necessary heat is obtained by electric arcs formed between the charge and the electrodes which project through the roof in triangular formation. In general, an acid lining is cheaper but this type of lining is 'dead', that is, it does not allow of impurities being removed from the bath. The more expensive basic lining, on the other hand, is suitable for refining. The position of the electrodes is adjusted either by hand or automatically. Hand adjustment is simple but is apt to give rise to violent fluctuations of power. Some form of automatic control, consisting of an electric motor, or a hydraulic servo motor on each electrode, is to be preferred. A special transformer is used with special tappings which allow of a voltage variation from 60 to 250 during service. The largest size in practice will usually take a charge of about 30 tons. There is one in use in America which has six arcs and will take a charge of 100 tons.

There exist to-day a very large number of alloy steels, some of which present manufacturing difficulties which can only be overcome in an electric furnace. Let us first consider the high-frequency furnace. It has very thin walls but it is possible to get through about fifty charges without relining. This corresponds to about one week's working. The advantages of this type of furnace are: the absence of oxidizing atmosphere, no carbon pick-up, suitability for intermittent operation and high temperatures are obtainable. The disadvantages are its high capital cost and limited capacity. It is known that an arc furnace load is such that with a good operating power factor the short-circuit current swings to be taken on the mains will not exceed twice full load. The swings usually occur in the first half of the melting period. In Great Britain until 1934 the proportion of electric steel was nearly constant, with two well-marked exceptions in 1918 and 1926—the last year of the War and the year of the General Strike respectively. Since 1934, which corresponds to a period first of trade depression and then of rearmament, there has been a steady increase in the proportion.

In the United States the electric steel follows very closely the total output of steel. The United States, Germany and Great Britain stand respectively first, second and third in regard to total output, but sixth, eighth and ninth in respect of proportion of electric steel produced, being above only Luxembourg and Belgium. The countries producing the greatest proportion of steel electrically are Italy and Sweden—countries rich in water power and poor in coal, and only standing seventh and eleventh in regard to total output. The world output of electric steel is about 3 per cent of the total, but if Italy and Sweden are omitted the proportion is only 2 per cent. From the tables given in the paper it is evident that in Great Britain the term electric steel must be confined at present to steels which have a high selling price. The weight of finished steel used to-day is far higher than that required in theory as engineers use a high factor of safety. With ordinary steel the material structure is not uniform and therefore the strength of the weakest point must be guessed and the steel dimensioned accordingly. An electric steel, on the other hand, has a very uniform structure and it would therefore seem possible to reduce the factor of safety at least by an amount sufficient to make the total cost of the steel requirements the same whether the steel is manufactured electrically or by one of the other methods. It is undoubtedly along these lines that some countries are working at the present time in order to reduce their internal steel consumption to a minimum.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

Teacher of Electrical Engineering—The Principal, County Mining and Technical School, Nuneaton, Warwickshire (January 8).

Experimental Officers (male or female) in the Chemical Inspection Department, Woolwich, or at Provincial Stations in Great Britain—The Ministry of Supply (S.E. 3.B), The Adelphi, W.C.2 (quoting Appts. 016/S.E.3(B)) (January 4).

A Master for Physics and Mathematics—P. Abson, Haberdashers' Aske's School, Chase Lodge, N.W.7.

Temporary Meteorological Assistants (male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.J., Air Ministry, Adastral House, Kingsway, W.C.2.

A Part-time Teacher of Engineering Drawing—The Director of Education, The Polytechnic, 309 Regent Street, W.1.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 45, Section A, No. 5: On Matrices of Quaternions and the Representation of Eddington's E-Numbers. By W. H. McCrea. Pp. 65–72. Vol. 45, Section B, No. 13: Larval Stages of the Euphausiid *Thysanopoda acutifrons* (Holt and Tattersall) taken off the South-West Coast of Ireland. By Winifred H. Frost. Pp. 301–320. 1s. 6d. Vol. 45, Section B, No. 14: River Development in Southern Ireland. By A. Austin Miller. Pp. 321–354. 2s. Vol. 45, Section B, No. 15: The Significance of Monomolecular Layers of Fatty Acids in the Control of Animal Oxidation. By J. M. O'Connor. Pp. 355–372. 1s. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.). [3011

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 11: Aniline Vapour. Pp. iv+9. (London: H.M. Stationery Office.) 3d. net. [3011

Charity and the Struggle for Existence. (The Huxley Memorial Lecture for 1939.) By Dr. R. R. Marett. Pp. 14. (London: Royal Anthropological Institute.) [112

University of Reading: National Institute for Research in Dairying. Annual Report for the Year ending 30th September 1938. Pp. 96. (Shinfield, Reading: National Institute for Research in Dairying.) [112

University of Cambridge: Solar Physics Observatory. Twenty-seventh Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1938 August 1–1939 July 31. Pp. 4. (Cambridge: Solar Physics Observatory.) [412

National Institute of Industrial Psychology. Annual Report and Statement of Accounts for the Year ended 30 September 1939. Pp. 24. (London: National Institute of Industrial Psychology.) [412

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 791, Vol. 238: The Effects of Thunderstorms and Lightning Discharges on the Earth's Electric Field. By Dr. T. W. Wormell. Pp. 249–303+plates 2–17. (London: Cambridge University Press.) 22s. [512

University of Sheffield. Summaries of Theses submitted by Successful Candidates for Higher Degrees, Session 1938–39. Pp. 4. (Sheffield: The University.) [612

British Museum and British Museum (Natural History). Annual Report of the General Progress of the Museums for the Year 1938. Pp. 29. (London: H.M. Stationery Office.) 6d. net. [712

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 8: Phosgene. Pp. iv+8+2 plates. 2s. 6d. net. Leaflet No. 9: Arsine. Pp. iv+6+2 plates. 2s. 6d. net. (London: H.M. Stationery Office.) [812

Other Countries

National Research Council of Japan. Report, Vol. 2, No. 8, April 1938–March 1939. Pp. iii+609–728. (Tokyo: National Research Council of Japan.) [2911

Journal of the Indian Institute of Science. Vol. 22A, Part 16: The Relation between the Iodine Values and Refractive Indices. Part 3: Hardened Safflower Oil. By R. V. Joglekar and S. K. K. Jatkar. Pp. 219–224. 10 annas. Vol. 22A, Part 17: Reactions of Chromates at High Temperatures. Part 10: Decomposition of Mixtures of Calcium Chromate with Sodium Carbonate and with Ferric Oxide. By D. S. Datar and S. K. K. Jatkar. Pp. 225–236. 1 rupee. Vol. 22A, Part 18: Researches on Utilization of Cane Molasses. Part 5: Nitrogen Fixation by the Solid-Lime Compound in the Soil and its Bearing on Plant Growth. By T. R. Bhaskaran, S. C. Pillai and V. Subrahmanyan. Pp. 237–247. 1 rupee. (Bangalore: Indian Institute of Science.) [2911

Symposium on Molecular Spectra, held in August 1934. (Supplement to the "Proceedings of the Indian Academy of Sciences".) Pp. 129. (Bangalore: Indian Academy of Sciences.) 2 rupees; 3s. [2911

Wood is Good. No. 1: Veneers. By W. Nagle. (Woodworking Series.) Pp. v+7+6 plates. (Dehra Dun: Forest Research Institute.) [3011

Canada: Department of Mines and Resources, Mines and Geology Branch. Geological Survey Paper 39-4: Preliminary—The Stratigraphy and Structure of Turner Valley, Alberta. By G. S. Hume. Pp. iii+20. (Ottawa: King's Printer.) 10 cents. [3011

Astrophysica Norvegica. Vol. 3, No. 5: The Meteor Train of March 24, 1935. By Carl Størmer. Pp. 117–128+3 plates. Vol. 3, No. 6: Über die Schwingungen eines stabil geschichteten, durch Meridiane begrenzten Meeres. Von Egil A. Hylleraas. Pp. 139–164. (Oslo: Jacob Dybwad.) [3011

Svenska Linné-Sällskapets Årsskrift. Årgång 22, 1939. Pp. vi+148. (Uppsala: Almqvist and Wiksells Boktryckeri A.-B.). [3011

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 221: Water-Table Effects. 4: Relative Incidence of Diseases on Cucurbits. By Dr. Amin Fikry. Pp. ii+9+19 plates. P.T. 3. Bulletin No. 225: An Expedition to Arabia for Locust Investigations. By M. Hussein. Pp. ii+22+10 plates. P.T. 2. (Cairo: Government Press.) [3011

Report on the Administration of the Meteorological Department of the Government of India in 1938–39. Pp. iii+41+4 plates. (Delhi: Manager of Publications.) 14 annas; 1s. 3d. [112

Journal of the Indian Institute of Science. Vol. 22A, Part 15: The Effect of Refining on the Digestibility of Edible Oils and Fats. By F. G. T. Menezes and B. N. Banerjee. Pp. 203–218. (Bangalore: Indian Institute of Science.) 1.2 rupees. [112

National Institute of Sciences of India. Symposium on Coal in India (August 25–26, 1939): Abstracts of Papers. Pp. 10. (Calcutta: National Institute of Sciences of India.) [112

The Observer's Handbook for 1940. (Thirty-second Year of Publication.) Pp. 80. (Toronto: Royal Astronomical Society of Canada.) [412

Publications of the Dominion Observatory, Ottawa. Vol. 13: Bibliography of Seismology. No. 2: Items 4379–4503, April, May, June, 1939. By Ernest A. Hodgson. Pp. 25–44. (Ottawa: King's Printer.) 25 cents. [412

Ministry of Finance, Egypt: Survey and Mines Department. Contributions to the Geography of Egypt. By Dr. John Ball. Pp. xv+308+9 plates. (Cairo: Government Press.) P.T. 50; 10s. 6d. [412

U.S. Department of the Interior. Office of Education. Bulletin, 1937, No. 2: Biennial Survey of Education, 1934–1936. Vol. 2. Pp. iv+972+4. (Washington, D.C.: Government Printing Office.) [512

Annals of the New York Academy of Sciences. Vol. 39, Art. 3: Electrophoresis. By Harold A. Abramson, Edwin J. Cohn, Bernard D. Davis, Frank L. Horsfall, Lewis G. Longsworth, D. A. MacInnes, Hans Mueller and Kurt G. Stern. Pp. 105–212. (New York: New York Academy of Sciences.) [512

Geological Series of Field Museum of Natural History. Vol. 6, No. 25: A Specimen of *Elasmosaurus serpentinus*. By Elmer S. Riggs. Pp. 385–391. 10 cents. Vol. 6, No. 26: *Nanodelphys*, an Oligocene Didelphine. By Paul O. McGraw. Pp. 393–400. 15 cents. Vol. 7, No. 5: Radioactive Determination of Protactinium in Siliceous Terrestrial and Meteoritic Material. By Robley D. Evans, Jane L. Hastings and Walter C. Schumb. Pp. 71–78. 15 cents. (Chicago: Field Museum of Natural History.) [512

University of Illinois: Engineering Experiment Station. Bulletin Series No. 316: The Effect of Range of Stress on the Torsional Fatigue Strength of Steel. By James O. Smith. Pp. 38. 45 cents. Bulletin Series No. 317: Fatigue Tests of Connection Angles. By Wilbur M. Wilson and John V. Coombe. Pp. 24. 30 cents. Circular Series No. 39: Papers presented at the Fifth Short Course in Coal Utilization held at the University of Illinois, May 23–25, 1939. Pp. 174. 50 cents. Reprint Series No. 15: Stress, Strain and Structural Damage. By Herbert F. Moore. Pp. 24. 15 cents. (Urbana, Ill.: University of Illinois.) [512

Ceylon Journal of Science. Catalogue of the Contents of Ceylon Journal of Science Publications. Pp. iv+78. (Colombo: Colombo Museum.) [612

Advisory Board of the Imperial College of Tropical Agriculture. Report on the Department of Agriculture, St. Lucia, 1938. Pp. iv+60. (St. Lucia: Government Printing Office.) 6d. [612

U.S. Department of the Interior: Office of Education. Bulletin, 1939, No. 4: The School Auditorium as a Theater. By Alice Burrows and Lee Simonson. Pp. v+51. 10 cents. Vocational Division Bulletin No. 200 (Trade and Industrial Series No. 58): Related Instruction for Plumber Apprentices. By Robert W. Hambrook. Pp. xi+87. 15 cents. (Washington, D.C.: Government Printing Office.) [612

Rubber Research Institute of Malaya. Annual Report 1938. Pp. 226. (Kuala Lumpur: Rubber Research Institute of Malaya.) 1 dollar. [712

Indian Central Cotton Committee. Annual Report of the Director, Technological Laboratory, for the Year ending 31st May 1939. Pp. 42. 6 annas. Technological Bulletin, Series A, No. 50: Technological Reports on Trade Varieties of Indian Cottons, 1939. By Dr. Nazir Ahmad. Pp. vi+109. 1·8 rupees. (Bombay: Indian Central Cotton Committee. [712

Proceedings of the United States National Museum. Vol. 87, No. 3074: A Revision of the Soapfishes of the Genus *Rypticus*. By Leonard P. Schultz and Earl D. Reid. Pp. 261–270. (Washington, D.C.: Government Printing Office.) [712

Proceedings of the American Academy of Arts and Sciences. Vol. 73, No. 5: Chang Po-tuan of T'ien-T'ai, his Wu chên p'ien, Essay on the Understanding of the Truth; a Contribution to the Study of Chinese Alchemy. By Tenney L. Davis and Chao Yün-ts'ung. Pp. 97–118. (Boston, Mass.: American Academy of Arts and Sciences.) 70 cents. [712

Catalogues, etc.

Practical Hints on the Use and Maintenance of Platinum Laboratory Apparatus. (Publication No. 47.) Pp. 16. (London: Johnson, Matthey and Co., Ltd.)

Roxburghe Club Publications. (No. 643.) Pp. 8. Books on Scandinavia and Northern Europe. (No. 644.) Pp. 14. (London: Francis Edwards, Ltd.)